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Reoperative Pelvic Surgery

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Preface

The impetus for this book came from the recent appearance of single specialty books pertaining to reoperative surgery on various organs in the pelvis, as well as from the recognition that several different disciplines are involved with the challenges of reoperative pelvic surgery. Surgeons often encounter challenging dilemmas involving organ systems that have historically been attended to by surgeons representing closely related but distinct specialty areas. With increasing sophistication and knowledge about management of anatomically adjacent organs by the specialties of gynecologic oncology, gynecology, urology, and colon and rectal surgery, as well as the emergence of specialty training programs in urogynecology and pelvic floor disorders, we thought it appropriate and timely to create a textbook acknowledging this increasing knowledge and interspecialty collaboration. To this end, where appropriate, we have included collaborative authors from each of the specialties, any of whom may be called upon to address a particular anatomic area. It seems inevitable that situations will arise in which the collaborative expertise of several separate specialties may converge to provide surgeons the benefit of the combined thought processes that would prove invaluable when such difficult problems are encountered.

With this in mind, the editors, from the fields of gynecologic oncology, urology, and colon and rectal surgery, identified experts in their own fields who could best contribute to the management of specific problem areas. For example, since reoperations for endometriosis may involve uterus, adnexae, ovaries, or the colorectum, the chapter concerning this condition has been coauthored by specialists in colorectal surgery and gynecologic oncology.

We have been fortunate to find experts who have collaborated to bring available evidence-based medicine, best demonstrated practices, and personal experience to their contributions. We are particularly indebted to Dr. Victor Fazio, who has given us an excellent overview of the principles of reoperative surgery, which are well worth reading carefully at any level of the reader's education. We would also like to thank Dr. William Curtis, Annie Cimino, Paula Callaghan, and Margaret Burns, of Springer, for their interest in and hard work organizing and editing this milestone project.

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Introduction and Overview: Principles of Reoperative Pelvic Surgery

Victor W. Fazio

For the abdominal surgeon, few situations pose greater potential difficulties than reoperative pelvic surgery. These challenges range from the surprisingly (relatively) easy, for example, refixation of recurrent rectal prolapse, to the nearly impossible, such as the frozen pelvis with complex chronic sepsis from a leaked low rectal anastomosis. This overview deals with reoperation for intestinal complications.

Considerations include the following: understanding pelvic anatomy, timing of reoperation, preparation of the patient preoperatively, preparation of the patient intraoperatively, conduct of the surgery, identification of structures, prevention and control of pelvic bleeding, and the specific operative procedures.

Pelvic Anatomy

The applied anatomy of the pelvis in the reoperative surgery setting implies knowledge that certain structures stay *fixed* and can be counted on as constants. The aortic bifurcation, common iliac vessels and its branches, the sacral promontory and sacrum, the prostate gland, bladder and vagina are included here (except where previous surgery may have involved partial or total excision). Others that we regard as usually constant, such as ureters, mesorectum, rectal stump, uterus, and tube ovaries, may be quite displaced. Examples included ureters coursing over the stump of a distal rectum.

The pelvis resembles a forward-tilted basin. Access is limited by the narrow pelvis, often with dense scarring; the absence of planes of cleavage; and the need for aids to anatomy identification. These include ureteric stents, vaginal or rectal bougies (a rigid proctoscope is useful), and irrigation/infusion of the urinary bladder to help identify the plane between loops of small bowel fixed to the posterior bladder. The problem is compounded by a history of previous pelvic sepsis or irradiation. The term *frozen pelvis* has been aptly coined to describe the dismaying spectacle of the deep pelvis where none of the ordinary landmarks can be visualized.

Timing of Reoperation

There is general agreement that reoperative surgery is the surgery of adhesions—the process of repair and recovery of peritoneal injury. All abdominal surgeons are well versed in the surgery of adhesions. Yet it is surprising that many still fail to appreciate the dynamic of adhesion formation and resolution. Serosal injury (abrasion, infection, ischemia) leads to an inflammatory response with rapid fibrin-rich, serofibrinous exudate deposited on the injured areas (small bowel, parietes). Platelet and leukocyte deposition occurs into the fibrin matrix. Fibrinous (soft) adhesions form. Organization of these adhesions occurs, and under the effects of plasminogen activation, the fibrin matrix is gradually lysed, leading to normal re-mesothelialization.

This cycle of injury and repair takes time. Although this time period varies somewhat, from 8 weeks up to months, there is in general a bell-shaped curve that results from contrasting the time since injury (index surgery) with the severity of the adhesions. This development of type IV adhesions (where separation of structures from each other, such as small bowel from abdominal wall, occurs) will be so difficult that perforation of the viscus will occur. This perforation can be predicted to appear within 14 days of index surgery and can last for 6 to 12 weeks. This situation, then, is the "no-man's-land" where reentry into the abdomen after previous major laparotomy should be an exceptional venture. These exceptions, where reoperative surgery may be considered on the basis of risk/benefit analysis, are few. Examples include ischemic gut (almost never, as this implies, a postoperative volvulus, which is hardly possible given the obliterative effects of adhesions in the peritoneal cavity; undrainable sepsis, as seen on

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computed tomography; and peritonitis or hemorrhage, unresponsive to endovascular radiologic techniques of hemostasis.

Thus the practical significance of genesis and resolution of adhesions is that prudence dictates a waiting interval from previous surgery. If one is contemplating elective, reoperative major pelvic surgery, such as a redo colorectal anastomosis or redo ileopouch anal operation, then the surgeon would be well advised to allow 6 months or longer (especially if pelvic sepsis or radiation of the deep pelvis has been an additional factor to consider).

This wait interval is strongly advised, but the patient should still be advised that fusion of pelvic structures to the point of the surgeon's decision to abandon pelvic dissection might remain despite the wait period. One method I have found useful as a rough guide to assessing the relative ease of abdominal reentry is the abdominal mobility test. This involves placing one's hands on either side of the midline and shaking the abdomen. If the abdomen "feels" mobile, then laparotomy is feasible.

Patient Preparation

Most cases of reoperative pelvic surgery are elective. As such, restoration of nutrition coagulopathies and electrolyte disturbance can usually be done. Deep venous thrombosis prophylaxis and sepsis control, obtaining appropriate imaging studies (to get a "road map"), embolization of tumors, venous and arterial access for monitoring, and obtaining or arranging for help from appropriate subspecialists (urology, orthopedics) are advised. The intraoperative considerations are presented in Table 1.1. All of these techniques may help in retracting structures out of the way, facilitate identification of certain structures, or improve access and visibility of relatively obscure areas of the pelvis.

TABLE 1.1. Intraoperative Considerations.

- Positioning of the patient
- Perineal access
- Bean bags and shoulder rests to stabilize patient position
- Arms tucked in by the patient's side, to maximize the surgeon's access to the pelvis
- Vertical midline incision, to provide maximum exposure
- Ureteric stents; urinary catheter
- Suture retraction of bladder dome or dome of uterus
- Self-retaining retraction
- Headlight for surgeon
- Lighted retractors

Conduct of the Surgery

Reoperative pelvic surgery calls for experienced surgeons and good assistants. One does not start the procedure late in the day; ideally, it is scheduled as the first (or only) procedure for the day. Small bowel adhesiolysis is facilitated with delivery of any matted loops of intestine out of the retroperitoneal areas where possible, so that dissection can be done extraabdominally.

Saline is injected between fused tissue planes ("hydrodissection") to increase the almost nonexistent space between fused visceral structures. Tag the ureters even when stents have been placed, with Silastic vessel loops. Stents are no guarantee against ureteric injury: they should be a guide and at very least facilitate a diagnosis of an injured ureter.

Where fusion to the abdominal parietes is complete, a sometimes useful maneuver is to dissect through the fascia, leaving it attached to small bowel, and then to reenter the peritoneal cavity several centimeters further away. Where an indurated fibrosed (sometimes radiated) base of bladder limits access to the deep pelvis, this might be remedied by multiple small incisions in this "crescent moon" appearance. Then bougie dilatation will serially stretch this restrictive band to allow better deep pelvic access.

Other Points to Consider During Surgery

- Adequacy of exposure generally calls for long incisions.
- It is often preferable to enter the peritoneal cavity through the easiest part, away from enterocutaneous fistulas, for example. In practice, this usually means through the upper abdomen, above the umbilicus.
- If the bowel is distended, try to decompress it. This is often best achieved by a large-bore, 14-gauge needle attached to suction tubing.
- Repair serosal injuries or enterotomies as they occur (to reduce enteric contamination or risk of making a full-thickness enterotomy).
- Leave the fixed, hand part to last (e.g., fusion of enterocutaneous fistula to mesh.)
- Use absorbable sutures.
- Use hot saline irrigation of peritoneal cavity throughout.
- Check all of the intestine at the end of the operation for occult enterotomies. This can be done by saline or air sufflation of small bowel through a stoma or enterotomy.

Identification of Structures

Rectal Stump

The rectal stump is frequently shortened, lying in the lower third of the pelvis. It is frequently fused to the sacrum, sacral promontory, vagina, or prostate. Rigid proctoscope or bimanual palpitation is a useful aid to identification.

Start the dissection in the midline posterior to where the stump is perceived to be: grasp the stump with long Babcock clamps; use electrocautery and do not stray more than 1 cm on either side of the midline until other land marks are identified.

For stump fusion to the promontory of the sacrum, where dissection at this point endangers the major common iliac vessels, dissection is facilitated by initiating dissection on the right side of the midrectal mesorectum. After entering the bloodless plane between the investing layer of fascia of the rectum and Waldeyer's fascia, the dissection can be extended first in a cephalad direction. This facilitates dissection of the mesorectum from the great vessels.

Where pararectal stump fibrosis is extensive, and an anastomosis of the colon to the distal stump is considered desirable, it is often best to remove the rectal stump (piecemeal if necessary) to the anorectal ring, or to complete the distal proctectomies transanally. A hand-sewn coloanal anastomosis is still feasible. In the deep pelvis, perineal pressure may elevate the rectal stump, facilitating dissection.

Vaginal Identification

For vaginal identification, vaginal preparation (e.g., Betadine) is used in all cases. Bougie stents or bimanual palpation is often useful. Hydrodissection using a No. 19/20 spinal needle helps to expand the space between the rectum and vagina, making dissection safer with less likelihood of vaginotomy. After vaginal mobilization or repair, do a final recheck with Betadine to identify any missed vaginal defects.

Prevention and Control of Pelvic Bleeding

Bleeding is expected in reoperative pelvic surgery. The principles of management include identification where problematic bleeding is likely and minimizing those maneuvers that can cause such bleeding. Of course, this is not always achievable. Areas of particular vulnerability include the following:

- The presacral area: Dissection behind (posterior to) Waldeyer's fascia may strip the basivertebral veins, structures that are impossible to cauterize, causing venous bleeding. In some situations, such as recurrent rectal cancer, dissection in this plane is necessary.
- Internal iliac vein bleeding (or its branches): This is especially likely where a viscus like the rectal stump or a ureter is fused to the lateral pelvic wall, which is related to sepsis, radiation, or recurrent cancer.
- Retroprostatic/rectrovaginal bleeding especially in posterior lateral aspects of these structures.
- Arterial injury to common or external iliac vessels is rare but very problematic. Some enteric contamination is usual, in the vicinity. Proximal and distal vascular control can be very difficult in the partially fixed pelvis. In the radiated pelvis as well, risks of arteriotomy repair may call for iliac artery ligation and a femora-femoral crossover graft.

Management of Bleeding

Management of bleeding involves good exposure and lighting of the pelvis. Initial management involves obtaining finger control, alerting the anesthesiologist to the situation, and ensuring adequate supply of blood products. The application of a cotton pledget (on a long clamp) can facilitate pressure to the point where finger control was effective, and with the hand and wrist out of the way, allow for better visualization of the problems.

Then determine the best method for control: thumbtack, suture, free muscle suture tamponade, etc. If venous, a vessel laceration is best treated by suture, for example, 5-0 Prolene; a cotton pledget pressure point on the caudal side of the injured vessel acts as vascular control, facilitating the suturing. If effective, use packing of the pelvis when other maneuvers are unsuccessful. This may require pack removal at separate laparotomy 48 hours later.

Specific Procedures and Reconstruction

This overview cannot do justice to the many technical maneuvers that may be applied to specific circumstances, such as restoration after Hartmann's procedure. Obtaining a soft, supple top of the rectal stump is important but not always possible with a fibrosed narrow stump. The end of the descending colon to the side of the midrectum with circular stapling technique may be a useful alternative in such cases.

For restoration after septic or ischemic stricturing of a low colorectal anastomosis, resection of the distal rectum to the anorectal ring may facilitate a coloanal anastomosis. While there is functional value to a colonic J pouch, if the operation has been at all difficult, I favor dispensing with this reservoir and performing a straight anastomosis. Long-term outcomes of straight anastomoses are similar to those with a reservoir in these settings. Where pelvic radiation has been used, especially if there is an associated vaginal or prostatic fistula, then I favor the Turnbull Cutait pull-through procedure. This negates the possibility of anastomotic leak, and the pulled-through colon is amputated at 7 days and delayed coloanal anastomoses are done.

In all reconstructive cases in the low pelvis, temporary fecal diversion is recommended. For restoration after a redo ileopouch anal anastomosis, pouch-anal disconnection is done; also curettage of any presacral sepsis/abscess and drainage are done; check for integrity of the pouch and its reach to the anus; and completion mucosal proctectomy and neo-pouch–anal anastomosis with loop ileostomy are performed.

A complete discussion of reoperation for recurrent rectal cancer is beyond the scope of this overview. The key to embarking on this procedure is patient selection, which involves clinical laboratory and imaging techniques to indicate if curative surgery is possible. Emphasis is placed on weighing the benefits against the complications or risk of death. Planned palliative surgery is rarely indicated in the setting of reoperative pelvic surgery. Pelvic exenteration and sacral resections may be performed when indicated, but they require experienced surgeons, as landmarks are frequently absent. Trial dissection of the presacral space may come to a halt when fusion to the sacrum occurs and distinction between cancer and radiation fibrosis is nearly impossible. The experienced surgeon may deem it then appropriate to dissect flush on the periosteum, risking bleeding from the basivertebral veins, but may be rewarded by finding a plane, an intact plane, posterior to the cancer.

Conclusion

Reoperative pelvic surgery may be a hugely challenging undertaking. Careful planning, timing, and patient selection, and an experienced team of surgeons and anesthesiologist are required for successful surgery while minimizing the risk of complications.

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2 Reoperations Within the First 30 Days After Pelvic Surgery

Jeffery Nelson

Reoperative problems that present within the first 30 days after pelvic surgery from either a perineal or abdominal approach require not only a high index of suspicion, but also constant vigilance on the part of the clinician in order to avoid unnecessary morbidity. These problems present acutely and demand quick recognition and subsequent treatment. Infection is one of the leading causes of early readmission after abdominal and anorectal surgery, but the surgeon must keep other factors in mind, as well. Kariv et al.[1] examined the characteristics of 150 consecutive patients readmitted within 30 days of surgery. The causes of readmission were surgical site infections (SSIs) (33%), ileus or small bowel obstruction (SBO) (23%), medical complications (24%), and others (24%). Risk factors for readmission were chronic obstructive pulmonary disease, low functioning capacity, previous anticoagulant therapy, steroid treatment, and discharge to a location other than home. Disease-related factors actually had little to do with readmission rates. Based on these findings, the authors concluded that in addition to the typical preoperative medical risk stratification, that patients also receive treatment to increase their functional capacities before surgery, minimize steroid use, or stratify perioperative anticoagulant use in order to decrease readmission rates. This study serves as a good reminder that we should keep the patient's overall condition in mind if we are to minimize the chances for complications. For the purposes of this chapter, we examine reoperative anorectal complications separately from those arising from pelvic operations using an abdominal approach.

Anorectal Complications

Infection

Any anorectal operation can potentially be complicated by local or systemic sepsis, but this is quite uncommon. Necrotizing soft tissue infections, such as Fournier's gangrene, after hemorrhoidectomy or perirectal abscess drainage are rare, with only case reports in the literature.[2–6] Suspected predisposing factors such as granulocytopenia,[2] urinary tract infection, and local trauma[3] have been reported, but frequently the cause is unknown. When this rare complication does occur after any anorectal procedure, surgical debridement of any and all infected devitalized tissue, combined with broad-spectrum antibiotics, is mandatory. One recent review examined the incidence of severe sepsis and any predisposing factors after hemorrhoid treatment using rubber band ligation, excisional surgery, sclerotherapy, and stapled hemorrhoidopexy.[4] Thirty-eight patients were identified in the literature who suffered severe sepsis after hemorrhoid treatment manifested by perineal sepsis, liver abscess, or retroperitoneal gas and edema. Ten deaths occurred. No definite predisposing factors were identified, but common presenting features included urinary difficulties, fever, severe pain, leukocytosis, and septic shock. Patients found to have necrotizing soft tissue infections were uniformly managed with surgery, but the minority who presented early without signs of soft tissue necrosis were managed without surgery. Localized wound infections of the perineum are managed identically to those found anywhere else. Primarily closed wounds should be opened (i.e., flap anoplasties or hemorrhoidal suture lines) and broad-spectrum antibiotics started if any cellulitis is present. Some procedures, such as an overlapping sphincteroplasty, may leave open perineal wounds for drainage, but they still can develop localized cellulitis. As long as no evidence of tissue necrosis or deep space infection of the repair is present, antibiotic treatment is sufficient to treat the cellulitis.

Wound Healing Complications

Wound healing complications after anorectal surgery that require reoperation within 30 days from the initial surgery are relatively few. Wound separation and flap necrosis after flap anoplasty are among the most serious problems, although thrombosed external hemorrhoids, anal fissure, and fistulas have also been reported as being reoperated on within 30 days.[7] Resuturing of separated flap anoplasties

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has been reported,[8] but many surgeons would choose to let them heal by secondary intent. Wound debridement of excessive exudate or necrotic tissue may also be necessary within the first 30 days to promote subsequent wound healing.

Anal fissure also may occur after flap procedures, or an excisional hemorrhoidectomy that leaves a wound in the posterior or anterior midline of the anus. The resultant fissure really represents a nonhealing wound, but may be treated like any other chronic anal fissure—with lateral internal sphincterotomy (LIS) or possibly pharmacologic therapy (nitropaste, Botox, etc.). However, once again most would wait beyond 30 days to offer sphincterotomy to ensure that normal healing does not occur first. Anal fissure resulting from stapled hemorrhoidopexy has also been reported within the first 30 days,[9] but LIS is typically reserved for chronic anal fissures beyond the 30-day mark. One meta-analysis of ten randomized controlled trials comparing stapled hemorrhoidopexy to Milligan-Morgan hemorrhoidectomy found no differences in the rates of anal fissure or sphincter damage.[10] If significant sphincter damage after hemorrhoidectomy, of any variety, or other anorectal procedure is noted at the time of the initial operation, the sphincter should be repaired at that time. If recognition of significant sphincter damage (e.g., disruption or division) is delayed, however, then repair should be delayed until healing of the anorectum is complete and scar has developed at the ends of the sphincter that would aid in eventual reconstruction. Fernando et al.[11] reported the results of their randomized prospective evaluation of end-to-end vs. overlapping sphincter repair for grades 3 and 4 (partially through the external sphincter and completely through the sphincter into the rectum, respectively) perineal lacerations immediately after childbirth. In both groups healing was complete, but at 12 months no patient in the overlapping repair group reported incontinence vs. the 24% reported incontinence in the end-to-end group (p = .009). Extrapolating from the obstetric literature, it is clear that repair should be carried out at the time of injury, regardless of the repair technique employed, if possible.

Anal fistulas, which may develop from wound healing problems during the first 30 days, may be dealt with in several ways, depending on the clinical situation. After a complex anorectal or perineal reconstruction (utilizing flaps for instance), fistulotomy or unroofing of the fistulous tract may not be the most attractive option if one wants to maintain the overall integrity of the repair, not to mention the anal sphincter. Fortunately, other options are available, such as fibrin glue or the anal fistula plug, which do not require the division of any overlying normal tissue. Again, depending on the location of the internal opening of the fistula in relation to the suture lines and flap locations of the initial reconstruction (or staple line in the case of stapled hemorrhoidopexy[7]), a V-Y or house flap anoplasty may be carried out to close the fistula, leaving the external opening open to drain. After restorative proctocolectomy with ileal pouch–anal anastomosis (IPAA), pouch-vaginal fistulas may also occur. Early complications associated with eventual pouch vaginal fistula development include pelvic sepsis, anastomotic separation, anastomotic stricture, SBO, hemorrhage, and pouchitis.[12]

Fecal Impaction

Difficult bowel movements after anorectal surgery are commonplace, making the postoperative prescription of fiber supplements and stool softeners routine, but fecal impaction also occurs. This complication typically requires a return to the operating room for disimpaction under anesthesia. Fecal impaction has been reported after many anorectal procedures, including excisional hemorrhoidectomy, stapled hemorrhoidopexy, and anorectal reconstructions, such as a sphincteroplasty.[7,13] In a randomized study comparing overlapping to end-to-end sphincteroplasty, two patients in the overlapping group developed fecal impaction vs. none in the end-to-end group.[13] This was not statistically significant, however. Examination under anesthesia for disimpaction is also useful for wound examination. The earlier this problem is recognized and dealt with, the better, since fecal impaction may lead to other problems besides wound disruption and patient discomfort, such as obstipation, postobstructive diarrhea, and in extreme cases stercoral ulceration with or without perforation.[14] Medical bowel confinement should be omitted from the postoperative management of patients undergoing elective anorectal surgery, because it leads to at least three times the rate of fecal impaction, increases overall costs, and does not impact the wound or septic complication rate.[15]

Reoperative Pelvic and Abdominal Complications

Infection

Surgical site infections have been categorized by the Centers for Disease Control and Prevention (CDC) as either superficial, deep, or organ space.[16] A superficial wound infection involves skin and subcutaneous tissue. A deep space wound infection involves components of the abdominal wall. Examples of organ space infections include intraabdominal abscesses and hepatic abscesses. All these SSIs require drainage and/or debridement, with or without antibiotic therapy. This may or may not require a return to the operating room. Superficial SSIs are typically managed at the bedside. However, deep and organ space SSIs may require a return to the operating room for definitive management.

When the infection involves the fascia, in addition to the subcutaneous tissue, concerns about fascial integrity may require operative debridement and washout to rule out dehiscence. Necrotizing soft tissue infections warrant special mention here. As in necrotizing infections of the perineum, the treatment of abdominal wound necrotizing infections is very similar. These infections are typically polymicrobial. In one prospective series of necrotizing infections from India, the clinical characteristics and outcomes of 75 patients were followed over their course of treatment.[17] *Staphylococcus aureus* was the most common bacteria cultured (46%), but β-hemolytic streptococci were isolated from only 13% of patients. *Bacteroides fragilis*, anaerobic cocci, and fungi were also isolated. The mortality in this series was 27%. As with Fournier's gangrene, wide debridement of all necrotic and infected tissue is mandatory. This may take more than one trip to the operating room. Large-volume blood loss during these debridements is not uncommon, and blood products should be typed and crossed ahead of time. The end result may be massive loss of the abdominal wall with wounds even extending onto the flank, back, buttocks, and thighs. These wounds require some very creative management techniques. Vacuum-assisted dressings are ideal for these large wounds, which otherwise would require constant dressing changes. We discuss complicated wound management in more detail below.

Intraabdominal and pelvic abscesses are typically discovered via a computed tomography (CT) scan, which may then lead to either percutaneous CT-guided drainage or open operative drainage. Another manner in which organ space SSIs may be discovered is when they lead to fascial dehiscence, prompting a return to the operating room. This is discussed in more detail below. Several studies have shown that CT-guided percutaneous drainage of postoperative abdominal and pelvic abscesses is highly successful and the preferred initial management strategy for this problem, with success rates reported at around 80%.[18–21] Even within 1 week of operation, CT-guided abscess drainage has been shown to be effective when the patient displays the appropriate signs and symptoms.[22] In the otherwise stable patient with no signs of diffuse peritonitis, this is the typical management strategy employed today. Only when CT-guided drainage fails to adequately drain the abscess(es), or if the patient's condition deteriorates, does reexploration become mandatory.

Pelvic sepsis after restorative proctocolectomy with IPAA is particularly troublesome, since it is associated with subsequent pouch failure.[23] Sagap et al.[23] reviewed 2518 IPAA patients and found that early sepsis, preoperative steroid use, and need for percutaneous abscess drainage were all associated with eventual pouch salvage. Hand-sewn anastomoses, hypertension, associated fistulas, need for transanal drainage of abscesses, need for laparotomy to control sepsis, delayed ileostomy closure, and the need for a new diverting ileostomy were all associated with eventual pouch failure. These results underscore the importance of hypervigilance for infectious complications in the early postoperative period, since an early abscess that is treatable with antibiotics or percutaneous drainage is less likely to lead to pouch failure in IPAA patients.

Wound and Fascial Dehiscence

This topic is closely related to that of infectious complications, because infection so often leads to the problem of wound and fascial breakdown. Once the infection is under control, management of the resulting wound, whether it be an open abdomen, an open perineal wound after abdominoperineal resection (APR), or a simple fascial dehiscence, becomes the management issue. Wounds do break down in the absence of infection, as well, but even in the presence of an SSI, once the infection has been dealt with appropriately the subsequent wound management itself is essentially the same.

In cases of simple fascial separation without overt dehiscence and evisceration, simple wound care normally suffices. This may involve wet to dry dressing changes or newer methods such as vacuum-assisted dressings, which are becoming increasingly popular. In one recent randomized controlled trial of 65 patients with acute and chronic wounds managed with either vacuum-assisted closure or modern wound dressings, the authors found that the time required to achieve a granulated wound bed was not significantly different from the regular dressings, unless the patient was diabetic or had cardiovascular disease.[24] Patient comfort was improved, however, as were the nursing costs. The total costs of both dressing methods were similar.

When abdominal wound dehiscence occurs with overt or threatened evisceration, a return to the operating room is mandatory. At least three different studies have demonstrated the association of intraabdominal sepsis with fascial dehiscence in both elective and trauma laparotomies.[25–27] Other associated factors include age over 65, pulmonary disease, hemodynamic instability, ostomies in the incision, hypoproteinemia, systemic infection, obesity, uremia, hyperalimentation, malignancy, ascites, steroid use, and hypertension.[27] A complete abdominal exploration should be carried out to search for any anastomotic leaks, enterotomies, and abscesses, which may have led to the dehiscence. Once these have been dealt with and drained, as appropriate, the fascia can be closed again with retention sutures, if possible. The retention sutures prevent evisceration from occurring again, if the fascia later dehisces. The skin should be left open to heal by secondary intention, or should be managed by delayed primary closure once granulation tissue develops. If too much tension on the fascia exists to close it safely due to bowel edema or previous fascial debridement, then open abdomen management techniques are employed (Fig. 2.1). One popular method is the abdominal vacuum-assisted dressing. The

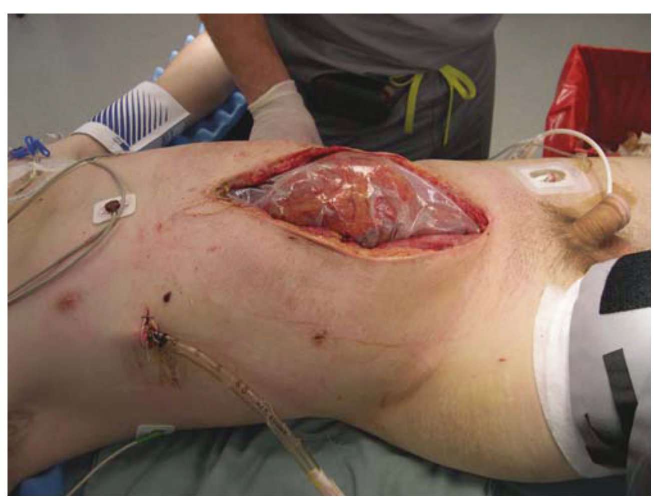

FIGURE 2.1. Typical appearance of open abdomen before placement of vacuum-assisted dressing or other dressing.

advantage of this method, over the older "IV bag" closure, is that it controls the abdominal fluid leakage making skin care and overall nursing care of the patient much easier.[24] These dressings are typically changed every 2 days along with an abdominal washout until the abdomen is again ready for closure, either primarily or with some kind of prosthetic or skin graft.[28] In the case of massive wounds created by soft tissue debridements secondary to necrotizing soft tissue infections, vacuum-assisted dressings can also be used to manage not only the open abdominal wound but also any open soft tissue defects created by the debridement, such as wounds extending onto the back, buttocks, or thighs. Again, these dressings are typically changed in the operating room during any scheduled abdominal washouts with abdominal vacuum-assisted dressing changes.

Besides abdominal wound dehiscence, the other contentious wound healing problem affecting pelvic surgery is perineal wound breakdown, especially after APR. Overall, the management principles here are the same as with abdominal wound dehiscence. The surgeon must rule out infection, usually through wound exploration. Computed tomography scanning of the abdomen and pelvis is also advised to rule out a pelvic abscess or fluid collection that may be contributing to breakdown of the perineal wound, especially in the presence of perineal wound drainage of any character. If a fluid collection is present, then it may be percutaneously drained. The next question facing the surgeon is how to manage the wound. Wet to dry dressings usually suffice, but vacuum-assisted dressings have also been used in this setting.[29] A return to the operating room for wound exploration, debridement, and placement of the initial dressing may be required. To avoid this complication after APR (in irradiated patients in particular), some surgeons have turned to prophylactic or primary myocutaneous flap reconstruction of the perineal defect or omentoplasty to prevent wound breakdown and perineal sinus formation.[30–32] These flaps may be taken from the abdomen, such as a transverse rectus abdominus myocutaneous (TRAM) flap, or from the thigh, such as a gracilis flap. This approach should definitely be considered routinely in reoperative recurrent rectal cancer cases where part of the sacrum may need resection. The perineal wound dehiscence rate has been reported to be as high as 48% in this setting.[33] However, there is no prospective, randomized data to completely support the mandatory routine use of these flaps for primary perineal wound reconstruction.

Anastomotic Leak

One of the most feared early postoperative complications, at the forefront of every surgeon's mind, is anastomotic leak. For the purposes of this chapter we limit our discussion to anastomotic leakage in the pelvis after rectal resection, which is especially problematic, not only because of the anatomic location of the leak, but also because of the functional and oncologic problems it may cause.

In one large prospective study, 622 patients were evaluated after low anterior resection for rectal cancer.[34] Either total mesorectal (TME) or partial mesorectal excision (PME) was used depending on the height of the tumor. The average height of the tumors from the anal verge was 8 cm. Overall the anastomotic leak rate was 8.1% in the TME patients and 1.3% in the PME patients. Independent risk factors for a higher leak rate were TME, male gender, absence of a stoma, and higher blood loss. Male gender has also been found to be a risk factor for anastomotic leak after low anterior resection in at least one other study.[35] In this prospective trial, 541 consecutive colon and rectal resections were evaluated. The leak rate for the rectal resections was 7.4% and that for the colon resections was 2.2%. These investigators found that male gender, previous abdominal surgery, Crohn's disease, tumor height less than or equal to 12 cm from the anal verge, and prolonged operating time were all significantly associated with anastomotic leak. Intuitively, it makes sense that a more difficult operation in a male patient with a deep, narrow pelvis and with a low rectal tumor making the anastomosis more difficult (i.e., more tension and compromised blood supply) might lead to higher leak rates. Most surgeons agree that the highest risk for anastomotic leakage after low anterior resection exists in men with unprotected anastomoses less than 5 cm from the anal verge, especially if they have received preoperative chemotherapy and radiation therapy.[36] Based on these data, one could conclude that a protecting ostomy for all such patients with low colorectal or ileorectal anastomoses would be mandatory. However, this topic remains somewhat controversial.

Protecting stomas have been criticized, because they probably do not decrease the actual leak rate, they require a second potentially risky operation with its own attendant morbidity, and the stomas themselves are associated with many different complications in patients who are typically elderly and debilitated from both their disease and the treatment for it.[37–39] Diverting loop ileostomies can cause many problems including dermatitis, stomal prolapse, and dehydration (which can lead to renal failure in severe cases). After these stomas are closed, the patients are again at risk for wound infection, anastomotic leak, SBO, and enterocutaneous fistula. Why do it then? Ultimately the goal in rectal cancer patients, as in all cancer patients, is to rid them of their tumor. There is significant concern that pelvic sepsis after rectal cancer resection may increase the local and distant recurrence rate. In a retrospective study of 300 patients who underwent rectal resection with TME, with and without preoperative radiation therapy, Laurent et al.[40] evaluated the effect postoperative sepsis had on overall and disease free survival. The patients who experienced pelvic sepsis postoperatively had a 5-year disease-free survival of 39% compared with a 5-year disease-free survival of 65% in those without it ($p < .001$). Also, even though a diverting stoma may not prevent a leak, it probably decreases the rate of having to return the patient to the operating room for reexploration.[38]

Neither does mechanical bowel preparation appear to protect against anastomotic leak, despite much time-honored dogma to the contrary. A Cochrane Database Systematic Review from 2003 found that the available evidence in the literature did not support the notion that mechanical bowel preparation protected against anastomotic leak or other complications.[41] The authors of the review examined the data in the literature for anastomotic leakage of rectal and colon anastomoses, as well as for peritonitis, mortality, surgical site infection, and need for reoperation, among other factors. They found no significant difference in any of these outcomes between patients who received mechanical bowel preparation and those who did not.

Many patients who undergo low anterior resection with an anastomosis at or below 5 cm from the anal verge have either a colonic J-pouch or transverse coloplasty constructed to aid in their defecatory function after surgery. These "neorectal" reconstructions, or pouches, probably only help with the frequency of bowel movements, leakage at night, and stool fragmentation in the first year or two after surgery (or after a defunctioning stoma has been reversed).[42,43] Anastomotic leak and pelvic sepsis also hampers the ability of these pouches to function properly, probably through scarring and subsequent inability to distend, leading to decreased capacitance of the pouch and more frequent bowel movements. There is disagreement in the literature regarding which of these techniques causes fewer problems postoperatively and which has the better long-term outcomes.[43,44] Ho et al.[43] examined 88 well-matched patients who underwent either coloplasty or colonic J-pouch reconstruction. They found no difference in function or quality of life at 1 year, but the coloplasty patients had more anastomotic leaks. Remzi et al.[44] examined 162 well-matched patients who underwent coloplasty reconstruction, colonic J-pouch reconstruction, or a straight coloanal anastomosis. Quality of life was better in the coloplasty and J-pouch patients, but the hand-sewn colonic J-pouch patients had more anastomotic leaks than the hand-sewn coloplasty patients. Overall, the outcomes in the literature of both these techniques seem similar enough that either one could be recommended depending on the clinical situation.

When an anastomotic leak in the pelvis causes diffuse peritonitis, abdominal reexploration is mandatory. Typically, the surgeon constructs a defunctioning ostomy in this situation, if it is not present already. This may be either a loop ileostomy or colostomy. An ileostomy is usually preferred in this situation, since much of the colon has already been mobilized and pulled down taut to the anastomosis in the pelvis. If the anastomosis is completely broken down, then the colon may be brought up as an end colostomy. More frequently, however, the pelvis is difficult to reach for a thorough evaluation of the anastomosis due to inflammation and adhesions. In this situation the pelvis should be drained as well as possible in addition to fecal diversion. It may be preferable to leave the leaking anastomosis intact, if possible, to prevent having to reconstruct it later in a reoperative or radiated pelvis, as long as in the judgment of the surgeon the situation is salvageable through drainage and diversion alone.

Small Bowel Obstruction

Early postoperative SBO is defined as that which occurs within the first 30 days from operation. The evidence definitely suggests that these SBOs behave differently from those that occur after this early period. It is difficult to predict which patients will need readmission, but SBO is one of the most common diagnoses. Azimuddin et al.[45] found in their retrospective analysis of 249 patients operated on from 1996 to 1998 that SBO was the most common readmission diagnosis. Fifty-nine of these patients were readmitted within 90 days of discharge from the hospital. Eighty-two percent of these readmissions occurred within 30 days. Thus, this seemingly random definition of what constitutes an early readmission has some statistical merit. A prospective evaluation of 242 patients undergoing laparotomy for various conditions (ulcerative colitis, malignancy, and Crohn's were the most common) resulted in 23 (9.5%) early postoperative small bowel obstructions (PSBO).[46] Only three (13%) of these patients required relaparotomy for lysis of adhesions, with one needing a small bowel resection. The authors used 6 days as the cutoff for reoperation, and recommended that patients who do not resolve with nasogastric decompression in this amount of time undergo reexploration.

Other studies have also demonstrated the wisdom of initial nonoperative management of early PSBOs. Recently, Miller et al.[47] retrospectively reviewed 1001 cases of SBO in 552 patients. Thirty were readmitted within 50 days of operation, but only seven (77% nonoperative success rate) required reoperation, and only one patient had strangulated bowel. Forty-three percent of these patients had undergone primary small bowel operations of some variety. Overall, cases of strangulation were no more common than in the late cases of SBO, and the nonoperatively treated patients did not take longer to resolve their obstruction, stay longer in the hospital, or recur more often than the patients with late SBOs. An earlier retrospective study from 1990 found no cases of dead bowel in any of the patients reoperated on within 30 days of the initial operation.[48] Morbidity and mortality were the same in those treated operatively and nonoperatively. The authors concluded that since dead bowel is unlikely in this setting (early PSBO within 30 days of operation), 10 to 14 days of nasogastric suction is warranted initially. After that, spontaneous resolution is unlikely.

Among the more notorious pelvic operations that are associated with postoperative SBO are hysterectomy, restorative ileal pouch-anal reconstruction (IPAA), and low anterior resection (especially after neoadjuvant treatment).[49–52] Rickard et al.[49] found that the SBO rate at any time was 16% after IPAA. Using a definition for early PSBO of a hospital stay of greater than 10 or 14 days due to delay of the return of bowel function, or readmission within 30 days for SBO, MacLean et al.[50] demonstrated a risk of SBO within 30 days of 8.7%, and 31.4% at 10 years in their group of 1178 patients who underwent IPAA. In a group of 297 patients who received neoadjuvant chemoradiation therapy followed by low anterior resection for rectal cancer, Chessin et al.[51] again found that the most common postoperative complication was SBO (11%). The need for relaparotomy for SBO within 30 days in this same study was 0.8%. Al-Sunaidi and Tulandi[52] calculated a rate of 13.6 SBOs per 1000 total abdominal hysterectomies performed in their hospital. It was the most common preceding gynecologic operation for benign disease in patients presenting with SBO in their series.

How long should one wait before reoperating on an early PSBO? As can be seen above, there is disagreement on this issue. Some authors recommend earlier reoperation than others for early PSBO, but 2 weeks is the usual recommendation. However, in reality this is a highly individualized decision, based on each patient's response to initial conservative management (e.g., nasogastric suction, fluid resuscitation, etc.). The literature tells us that initial nonoperative management is safe, because it is successful about 80% of the time, but beyond that the decision to reoperate depends on the patient's response to treatment and the best judgment of the surgeon.

Adhesive disease is the most common cause of SBO, which has fueled interest in adhesive barrier technology. One such product is a carboxymethylcellulose-based bioresorbable membrane placed directly into the abdomen at the conclusion of an operation. Two large randomized controlled trials have examined both the safety and the efficacy of this product with respect to prevention of SBOs.[53,54] Beck et al.[53] examined the incidence of abscess, pulmonary embolism, foreign-body reaction, and peritonitis in 1791 patients randomized to either the adhesion barrier group or a no-treatment group. Randomization took place just prior to closure of the abdomen. There were no statistically significant differences in the above variables between groups, and no foreign-body reactions were seen in either group. Of note, in a subpopulation of patients whose anastomoses were wrapped with the adhesion barrier, the incidence of leak-related events was higher (e.g., anastomotic leak, fistula, peritonitis, abscess, and sepsis). The authors concluded that this adhesion barrier was safe, but should not be placed around fresh anastomoses. One hypothesis may be that wrapping an anastomosis with an adhesion barrier prevents adequate scarring from taking place and thus allows small leaks that may otherwise be subclinical to become clinically apparent. The second study, conducted by Fazio et al.,[54] randomized 1701 patients who underwent intestinal resection to either the adhesion barrier group or a no-treatment group. Again, randomization took place just prior to closure of the abdomen. The incidence of SBO was then compared between the two groups. Overall, the rate of bowel obstruction in both groups was unchanged. However, the incidence of bowel obstructions requiring reoperation was lower in the adhesion barrier group by 1.6% ($p < .05$). In both groups, 30% of bowel obstructions occurred in the first 30 days after surgery.

Trocar site hernias after laparoscopic surgery also warrant mention. Prior to the advent of nonbladed trocars, trocar sites greater than 10 cm required closure due to the postoperative hernia and SBO rate.[55,56] However, Liu and McFadden[57] evaluated 70 patients with a total of 180 laparoscopic port sites and found that after the use of 10- to 12-mm nonbladed trocars, no patient developed a port site hernia after 11 months of follow-up. They also found that the fascial defects were all 6 to 8 mm. Presumably this is because the nonbladed trocars spread the tissue apart as opposed to dividing it, making a smaller defect once the trocar is removed.

Fistulous Complications

The cornerstone of management for enterocutaneous fistulas early on is to first control any septic process. In addition to early control of sepsis, nutritional support, wound and skin care, and a well-timed subsequent operation to close any recalcitrant fistulas have been shown to be the most effective management strategy.[58] New treatment options have also emerged in recent years, which have shown anecdotal success. These treatments, such as vacuum-assisted dressings, fibrin glue, and the anal fistula plug are long-term treatment options. In the first 30 days, reoperative therapy is typically reserved for control of intraabdominal sepsis, such as an exploratory laparotomy to drain an abscess and establish controlled drainage of any enterotomies or leaking anastomoses. In the case of the patient with an open abdomen who begins to leak succus from exposed loops of small bowel, the management becomes much more challenging. This problem occurs more commonly now, especially in military service members injured in the conflicts in Iraq and Afghanistan. Small patient series have begun to emerge of patients with succus from small bowel breakdown leaking right through the open abdominal wound being managed with vacuum-assisted dressings to control the drainage while simultaneously managing the open abdomen.[59] This problem will typically emerge within 30 days of the initial insult, which resulted in the open abdomen. Vacuum-assisted dressings are very effective in controlling wound drainage and protecting the surrounding skin. Stoma appliances can be fashioned to fit right over the vacuum sponges with the fistulas draining through cut holes in the sponges. Once the wound bed has granulated around the fistulas (or the fistulas have closed), skin grating may be carried out. The fistulas and resulting large hernia defects may then be closed at a much later time (6 to 12 months) when the patient has healed and the abdominal scar has softened. In the absence of fistulas, open abdominal wounds may be closed with other methods besides skin grafting. Once the wound is ready for closure (i.e., adequate bed of granulation tissue over the bowel, no further abdominal washouts required, and the patient has normalized physiologic and nutritional parameters), prosthetic materials can be used to cover the wound, and thus largely eliminate the resulting hernia defect after skin grafting. Polypropylene mesh is a good choice for this purpose due its porosity and relative ability to resist infection (Fig. 2.2).[60] Acellular dermal matrix materials have also achieved success recently. However, Schuster et al.[61] showed that once this material has been placed, the skin should be closed over it in order to avoid an 83% incisional hernia recurrence rate in those receiving subsequent open wound management.

Early Stoma Complications

With the exception of full-thickness necrosis of the stoma, most other early stoma complications are managed nonoperatively. It is important for patients who the surgeon

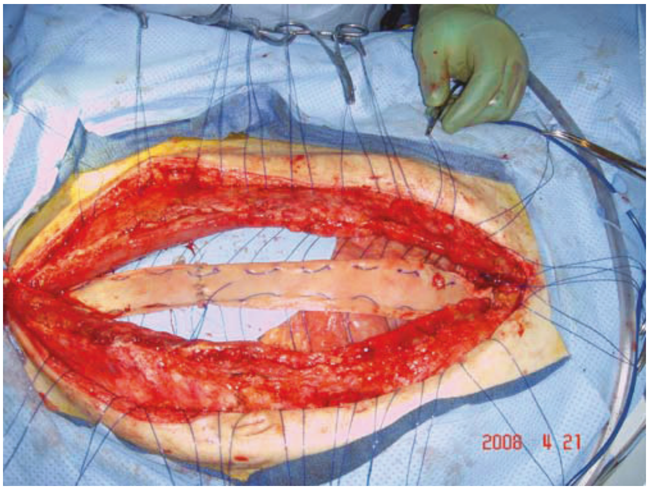

FIGURE 2.2. Closure of open abdomen with biologic mesh.

knows will need an ostomy to have a preoperative consultation with an enterostomal therapist, if possible. Starting this relationship early can prevent problems later and make dealing with those that do occur less distressing for the patient. The therapist can mark an appropriate location on the abdomen for the stoma and do important teaching and counseling about how to take care of the stoma and troubleshoot problems that will likely arise.

Loop ileostomy is one of the most popular choices for defunctioning a low rectal anastomosis in the pelvis. The loop ileostomy is a safe choice, but not without complications. In a large retrospective study of 222 patients diverted with a loop ileostomy after low anterior resection, the overall mortality was 0.5% and the overall ostomy-related morbidity, including the need to reoperate, was 6%.[62] The transverse loop colostomy is also still used for this same purpose. However, in a randomized, prospective trial involving 70 subjects undergoing low anterior resection, Edwards et al.[63] found that the incisional and parastomal hernia rate, before and after closure, was higher in the loop transverse colostomy group than in the loop ileostomy group. One fecal fistula and two stomal prolapses also occurred in the loop transverse colostomy group, but none occurred in the loop ileostomy group. Both stomas protected the anastomosis equally, however.

In the immediate postoperative period one of the more frequent problems that may challenge the surgeon is the dusky ostomy. Whether or not this represents full-thickness necrosis or impending necrosis is the chief concern. Usually the stoma will not necrose and the duskiness of the mucosa is secondary to venous congestion from a trephine defect that is too tight. This may either be from too small a defect, or from swelling of the bowel or the abdominal wall postoperatively. In this situation one should digitalize the stoma to ensure it is open below the fascial level. It may also be reassuring to insert a glass test tube or blood tube into the stoma with a light to examine the mucosa below the skin level. If this too is dusky appearing, impending full-thickness necrosis of the stoma is more concerning. Over time, if the stoma does not worsen in appearance and becomes productive, the compromised mucosa may slough. This may or may not produce a strictured stoma requiring revision. A frankly necrotic stoma that is plainly black in appearance should be revised in the operating room.

Postoperative Cholecystitis

When cholecystitis occurs in the early postoperative period (<30 days) either from a calculous or acalculous etiology, cholecystectomy is indicated. This may be accomplished through the initial operative incision, a right subcostal incision, a right paramedian incision, or even a laparoscopic approach, depending on the clinical situation. In critically ill patients, who may no longer be operative candidates, a percutaneous cholecystostomy may be performed, as long as the gallbladder has not necrosed. To avoid the need for early postoperative as well as late postoperative cholecystectomy, incidental cholecystectomy has been advocated when gallstones are discovered intraoperatively during colorectal procedures, as long as the cholecystectomy does not inordinately increase the morbidity of the overall operation.[64] The cumulative risk of needing a subsequent cholecystectomy in patients with cholelithiasis discovered intraoperatively at 2 and 5 years has been quoted at 12.1% and 21.6%, respectively.[64]

Ureteral Injury

Ureteral injury is an uncommon complication of colorectal surgery in the pelvis, and when recognized at the time of the initial operation it usually can be repaired with little or no subsequent morbidity for the patient. However, when the injury goes unrecognized, the outcome may be very different. Surgeons routinely identify the ureter when carrying out colon and rectal resections in order to ensure that injury does not occur. The most common reason for injury is dissection in an area where the ureter is stuck or scarred to structures that are being resected, such as the colonic mesentery or the adnexa. Scarring may occur secondary to any inflammatory process (e.g., diverticulitis) or after radiation therapy. Routine stenting of the ureters has been shown not to necessarily prevent injury, but it does aid in making sure that injuries are discovered at the time of surgery and repaired.[65]

Most injuries consist of either cutting or crushing the ureter and involve short segments. However, ischemia of the ureter may also occur from circumferential dissection during the course of the case.[66] Unfortunately, this is typically recognized postoperatively as either frank perforation with urinoma formation or peritonitis, or subsequent stricture formation. Once the injury is recognized, the patient should be returned to the operating room for repair, if possible. Stenting across the injury may be attempted, but this has met with problems such as continued urinary leakage and stricture formation.[67] Many options for repair exist, but the most commonly employed methods are primary repair (ipsilateral ureteroureterostomy) over a stent, for proximal and midlevel injuries, and ureteroneocystostomy, for low-level injuries in the pelvis.[68] Other less commonly employed options are the psoas hitch and the Boari flap, usually in cases where a segment of ureter is missing and length is needed. In cases where length is needed proximally, the kidney also can be mobilized and brought down toward the pelvis so that reconstruction may be done without tension. Percutaneous nephrostomy is another option for patients who are unstable, and cannot be returned to the operating room.

Compartment Syndrome

Compartment syndrome of the calf after colon and rectal surgery, or any pelvic surgery, requiring placement of the patient in the lithotomy position for an extended period of time, is a rare complication. As a result, we have no large studies examining the problem that might illuminate for us what might be the main risk factors. A literature review by Beraldo and Dodds[69] examined the English-language literature and found that the lithotomy position itself, ankle and knee positioning, external compression for deep venous thrombosis prophylaxis, the method of leg support, the duration of surgery, and physiologic factors (e.g., age, gender, body mass index) all were potential factors that place patients at risk for developing compartment syndrome of the calf postoperatively. Others have also found these same factors to put patients at risk for the calf compartment syndrome.[70] Specifically, the Trendelenburg position is thought to cause hypoperfusion of the lower extremities and place the patient at increased risk for developing calf compartment syndrome when combined with the other risk factors (lithotomy position, operative time >5 hours, etc.).[69] Patients at risk should be identified by the surgeon and monitored carefully postoperatively for the signs and symptoms of this complication. Should it occur, an emergent four-compartment fasciotomy utilizing two incisions is the safest method to ensure adequate decompression of the calf. More research is necessary to determine if monitoring modalities, such as pulse oximetry of the lower extremities to detect hypoperfusion, will be effective in preventing the calf compartment syndrome, and what the appropriate use of sequential compression devices should be.[69]

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3

Reoperation and Management of Postoperative Pelvic Hemorrhage and Coagulopathy

Jennifer L. Young, Jason A. Lachance, Laurel W. Rice, and Eugene F. Foley

This chapter reviews the causes of pelvic hemorrhage in the postoperative setting as well as both the surgical and nonsurgical techniques available to manage this life-threatening clinical situation. The etiology of postoperative hemorrhage directly relates to the treatment options available and the management algorithm employed. Further understanding of this topic will enable the surgeon to choose from many available techniques based on patient parameters.

Etiology

Pelvic hemorrhage may be the result of arterial or venous injury, tissue necrosis, sepsis, cancer, or a coagulopathy. The diagnosis of pelvic hemorrhage after surgery can be divided into early postoperative hemorrhage and late postoperative hemorrhage. Vascular injuries and coagulopathy cause most early postoperative hemorrhage. Late postoperative bleeding (greater than 48 hours after surgery) can result from an arteriovenous fistula, abscess, or recurrent malignancy.

Arterial bleeding is often from a distinct identifiable source and frequently presents in the immediate postoperative setting with signs of hemodynamic instability. When arterial bleeding occurs in the retroperitonium, tamponade commonly results in a delay of diagnosis.

Venous bleeding is more common and is more difficult to control. Frequently, no distinct bleeding site can be identified at the time of reexploration. A steadily falling hematocrit over 12 to 48 hours or imaging reporting an intraabdominal or retroperitoneal hematoma is suggestive of venous bleeding. In the setting of venous bleeding, coagulopathy secondary to pharmacologic agents, such as aspirin, nonsteroidal antiinflammatory drugs (NSAIDs), and heparin among others, should be considered.

Postoperative pelvic hemorrhage may result from any type of pelvic surgery, including general surgery, colorectal, orthopedic, urologic, and gynecologic procedures.[1] Factors leading to vascular injury include oncologic resection (65%), difficult anatomic exposure (63%), previous operation (48%), recurrent tumor (28%), and radiation therapy (20%).[1]

Incidence

Reexploration for hemorrhage occurred in 0.3% of radical prostatectomy cases.[2] In gynecologic surgery, the incidence is reported to be between <1% for urogynecologic surgery[3] and up to 2% to 3% for hysterectomy.[4] A large series of 942 cases of gynecologic surgery for cancer found that 22 women underwent reoperation for bleeding within 48 hours of surgery (2.3%).[5] In this study, nine women (40.9%) had an identifiable bleeding site while diffuse bleeding was identified in the majority of cases.[5] In a series of over 36,000 cesarean sections, the rate of reoperation for pelvic hemorrhage was 0.7%, all for hemorrhage of various etiologies. The case fatality for reexploration in this setting was high at 9%.[6] In the surgical literature, the largest series of 6499 diverse elective procedures reported 30 cases of reoperation for postoperative bleeding (0.5%).[7] Only 10 of these patients were noted to have a distinct bleeding site. Of the 20 patients with diffuse bleeding, 19 of 20 had a history of preoperative NSAID use compared to none in those with a single bleeding site ($p < .001$).[7]

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Diagnosis

Signs of hypovolemia including tachycardia, hypotension, and oliguria are the most common clinical indicators prompting evaluation for postoperative hemorrhage. In addition, increasing abdominal girth, increased sanguinous output from intraabdominal drains, and flank discoloration (in the setting of retroperitoneal bleeding) can all be signs of pelvic hemorrhage. Shock is indicated by the presence of hemodynamic instability as well as pallor, diaphoresis, cyanosis, hyperventilation, confusion, and oliguria.

Venous bleeding typically presents after the immediate postoperative period. Bleeding is suspected when a postoperative hematocrit is unexpectedly low or a patient has a syncopal episode. In this setting, serial hematocrits, physical exam, and imaging may prompt aggressive resuscitation, which may obviate surgical reexploration.

One approach to laboratory parameters for diagnosis of postoperative bleeding includes using a steadily falling hematocrit at a rate greater than 3% per 4 hours or a greater than 10% hematocrit drop from the preoperative value not commensurate with the estimated blood loss. Intraabdominal bleeding can often be confirmed by a bedside ultrasound demonstrating hyperechoic fluid around the liver. Computed tomography (CT) of the abdomen and pelvis is also useful for identifying free fluid or hematoma. This imaging modality allows for assessment of a possible retroperitoneal hematoma, which is frequently missed on ultrasound evaluation.

Factors such as fluid shifts secondary to ascites or hypovolemia secondary to preoperative bowel preparation may cause hypotension, tachycardia, and oliguria in the postoperative period. These problems should be included in the differential diagnosis. Other causes of hypotension must also be considered when laboratory values do not support the diagnosis of hemorrhage, including sepsis, pulmonary embolus, or congestive heart failure. The details of the surgery and the overall medical condition of the patient direct both the evaluation and medical management of patients presenting postoperatively with the symptoms described previously.

Coagulopathy

Coagulation disorders, either acquired or genetic, can result in pelvic hemorrhage in the intraoperative and postoperative setting. Preoperative assessment is critical in preventing complications due to genetic or drug-induced coagulation disorders. Multiple abnormalities (Table 3.1) result in disorders of the coagulation cascade or platelet dysfunction (Fig. 3.1). A careful history of menstrual bleeding, epistaxis, and bleeding with prior surgeries, including dental surgeries, may reveal an undiagnosed coagulation disorder. Chronic anticoagulation with warfarin or heparin requires strict adherence to a transition protocol. This should take into consideration all medical issues specific to that patient, including disease processes such as atrial fibrillation and mechanical heart valves.

Acquired Platelet Dysfunction

The NSAIDs and aspirin are well recognized as etiologic agents in the setting of postoperative hemorrhage. A careful history of NSAID use must be obtained preoperatively, with discontinuation of this medication 1 to 2 weeks prior to surgery, depending on the NSAID employed. In the cardiac literature, the use of aprotinin and desmopressin have been shown by some investigators to reduce aspirin-related perioperative and postoperative bleeding.[8]

TABLE 3.1. Examples of Bleeding Diatheses.

Location of disorder	*Laboratory abnormality*	*Disease*	*Factor affected*
Intrinsic	aPTT	Hemophilia A	Factor VIII
		Hemophilia B	Factor IX
		Acquired hemophilia	Auto-ab to factor VIII
		Factor XI deficiency	Factor XI
		Systemic lupus erythematosus (SLE)	Lupus anticoagulant
Extrinsic	PT	Factor VII deficiency	Factor VII
	Both PT, aPTT	Hypoprothrombinemia	Prothrombin
		Hypofibrinogenemia	Fibrinogen
Platelet	Bleeding time or platelet function analyzer (PFA)	Thrombotic thrombocytopenic purpura	
		Immune thrombocytopenic purpura	
		Von Willebrand's disease	Von Willebrand's factor (vWF)
Collagen	None vs. bleeding time	Ehlers-Danlos	Collagen type II
Vitamin K deficiency	PT	Malnutrition	Vitamin K
		Antibiotics	
		Warfarin therapy	
		Rare genetic enzyme abnormalities	

PT, prothrombin time; aPTT, activated partial thromboplastin time.

Source: From Young N, Gerson, SL, High Katherine A. Clinical Hematology, 2006. Philadelphia: Mosby, by permission of Elvesier, Inc.

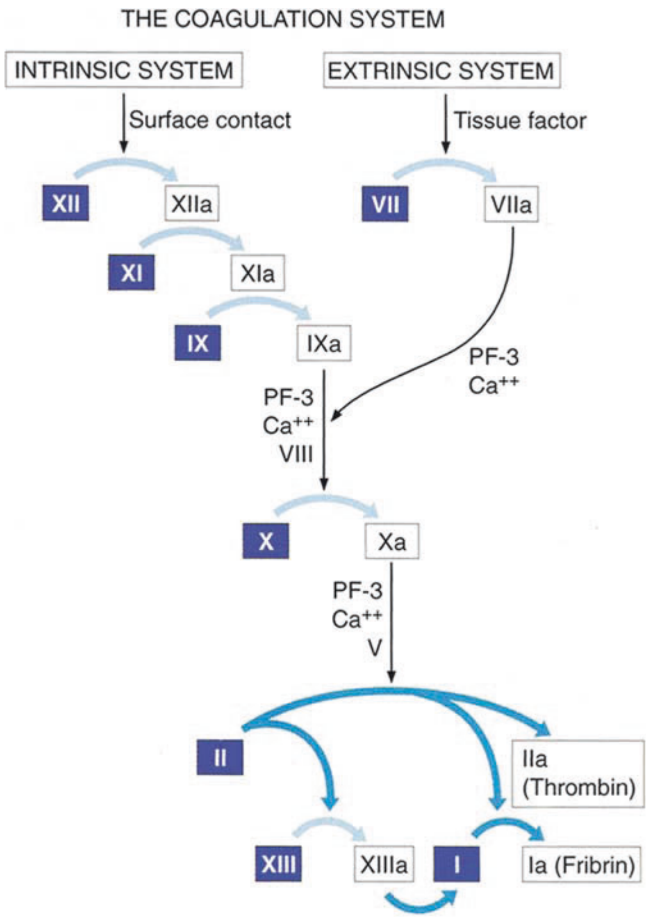

FIGURE 3.1. Coagulation cascade. (From Young N, Gerson, SL, High Katherine A. Clinical Hematology. Philadelphia: Mosby/Elvesier; 2006, by permission of Elsevier, Inc.)

However, other investigators have found minimal benefit in the utilization of these drugs.[9] Any advantage from these two pharmaceutical agents in other surgeries in the setting of NSAID-induced perioperative or postoperative bleeding has not been conclusively established.

Acquired Coagulopathy

Causes of acquired coagulopathies, including dilution of coagulation factors during resuscitation, consumption of coagulation factors, liver disease, sepsis, and even pregnancy, all may lead to disseminated intravascular coagulation (DIC) in the setting of significant hemorrhage. Additionally, large-volume blood loss and subsequent resuscitative efforts can lead to decreased calcium concentration, hypothermia, and acidosis, which contribute to coagulation cascade dysfunction.[10] The diagnosis of DIC is established in the presence of thrombocytopenia, prolonged prothrombin time (PT), prolonged partial thromboplastin time (PTT), low fibrinogen, fibrin split products, and fibrin monomers on a coagulation panel. The risk of reexploration in the setting of pelvic hemorrhage with DIC is significant. In an emergency setting when there is no time for obtaining laboratory tests, one can use an unheparinized blood sample tube to quickly diagnose a patient's coagulation status prior to reoperation. Treatment of DIC involves transfusion of packed red blood cells, fresh frozen plasma, cryoprecipitate, and platelets. This resuscitation should be undertaken prior to or simultaneously with reexploration, with constant laboratory reassessment. Recently, recombinant activated factor VII (rFVIIa) has been used successfully in the setting of postoperative DIC.[11–15] In hemorrhage, a tight fibrin hemostatic plug is induced through increased thrombin generation.[16] Recombinant FVIIa induces hemostasis in hemophilia A and B as well as in major surgery at a dose of 90 to 110 µg/kg bolus every 2 hours up to 24 hours.[16] The utilization of rFVIIa can result in an increased risk of thromboembolic events. There are several case reports of deep venous thrombosis in patients treated with this drug.[12] In a series of 13 trauma patients receiving rFVIIa, nine of 13 stopped bleeding, seven of 13 survived, and one patient sustained an embolic stroke.[17] This agent is recommended only as a last resort when other means of correction of bleeding and coagulopathy have been exhausted.

Decision to Reoperate

There are three factors that must be considered when reexploration is being contemplated: the hemodynamic stability of the patient, the likelihood of success, and the consideration of alternate treatment modalities such as transcatheter arterial embolization (TAE). Patients who are acutely unstable secondary to hemorrhage often have an arterial vessel injury and are likely to benefit from reoperation or TAE. In patients who are hemodynamically stable, but have clearly sustained a postoperative hemorrhage, a more complex algorithm exists. Observation with serial laboratory evaluation may result in stabilization without operative intervention. Kaufman and Lepor[18] randomized stable patients who had bleeding after radical prostatectomy to either reoperation or observation. They found a significantly higher rate of blood transfusion in the reoperation group and longer duration of hospital stay. However, the authors noted that reexploration may have contributed to healing with improvements in bladder extravasation, urinary continence, and indwelling catheter interval in the reoperation group.[18] Another series reported that 27 of 32 hysterectomy patients with postoperative pelvic bleeding were successfully managed conservatively with supportive care.[19]

The treatment of patients with postoperative hemorrhage is dependent on the etiology. For suspected arterial vessel injury, the possibility of identifying and ligating a distinct bleeding site is high, and the patient is likely to benefit from immediate reoperation. However, in the setting of suspected generalized bleeding from a venous plexus or NSAID use, observation and support with blood products may be the best alternative. Lastly, in cases of DIC, correction of the coagulopathy and treatment of the cause of DIC, particularly in sepsis, must be initiated prior to reoperation. In DIC, the likelihood of the successful reexploration is low unless the source of the bleeding can be controlled.

Lastly, in considering observation versus reoperation, transcatheter arterial embolization should be considered. Availability of interventional angiographic services is variable, depending on the hospital and the timing, particularly in the emergency setting.

Transcatheter Arterial Embolization

Transcatheter arterial embolization has been successfully reported to treat all types of pelvic hemorrhage including arterial and venous bleeding, radiation necrosis, septic graft bleeding, and obstetric hemorrhage.[20–23] Poor patient performance status, distorted anatomy, and bleeding in the setting of recurrent cancer are also possible indications for the preferential use of TAE. Multiple occlusive agents have been utilized during TAE including gelatin sponges, cellulose, wire coils, autologous blood clots, balloon catheters, and vasopressin injection. Most commonly, TAE controls pelvic hemorrhage via the anterior branch of the internal iliac artery (Fig. 3.2).

Intentional occlusion of the external iliac artery in the setting of hemorrhage has also been reported. One series reported on external iliac hemorrhage associated with postoperative abscess and pelvic malignancy in four patients with rectal cancer and one patient with cervical cancer.[24] Hemostasis was achieved in all five patients with no limb loss. One patient subsequently died of sepsis and one patient required femoral/femoral bypass 5 months later. The authors noted that preservation of the inferior epigastric and deep iliac circumflex arteries maintained blood flow to the ipsilateral femoral artery via collateral pathways.[24]

In the largest series reported, 33 patients underwent TAE for postoperative bleeding after abdominal surgery. This study found that a distinct bleeding site was identified in 26 patients and was successfully treated in 24 of 26.[25] Four of 26 patients had rebleeding (15%) and all were managed with repeat angiography. There were no major complications during follow-up.[25] In obstetric hemorrhage, many consider TAE the first-line therapy for obstetric hemorrhage that is unresponsive to medical treatment. One series reported six cases over 5 years, with only one patient requiring hysterectomy to control bleeding.[26] Angiography has also been used to control hemorrhage in the space of Retzius.[20] Arterial embolization is an excellent alternative in the management of postoperative hemorrhage.

Reoperative Techniques

In the setting of pelvic hemorrhage, optimizing resuscitation prior to reexploration is the ideal. This includes ensuring adequate venous access, replacement of fluid and blood products, correction of a coagulopathy, and consideration of redosing antibiotics. Acidosis, if present, must be corrected to protect against DIC. Hypothermia must be prevented by increasing the temperature of the room, warming fluids and blood products, and using a warming blanket.

Careful preparation and planning are mandatory prior to reexploration for pelvic hemorrhage. The surgeon must ensure that all necessary equipment is readily available. This includes adequate lighting, self-retaining retractor, sufficient suction apparatus, vascular clamps, and appropriate suture material. Surgical consultants should be available at the time of reexploration if indicated. A midline, vertical incision is preferred for postoperative hemorrhage, recognizing that the source of the bleeding is infrequently established prior to reexploration. Upon entry into the abdomen, the blood should be evacuated promptly and a rapid systematic inspection of the entire abdominal-pelvic cavity should be accomplished. After identifying the site of injury, pressure should be applied immediately to that site, obtaining control of the hemorrhage. While applying pressure to the site of injury, the bowel should be packed away from the operative field in preparation for repair of the injury. Proximal and distal control, whether it is a venous or arterial injury, is imperative. Direct pressure with two sponge sticks above and below the injury is ideal; if it is an arterial injury, vascular clamps can also be utilized (Fig. 3.3). A running closure of the injury using a 5-0 Prolene suture can then be performed. In the case of bleeding from a venous plexus, direct ligation as described above, is infrequently effective. Alternative methods of control must be considered, including clips, proximal suture placement, and topical procoagulants.

In the setting of pelvic hemorrhage, ligation of the anterior division of the internal iliac arteries has been shown to

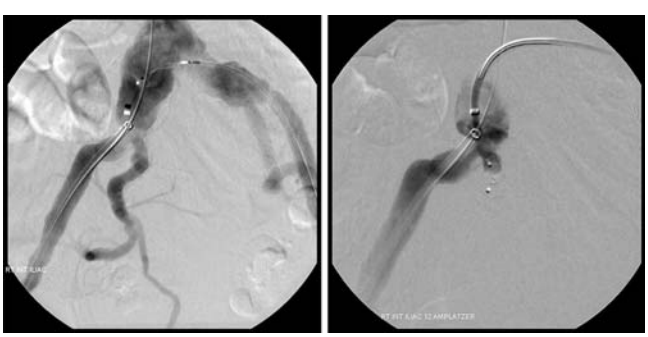

FIGURE 3.2. Angiography demonstrating embolization of the anterior division of the internal iliac artery. (Courtesy of Dr. Daniel Hendricks, University of Virginia, Charlottesville, VA.)

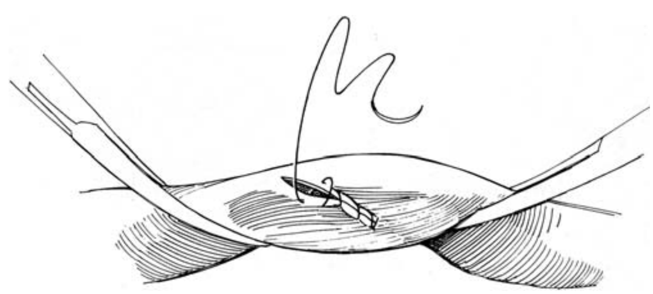

FIGURE 3.3. Repair of vessel injury after obtaining distal and proximal control of bleeding. (From Hinman F Jr. Atlas of Urosurgical Anatomy. Philadelphia: W.B. Saunders; 1993, by permission of Elsevier, Inc.)

enhance control of pelvic bleeding by reducing pulse pressure by 77%.[27] Circulation is maintained because the mean arterial pressure to distal vessels is only decreased by 24%.[28] Overall reported success rates for this procedure vary from 40% to 100%.[29,30] When ligating the anterior division of the internal iliac artery, the surgeon should open the retroperitoneal spaces and identify all important structures, including the ureters, common iliac artery and vein, external iliac artery and vein, and internal iliac artery and vein. Approximately 2.5 to 3 cm distal to the bifurcation of the common iliac artery, the tip of a right angle clamp is passed lateral to medial thus preserving the posterior branch of the hypogastric artery (Fig. 3.4). Utilizing nonabsorbable suture, the vessel should be double ligated without transsection.[30]

Topical hemostatic agents can significantly contribute to hemostasis in any operative situation. There are many types and combinations currently available (Table 3.2). These agents work by establishment of a stable fibrin clot, which seals the vessel and promotes normal wound healing. In a Cochrane database review of seven controlled clinical trials using fibrin sealants during cardiac surgery, these agents demonstrated a relative risk of 0.46 for transfusion, suggesting their efficacy at controlling hemorrhage.[31] In a study comparing the addition of thrombin to gelatin for control of hemorrhage, there was significant improvement of bleeding site control of the thrombin-gelatin combination over gelatin alone.[32] The main concern with use of these agents is the risk of anaphylaxis, which can be as high as 5% in the setting of reexposure within less than 6 months.[33] Severe coagulopathy after topical thrombin has also been reported.[34]

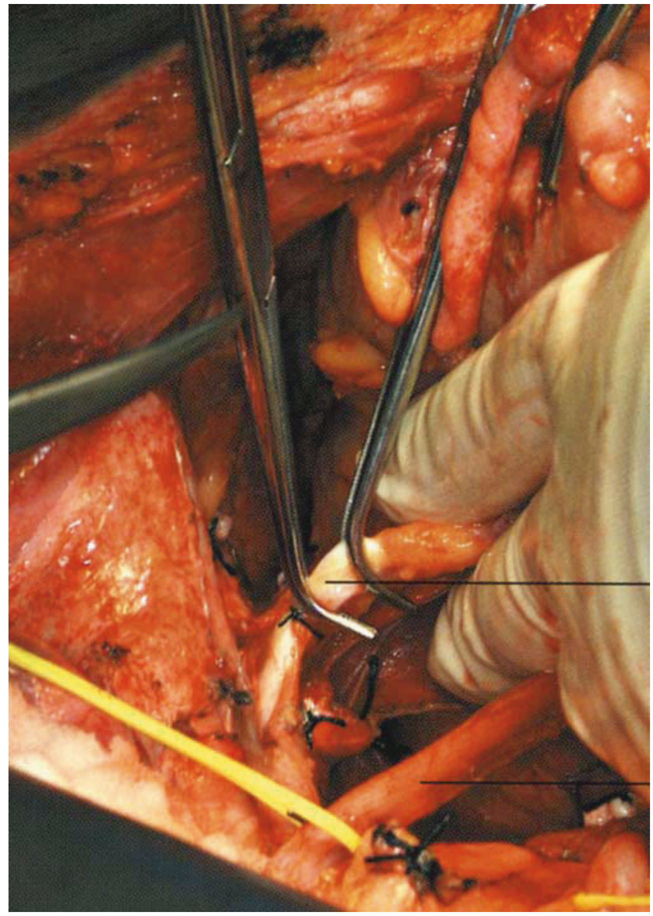

FIGURE 3.4. Surgical ligation of the anterior division of the internal iliac artery. (From Smith JR, Del Priore G, Curtin J, et al. [eds], An Atlas of Gynecologic Oncology, 2000, by permission of Taylor & Francis, Inc.)

Space-Specific Surgical Techniques

Presacral Space

Rarely, bleeding from the presacral space is diagnosed postoperatively. Most commonly it is identified as an intraoperative injury during lymphadenectomy, sacrocolpopexy, or other retroperitoneal dissections over the sacral promontory and is almost always an injury to the venous plexus overlying the sacral periostium.[30] Conventional means of vessel control in this setting are unsuccessful due to vessel retraction into the bony foramina of the sacrum. Options include sterile thumbtacks specifically designed for bony ostia, presacral packing, cyamonacrylate adhesive, bone wax, and electrocautery of rectus fascia over the presacral space, all of which have been reported to control bleeding.[35–39]

TABLE 3.2. Commonly Used Topical Hemostatic Agents.

Type	*Example*	*Active ingredient(s)*	*Source*	*Form*	*Pathway*
Polyethylene glycol (PEG)	CoSeal	Biocompatible PEG polymers, collagen	Synthetic	Gel	Intrinsic
Microfibrillar collagen	Avitene	Collagen	Bovine	Nonwoven web or powder	Intrinsic
Oxidized regenerated cellulose	Surgicel, Oxycel	Cellulose	Plant	Knit or microfibrillar	Intrinsic
Gelatin sponge	Gelfoam, Surgifoam	Absorbable gelatin	Porcine	Sponge or powder	Intrinsic
Thrombin collagen	Costasis	Mixture of thrombin and collagen	Bovine	Gel	Both
Fibrin Sealant	Tisseal, Crosseal, Hemaseel HMN	Fibrin, thrombin, FXIII, Aprotinin, calcium	Bovine, human	Gel	Extrinsic
Topical thrombin	Thrombostat Floseal	Thrombin	Bovine	Powder or solution Gel	Extrinsic

Obturator Fossa

Vessel injury in the obturator fossa most commonly occurs during lymphadenectomy for pelvic malignancy. However, orthopedic surgeries, urogynecologic surgeries, and dissection of a Richter's hernia may also result in these injuries. Injuries to the obturator artery, vein, or the venous plexus under the obturator nerve are all possible. Adequate exposure is essential in controlling hemorrhage in this space. Surgical clips are often successful, always maintaining direct visualization of the obturator nerve.[30]

Space of Retzius

Postoperative venous plexus bleeding from the space of Retzius may present as a scrotal or vulvar hematoma. These vessels can be injured in urologic and urogynecologic surgery, as well as during radical dissections for malignancy. Tamponade of bleeding vessels is more likely than dissection to succeed in controlling hemorrhage. Backfilling the bladder with 500 mL sterile water and clamping the Foley will provide significant pressure to this area, recognizing that patient discomfort is prohibitive in utilizing this technique for an extended period of time.

Pelvic Floor

Bleeding from the pelvic floor venous plexus can frequently be controlled by pressure, vessel ligation of any distinct bleeding sites, and application of topical thrombin agents, as described above. If hemorrhage cannot be controlled, packing for 24 to 48 hours while simultaneously resuscitating the patient has been reported.

Abdominal Packing

In the setting of uncontrolled pelvic hemorrhage and coagulapathy, with or without hypothermia and acidosis, abdominal packing can be lifesaving. The surgical procedure is aborted in favor of resuscitation with a plan to return after achieving hemodynamic stability.[10] Data from the trauma literature on damage control surgery, a similar concept, speaks to the utilization of this method in the setting of the lethal triad of DIC, hypothermia, and acidosis, where the mortality rate exceeds 90%. The literature supports an improvement in overall mortality to 50% in this setting.[10] The goal of this method is to compress bleeding and provide time to rewarm and resuscitate the patient before definitive surgical correction is completed. At the time of laparotomy, 5-cm gauze packs, overlapped with laparotomy packs, are utilized to tightly compress the bleeding site. The abdominal incision is closed, employing one of several possible closure techniques, including retention sutures, with or without closure of the fascia.[10] Jackson-Pratt drains are recommended to allow for monitoring of ongoing intraabdominal bleeding. If the abdomen cannot be closed due to bowel distention, the abdomen can be covered with a sterile towel followed by a sterile adhesive drape, open wound vacuum closure, or nonabsorbable mesh. The packs are removed at reexploration, typically within a 48-hour time frame once the patient has been adequately resuscitated. During the resuscitation period, patients must be monitored closely for abdominal compartment syndrome. This may present with decreased venous return and respiratory dysfunction. Signs of abdominal compartment syndrome warrant immediate reexploration for decompression. Of the cases reported in the trauma literature, definitive repair and fascial closure were possible in over 85% of cases.[10] Complications of packing include abdominal abscesses (23%), wound dehiscence (9%), and enterocutaneous fistula (9%).[40]

Conclusion

The single most important factor in preventing life-threatening postoperative hemorrhage is primary hemostasis. Preoperative evaluation for underlying bleeding disorders, use of NSAIDs, and control of anticoagulation medication can decrease the risk of postoperative hemorrhage. The successful management of pelvic hemorrhage depends on the etiology, the site and type of injury, the medical status of the patient, and the availability and appropriate utilization of the resources described previously.

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4

Reoperative Considerations After Laparoscopic Pelvic Surgery

Marco J. Tomassi and Deborah Nagle

Laparoscopic surgery has been associated with a number of positive outcomes for the patient: decreased pain, improved cosmesis, shorter hospital stays, and quicker returns to work or baseline activity. Laparoscopic pelvic surgery is technically complex, but utilized more and more frequently as surgeons ascend the learning curve of laparoscopic surgery. Minimally invasive abdominal surgery is major surgery, with all the inherent risks and complications that are seen in open surgery, plus a few complications unique to laparoscopic surgery. The laparoscopic pelvic surgeon needs to recognize the complications, identify those requiring reoperation, and know the best practices for management of those complications. The focus of this chapter is the laparoscopic management of surgical complications in the early postoperative period, which we define as within 30 days of initial surgery.

Expected Postoperative Course

The postoperative management of colon and rectal surgical patients has been standardized in many ways. Expected signs of steady recovery include stable vital signs, normothermia, adequate pain control, and recovery of gastrointestinal tract function. In our institution we utilize a printed clinical pathway with an associated predefined order set. Having an expected postoperative course for patients has been shown to streamline patient care,[1] and it helps the clinical team more quickly identify outliers who may be having complications, since these patients often do not adhere to the usual postoperative course. If a patient has delayed return of bowel function, persistent fevers or malaise, there ought to be a heightened sense of awareness on the clinician's part that something is awry.

Evaluation of Patients Who Deviate from the Expected Postoperative Course

The primary indications for reoperative laparoscopic surgery in the early postoperative period are the same as those for open surgery, and are listed in Table 4.1.

Clinical Signs and Symptoms

As always, physical examination is the first step in evaluating any patient. Usually, abnormal vital signs (persistent fevers, tachycardia, hypotension), postoperative oliguria, or a persistent parenteral fluid requirement indicates a potential clinical problem.

A focused abdominal examination elicits signs of distention and nonspecific tenderness in almost all postoperative patients, but may also reveal a hematoma or bulging hernia at a trocar site. Tenderness out of proportion to the normal postoperative course, or that which cannot be relieved with narcotics, is a significant finding, as it may indicate the presence of an intraabdominal infection, an incarcerated hernia, or another pathology that may only be relieved with an intervention. A patient with a missed enterotomy often presents on postoperative day 1 or 2 with frank peritoneal signs. A digital rectal exam may be helpful in the situation of the ultralow rectal anastomotic dehiscence, where an anastomotic defect may be palpated directly.

Laboratory Studies

Routine laboratory studies (complete blood count, basic metabolic panel) may be useful in the postoperative patient who is not progressing clinically as expected. A complete blood count may show significant or rising leukocytosis in the setting of an intraabdominal infection. Alternatively, the total white count may be mildly elevated, but a

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TABLE 4.1. Indications for Reoperation in the Early Postoperative Period Following Laparoscopic Surgery.

	Pathology	*Presentation*	*Radiology*
Infectious complications	Pelvic abscess Anastomotic dehiscence Missed enterotomy	Fever after postoperative day 1 Leukocytosis Ileus/urinary retention Peritonitis	CT abdomen KUB Water-soluble enema for rectal anastomoses
Obstruction	Postoperative ileus Trocar-site hernia Adhesive disease Internal hernia	Distended abdomen Obstipation Bilious nasogastric tube (NGT) output Tender trocar site	KUB CT abdomen
Bleeding	Intraluminal Extraluminal	Hematoma Hypotension, oliguria Unstable hematocrit	CT abdomen

KUB, x-ray of kidneys, ureters, and bladder.

bandemia or prominent left shift may be present. An unstable postoperative hematocrit despite transfusions of packed red blood cells can indicate the presence of a bleeding source within the abdomen. Chemistries may reveal remediable electrolyte causes for a persistent ileus (hypokalemia, hypomagnesemia, or hyperglycemia), or may show hypovolemia through an elevated blood urea nitrogen (BUN) and creatinine.

Many of the postoperative complications listed in Table 4.1 can present nonspecifically, with delayed return of bowel function, low-grade fevers, or leukocytosis. Vigilant postoperative assessment is key to identifying complications early.

Radiologic Evaluation

If an apparent ileus is not relieved with 48 to 72 hours of medical treatment, imaging is warranted to identify the presence of a mechanical obstruction or correctable causes of ileus, such as extraluminal abscess, anastomotic leak, or hematoma. Standard abdominal radiographs can be helpful to evaluate for free intraperitoneal air or ileus/bowel obstruction.

Contrast studies are more useful for definition of bowel obstruction and delineation from ileus. There are several studies in the literature evaluating the use of water-soluble oral contrast studies, which are reported to predict the need for operative intervention and also to possibly therapeutically resolve small bowel obstructions. A recent review in the Cochrane Database identified randomized, prospective studies of contrast studies in bowel obstruction and a meta-analysis was performed.[2] It is clear that administration of oral contrast and follow-up radiographs is a significant aid in the prediction of resolution of partial small bowel obstruction. It is not, as previously postulated, therapeutic, but it does decrease hospital stay, likely because a treatment algorithm is created expeditiously.

A retrospective study by Nicksa et al.[3] showed that water-soluble contrast enemas (WSE) with fluoroscopy were more sensitive than triple-contrast computed tomography (CT) scans at detecting leaks in low rectal anastomoses (88% vs. 15%), although the CT scans were read as positive only if they showed active extravasation of enteral contrast. Looking at secondary signs of leak, such as free intraperitoneal air or fluid and radiographic abscess adjacent to an anastomosis, increased the rate of CT positivity to 48%. In their study, more proximal anastomoses were better evaluated with CT scan. Directly contradicting this data, Hyman et al.[4] also compared CT and WSE, and found that CT scans were markedly better at identifying anastomotic leaks (90% vs. 40%), although they were comparing anastomoses throughout the gastrointestinal (GI) tract rather than focusing on rectal anastomoses. We advocate a triple phase (intravenous [IV], oral, and rectal) contrast CT because it can also reveal extraluminal pathologies, such as abscesses or hematomas, and may have better sensitivity in more proximal anastomoses. However, a water-soluble enema under fluoroscopy may well be useful in the setting of the suspected low rectal anastomotic leak, even if the CT scan is negative.

The timing of this imaging following laparoscopic surgery is controversial. The classic teaching that anastomoses are weakest and are most likely to break down about postoperative day 7 was recently challenged by Hyman,[4] who showed that radiologic anastomotic leaks could be diagnosed as far as out as 38 days following the initial operation.

The traditional mantra of conservative management for postoperative small bowel obstruction in stable patients was supported by studies showing that the majority of patients' obstructions resolved with 2 weeks of bowel rest, nasogastric (NG) decompression, and total parenteral nutrition (TPN). However, laparoscopic surgery has introduced a new etiology for postoperative obstruction not seen in open surgery: the incarcerated trocar site hernia (Fig. 4.1).

Duron et al.[5] showed that 40% to 50% of early postlaparoscopic obstructions are due to incarcerated trocar site hernias. Trocar-site hernias (TSHs) occur in up to 1.8% of laparoscopic cases. Unfortunately, because of increasing patient abdominal wall girth and the small size of these hernias, physical exam cannot reliably rule out TSH as an etiology for postlaparoscopic obstruction, and a CT of the abdomen is usually sufficient to confirm the diagnosis.

Since TSHs are such a frequent cause of small bowel obstruction following laparoscopy and since they are not amenable to traditional conservative management,[6] a

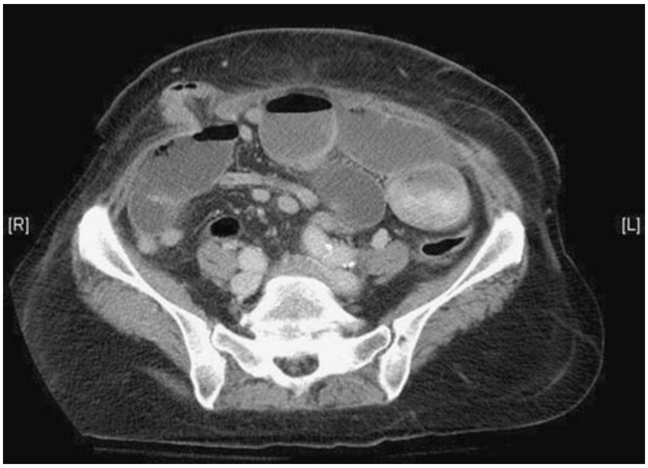

FIGURE 4.1. Axial computed tomography (CT) scan showing an incarcerated obstructing trocar site hernia, with dilated proximal loops containing oral contrast and decompressed distal small bowel loops.

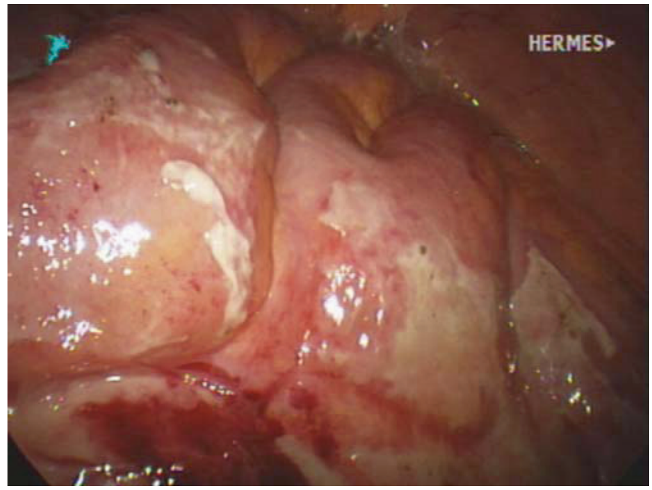

FIGURE 4.2. Laparoscopic image of small bowel with overlying fibrinous exudate covering peritoneal surfaces.

more aggressive surgical approach should be adopted for small bowel obstruction following laparoscopic surgery. If a postoperative obstruction does not resolve after 48 hours of hydration and NG decompression, surgery should be performed to relieve the obstruction.

Laparoscopic Management of Postoperative Complications

The decision to return to the operating room (OR) should follow traditional surgical maxims and the indications for reoperation listed in Table 4.1. Once the surgeon has concluded that a second look is needed, a laparoscopic approach is indicated if the expected pathology can be handled laparoscopically in that surgeon's hands. In addition to lack of surgical experience, there are several situations when laparoscopy is contraindicated: patients with hemodynamic instability, severe cardiopulmonary disease, or advanced cirrhotics with uncorrectable coagulopathies.[7]

Reoperative surgery within 2 weeks of an operation is feasible and can be accomplished safely in the stable patient. The 2-week "window of opportunity" is surgical dogma based on the natural progression of adhesion formation after surgery. Beyond 14 days, adhesions can be quite dense and matted, making reoperative surgery by any technique more difficult and the risk of complication higher.

The laparoscopic approach to the postoperative abdomen should consider port-site reuse and placement. With the possibility of distended bowel in the setting of obstruction or adhesions to the abdominal wall, it is prudent to consider direct reopening of a previously used port site for introduction of the scope. Veress needle access in the early postoperative patient intuitively presents a higher risk of intraabdominal injury, so it should be avoided.

While there are adhesions seen in this early postoperative period, these adhesions are typically quite filmy and can generally be divided with blunt dissection. Later in the postoperative period, or if infectious complications have occurred, one should expect to see a fibrinous exudate coating all surfaces within the peritoneal space (Fig. 4.2). This exudative surface can confound a laparoscopic exploration, but, like the flimsy adhesions, can usually be dissected away bluntly.

Once abdominal access is achieved, a focused search for the culprit lesion (bowel injury, abscess, anastomotic leak, site of bleeding, etc.) should be started. Excessive adhesiolysis, irrigation, or manipulation of the bowel in the postoperative period may result in inadvertent enterotomies or colotomies that can complicate this second abdominal approach. Finally, remember to use the mobility of the operating table to your advantage by using gravity to help with retraction. We now discuss several laparoscopic interventions for the complications listed in Table 4.1.

Postoperative Bleeding

When a patient continues to have an ongoing blood requirement, concomitant hemodynamic instability, or signs of intraperitoneal hemorrhage, there are usually three sources: intraluminal (i.e., anastomotic), intraperitoneal, or a trocar-site hemorrhage. An anastomotic bleed typically presents as persistent bloody stools with persistent transfusion requirement. Port-site bleeding is typically slow and often easily seen on physical exam as a subcutaneous hematoma at the trocar site. However, if the abdominal muscular bleed is down below the skin surface in the rectus sheath, the patient can develop an abdominal wall hematoma or intraperitoneal hematoma. Figure 4.3 demonstrates a large intraperitoneal hematoma on CT scan.

Most postoperative bleeding will spontaneously resolve, but persistent hemorrhage may require a return to

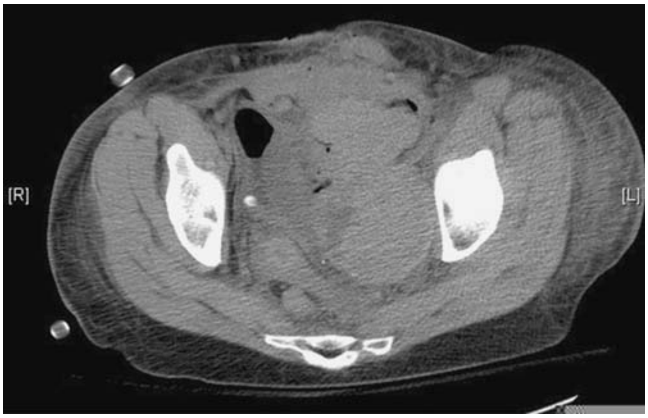

FIGURE 4.3. Large pelvic hematoma due to intraperitoneal bleeding from laparoscopic trocar site.

the operating room. After laparoscopic irrigation of the peritoneal blood, surgeons should turn their attention to controlling the source of the hemorrhage. Electrocautery or simple suture repair is usually sufficient for port-site or extraluminal bleeding. If the bleeding is intraluminal, endoscopic control, if feasible, is a preferable alternative to laparoscopic anastomotic revision. Cirocco et al.[8] reported successful use of endoscopic electrocautery to control intraluminal anastomotic hemorrhage. Their literature review in 1995 showed significant (i.e., requiring intervention) postoperative anastomotic bleeding occurred in 1.8% colorectal anastomoses, and was treated nonoperatively in 14 of 17 patients. If conservative or endoscopic treatment fails, laparoscopic anastomotic resection and revision is the next step in the treatment algorithm.

Bowel Obstruction

Trocar Site Hernias

In 1968, R.E. Fear,[9] a gynecologist, first reported the herniation of the bowel through a laparoscopic port site as the laparoscope and trocar were removed at the end of the procedure during peritoneal desufflation. Tonouchi's[10] literature review reports the incidence of TSHs to be 0.4% to 1.8%. These hernias are more likely to occur in the midline, especially at the umbilicus. Also, larger caliber trocars (8 mm or larger) are a risk factor for subsequent TSH formation, although TSH have occurred at lateral 5 mm port sites.[11] As a result, many surgeons close larger trocar sites with a figure-of-eight suture, which lowers, but does not eliminate, the risk of TSH. Tonouchi's group clearly showed that TSHs present as acute mechanical obstructions in the immediate postlaparoscopic period, but would present as nonobstructive abdominal wall bulges more than 2 weeks after surgery (Fig. 4.4).

Repairing the early Richter-type TSHs can be performed using a laparoscopic approach, with reduction of the herniated loop of bowel and figure-of-eight suture repair of the fascial defect (Fig. 4.5). In leaner patients, an open approach is another feasible, and perhaps quicker, option (Fig. 4.6). As

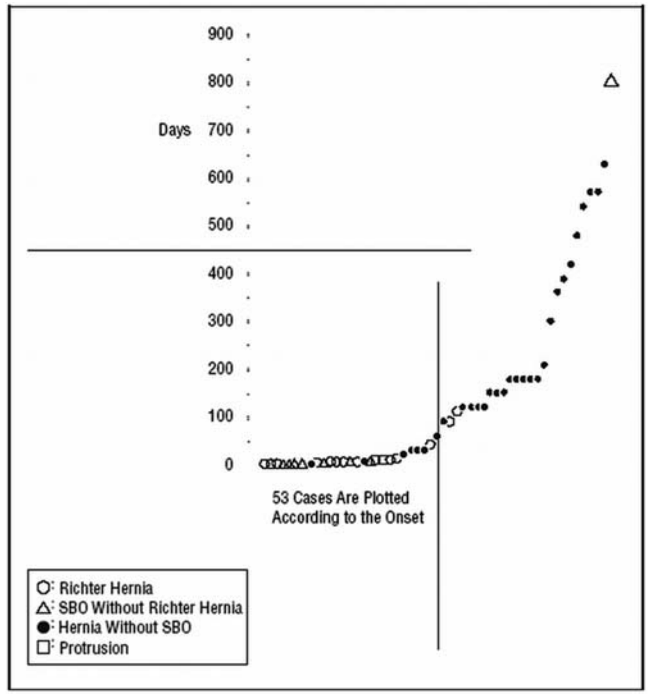

FIGURE 4.4. Diagram showing difference in clinical presentation of patients with trocar-site hernias (TSHs). Vertical line at 21 postoperative days shows that early TSHs (to the left of the line) present as obstruction, whereas hernias that present later usually present as cosmetic bulges in the abdominal wall. (From Tonouchi H, Ohmori Y, Kobayashi M, et al. Trocar site hernia. Arch Surg. 2004 Nov;139(11):1248–56. Copyright © 2004, American Medical Association. All rights reserved.)

for the late-onset hernias that present as nonobstructive abdominal wall bulges, a laparoscopic approach with underlain dual mesh should suffice.

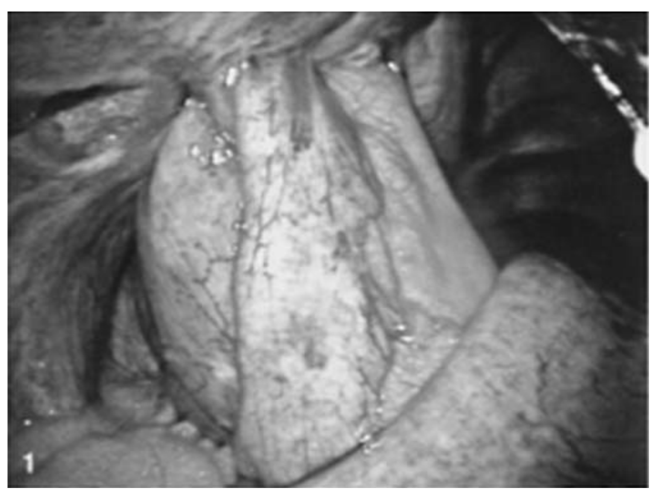

FIGURE 4.5. Laparoscopic photograph showing incarcerated trocar-site hernia. (From Velasco JM, Vallina VL, Bonomo SR, et al. Postlaparoscopic small bowel obstruction. Rethinking its management. Surg Endosc. 1998 Aug;12(8):1043–5, with permission from Springer Science + Business Media.)

FIGURE 4.6. Photograph showing open approach for repair of an incarcerated trocar-site hernia. Kocher clamps hold tension on fascia while small bowel loop is manually reduced.

Adhesive Obstructions

The obstructive adhesive disease in the early postlaparoscopic period can be treated similarly to early postoperative obstructions seen following open surgery. Since most of these obstructions will resolve with bowel rest, NG decompression, and TPN (if indicated), a conservative approach is advocated once other treatable pathologies are ruled out with CT scan.

Diagnostic laparoscopy should proceed as with other postoperative laparoscopy, by using an open or Hassan approach to establish pneumoperitoneum. The initial incision used to gain peritoneal access should be made away from previous incisions. Once pneumoperitoneum is established, inspection should reveal the segment of obstructed bowel. Adhesive bands should be divided sharply to avoid inadvertent injuries to adjacent bowel. Any internal hernia or volvulus should be reduced and mesenteric defects may be closed, if feasible, in the hope of preventing subsequent herniation. There is no prospective data indicating that closing mesenteric defects is effective in preventing bowel obstruction. Any concerns that a laparoscopic approach cannot be accomplished safely should prompt a conversion to open; Van der Krabben et al.[12] reported an inadvertent enterotomy rate of 19% in reoperated abdomens.

The use of laparoscopic approaches to postoperative adhesiolysis is debated in the literature. While several reports have indicated increased rates of inadvertent enterotomies and conversions to open approaches,[12,13] more recent groups have detailed the safety of laparoscopic lysis of adhesions.[14] A review of the laparoscopic approach to acute small bowel obstruction in 1061 cases (19 studies) revealed that adhesions were the cause of obstruction in 83%. The conversion rate was 33% in laparoscopic cases. There were nine missed perforations, including one trocar injury, for an overall rate of 1.2%. However, there was significant morbidity associated with these cases of enterotomy, and it is presumed that the missed enterotomy rate of 1.2% is higher than expected in open cases. Caution is warranted, even in experienced hands.[15] It is likely that as surgeons gain experience with advanced laparoscopic reoperative surgery that minimally invasive experience with adhesive disease will approach that of the traditional open surgery.

Infectious Complications

Postlaparoscopy patients with infectious complications should be categorized as toxic or nontoxic before deciding on a course of treatment. While all infected patients can be febrile, with high white counts and focal abdominal tenderness, patients who are maintaining their blood pressure and urine output may sometimes be treated conservatively with broad-spectrum antibiotics or nonsurgical interventions. The surgeon should be wary that any nonoperatively treated patient can acutely decompensate, thus requiring laparoscopy or laparotomy to repair the infectious complication.

Missed Enterotomies

A rare, but very serious, infectious complication of laparoscopic surgery is the missed enterotomy. Laparoscopy-induced bowel injuries are infrequent, with rates of 0.13% to 0.58% in uncomplicated laparoscopic surgery.[16,17] Unfortunately, possibly because of decreased visualization during laparoscopy versus open surgeries or perhaps thermal arcing, these injuries can be missed or have a delayed presentation and are associated with a mortality of 21%.[18]

While infectious anastomotic complications classically occur around postoperative day 7, inadvertent enterotomies present earlier in the postoperative course. Moreover, these complications are difficult to miss, as the patients have signs of peritonitis from the spillage of succus into their peritoneal space. These patients present with severe abdominal pain, high fevers, and acute abdomens on postoperative day 1 or 2.

If the patient is hemodynamically stable, laparoscopy is often a successful way to approach these patients. Using the mobility of the operating room table to one's advantage (Trendelenburg, airplaning, etc.), allows the laparoscopic surgeon to irrigate the succus from all of the recesses of the peritoneal space and pelvis, but will also enhance visualization of the small bowel during inspection along its length. Once the injured segment of small bowel is encountered, mark it with a stitch for later repair or perform immediate repair, and then do a complete inspection of the small bowel to rule out additional enterotomies. It is essential to visualize the entire circumference of the bowel, as a segment of bowel adjacent to the mesentery may be the injured portion and can be missed with less aggressive inspection. Figure 4.7 shows a segment of injured small bowel that was repaired laparoscopically during an initial operation.

Repair of enterotomies can be accomplished either laparoscopically or through an open technique. Primary suture repair of the enterotomy will preserve small bowel length, and may be attempted if the tissue is not excessively friable. If bowel is too edematous or otherwise compromised, resect the injured segment of bowel with subsequent intra- or extraabdominal anastomosis.

FIGURE 4.7. Reoperative laparoscopic image showing a repaired enterotomy along mesenteric border of small bowel. The location demonstrates the importance of circumferential inspection of the small bowel when looking for enterotomies.

Anastomotic Dehiscences

Abscesses adjacent to intestinal anastomoses should be investigated particularly closely, as an anastomotic leak or dehiscence is a different clinical entity than a pelvic abscess. The literature widely defines *anastomotic leak* and *dehiscence*; we use these terms interchangeably when discussing disturbances in the anastomosis leading to spillage of succus into the peritoneal space. The literature reports anastomotic leak or dehiscence rates from 1% for intraabdominal operations to up to 20% for deep pelvic anastomoses. Dehiscences can be identified radiologically with extraluminal leakage of enteric contrast during water-soluble enema or CT scan, or indirectly by escape of colonic gas causing free intraperitoneal air on x-ray, or unexplained free fluid or pelvic abscesses adjacent to the anastomosis.

Similar to the management of pelvic abscesses in nontoxic patients, the least invasive approach is antibiotics and percutaneous drainage for accessible collections. Simple drainage may suffice to relieve the patient's ileus, if the leak has healed over. In a subset of patients, the drain may continue to have large-volume output, necessitating diversion or bowel rest and TPN.

If the radiographic images document a large anastomotic disruption, or the patient is developing signs of sepsis, a return to the operating room is indicated. If it can be performed safely, diagnostic laparoscopy can be used to identify the anastomosis and assess the degree of the dehiscence. Irrigation of any fecal or purulent soilage within the pelvis should also be performed. Performing a transanal air enema leak test may be helpful in identifying a posterior defect or one that is difficult to visualize. At this point, the surgeon must decide whether that anastomosis is salvageable. Common wisdom is that if more than 30% of the circumference of the anastomosis is disrupted, the anastomosis should be taken down and a colostomy formed. The laparoscopic surgeon has two options: takedown of the anastomosis with creation of an end colostomy (Hartmann-style procedure), or anastomotic salvage and fecal diversion.

If the patient is septic, if there is gross fecal contamination of the pelvis, or if there is a wide anastomotic defect, then a Hartmann approach is advocated. Using an endo-GIA stapler, the surgeon should divide the colon at the proximal healthy bowel and along the rectum below the anastomosis. This colon should be mobilized sufficiently to create an end colostomy, if possible through one of the trocar sites. Once the rectum is divided, remove the anastomosis through one of the ports with a laparoscopic sac or a handport. The rectal stump should be marked with nonabsorbable sutures for future location during ostomy reversal.

If, on the other hand, the anastomosis can be salvaged, a diverting proximal ostomy can be fashioned. For an ileostomy, the terminal ileum is mobilized laparoscopically to reach the right lower quadrant abdominal wall without tension. The abdomen is then desufflated and the other incisions are closed in the usual fashion. The right lower quadrant trocar is removed and the port site is enlarged to comfortably fit two of the surgeon's fingers through both the skin and the fascia. The terminal ileum is brought up to the skin and a transverse enterotomy is made on the antimesenteric surface of the distal limb. The partially divided ileum can be matured to create a dominant proximal limb and a nondominant distal limb that functions as a mucus fistula. The bowel is sutured to the skin with interrupted absorbable sutures, and finally an ostomy bag in applied.

Pelvic Abscesses

Intraabdominal pelvic abscesses are complex air and fluid collections with contrast-enhancing walls, perhaps from fecal contamination during the initial case or superinfected postoperative hematomas. They can be differentiated from anastomotic dehiscences radiographically, in that they do not contain extravasated enteral contrast nor do they connect to adjacent bowel. Usually, these abscesses can be drained percutaneously under radiologic guidance with placement of drainage catheters. If these cavities are too small or not safely approached percutaneously, antibiotics are an alternative in the nontoxic patient.

The toxic patient with a radiologically undrainable abscess should be returned to the operating room. On entering the abdomen, the abscess cavity should be identified, incised, and copiously irrigated. Cultures of the purulent abscess should be sent to microbiology to direct antibiotic therapy. Finally, a percutaneous drain should be left in the cavity for continued drainage postoperatively.[19]

Conclusion

Laparoscopic surgery is an integral part of pelvic surgery, and 21st-century surgeons will need to be able to operate through a scope as skillfully as they tie a knot during an open procedure. Knowing that laparoscopy is another tool in the belt of the surgeon, with benefits and pitfalls to the patient, will allow the surgeon to wisely choose a laparoscopic approach to a specific surgical problem. This chapter has been a brief summary of the current minimally invasive approaches to common postoperative complications. As we surgeons employ laparoscopic techniques more frequently, we will become more innovative and adept in our approach to these difficult situations, and our patients will benefit from our ingenuity.

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5

Laparoscopic Reoperative Surgery for Incompletely Staged Gynecologic Malignancies

Dan S. Veljovich

Despite published recommendations for gynecologic oncology consultation in patients with endometrial cancer or suspicious adnexal masses, patients still undergo surgical evaluation for these conditions in settings where surgical staging is either not immediately available or not performed.[1] In addition, although recent Pap smear evaluation is a standard prerequisite for hysterectomy, this operation is occasionally performed either in the absence of recent cervical cytologic evaluation or in the context of false-negative cervical cytologic evaluation or known cervical dysplasia, leading to the discovery of occult cervical cancer on pathologic evaluation of the uterus.

In the event that a patient is diagnosed intraoperatively or postoperatively with gynecologic malignancy and staging is not performed, three options for management exist. In low-risk patients, it may be appropriate to simply recommend careful surveillance examinations, such as with grade 1 endometrial carcinoma confined to the endometrium and with no adnexal metastases and negative washings. In high-risk patients, adjuvant therapy may be recommended on occasion in the absence of formal surgical staging. Formal surgical staging, the third treatment option, is usually the preferred treatment strategy, as it allows accurate documentation of disease extent (stage) and better data upon which to base adjuvant therapy recommendations. Although reoperation for surgical staging of gynecologic cancer has traditionally been performed via laparotomy, these staging procedures have been performed via laparoscopy since the early 1990s[2,3] (Fig. 5.1).

This chapter focuses on reoperative staging utilizing minimally invasive techniques for cancers of the uterus, ovary, and cervix. Data demonstrating feasibility and outcomes with laparoscopic staging techniques in the primary operative and reoperative setting are reviewed for each primary tumor site, followed by a discussion of operative techniques for minimally invasive staging of these malignancies.

Endometrial Carcinoma

Surgical staging has evolved into the standard of care in the United States for uterine cancer since the International Federation of Gynecology and Obstetrics (FIGO) proposed this concept in 1988.[4] Early data derived from a multiinstitution study by Boronow et al.[5] showed that in 222 patients with clinical stage I endometrial cancer, pelvic nodal disease was present in 8% and 14% of clinical stage IA and IB patients, and aortic nodal disease was present in 7% and 9% of these substages, respectively. A larger study done by Creasman and colleagues[6] in the Gynecologic Oncology Group (GOG) evaluated 621 patients with clinical stage I disease and showed extrauterine disease in 22% of patients. Lymph node metastases in this study were correlated with grade of tumor and depth of invasion. For patients with myoinvasion to the inner one third, middle one third, and outer one third, pelvic lymph node metastases were present in 3% to 11% of grade 1 tumors, 5% to 19% of grade 2 tumors, and 9% to 34% of grade 3 tumors. Aortic nodes were found to be involved in 1% to 6% of grade 1 tumors, 4% to 14% of grade 2 tumors, and 4% to 24% of grade 3 tumors.

Since these seminal early staging studies, multiple publications have shown surgical staging to be safe[7,8] and cost-effective,[9] leading to the recommendation by the American College of Obstetricians and Gynecologists (ACOG) in 2005 that "most women with endometrial cancer benefit from systematic surgical staging, including pelvic

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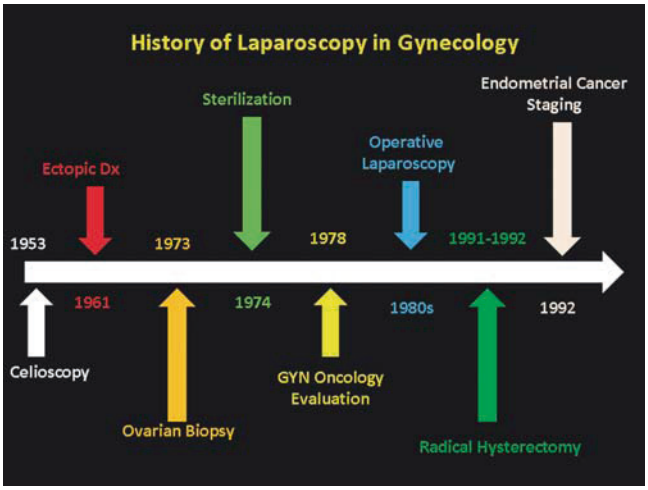

FIGURE 5.1. History of laparoscopy in gynecology.

washings, bilateral pelvic and paraaortic lymphadenectomy, and complete resection of all disease."[10]

Benefits of universal surgical staging include minimizing radiotherapy or other adjuvant therapies in cases where there is a low chance of benefit and in identifying node-positive patients who would otherwise not be treated with adjuvant therapy based on intrinsic uterine factors alone.[11] There is also growing evidence that lymphadenectomy may confer a survival benefit to this patient population[12,13] and that chemotherapy appears superior to radiotherapy in the treatment of node-positive disease,[14] making knowledge of nodal status even more critical.

Guidelines published by the Society of Gynecologic Oncologists (SGO) in 2000 suggest that patients with endometrial cancer "could benefit from pretreatment consultation with or evaluation by a gynecologic oncologist to assist in determining the most appropriate surgical approach as well as extent of surgery and the potential benefit of adjuvant therapy."[1] Although the benefits of lymph node dissection in endometrial carcinoma appear widely accepted, many patients still undergo hysterectomy and bilateral salpingo-oophorectomy for this disease without appropriate surgical staging. Treatment options for patients with intermediate or high-risk tumors found on final pathologic evaluation include careful surveillance, administration of adjuvant therapy, or reoperation with surgical staging.

Given that nodal status is the single most important prognostic factor for patients with endometrial cancer, the standard recommendation for these patients is surgical staging. This approach reduces overtreatment of patients who prove to be node-negative while identifying patients who are node-positive and benefit from a more aggressive treatment strategy utilizing chemotherapy with or without radiotherapy.

With the advent of minimally invasive surgical techniques, reoperation on patients with unstaged endometrial cancer via laparoscopic surgical staging has become feasible. Childers and Querleu are widely credited with championing these techniques in the United States and Europe, respectively. Following initial descriptions of laparoscopic lymphadenectomy in patients undergoing primary surgery for endometrial carcinoma in 1992 and 1993,[3,15] Childers et al.[16] and Querleu[17] published papers in 1993 demonstrating that paraaortic lymph node evaluation was possible utilizing laparoscopic techniques.

The concept of reoperation using minimally invasive surgery for endometrial cancer was introduced when Childers et al.[18] published a series of 13 patients with incompletely staged adenocarcinoma of the endometrium who underwent laparoscopic staging. Of these 13 patients, 23% had extrauterine disease documented, including two patients with positive pelvic lymph nodes. The average lymph node yield was 17.5 nodes, blood loss was less than 50 mL, and the mean hospital stay was 1.5 days. Spirtos et al.[19] reported in 1995 on 40 patients who underwent laparoscopic bilateral pelvic and paraaortic lymph node sampling, with an average number of lymph nodes sampled being 28. Complications included five conversions to laparotomy, two port-site herniations, and two deep venous thromboses. Possover et al.[20] later reported on 150 patients with gynecologic cancers who underwent laparoscopic pelvic and periaortic lymphadenectomy, of which 52 had laparoscopic lymph node dissection alone performed. An average of 27 pelvic nodes and seven paraaortic nodes were procured, with seven patients sustaining major vessel injury, for which four required laparotomy.

The decision to surgically stage a patient with endometrial carcinoma, status-post hysterectomy without lymph node evaluation must take into account patient factors (age, medical comorbidities and obesity) as well as intrinsic uterine factors (grade, depth of invasion, tumor size, presence of lymphovascular space invasion or cervical involvement). Careful evaluation by a skilled gynecologic pathologist in a cancer treatment conference setting may aid in deciding whether to proceed with surgery. At our institution, patients with deep invasion (stage IC disease) regardless of grade and myoinvasive grade 2 or 3 disease are considered for reoperation if they are good surgical candidates. In addition, cervical involvement, lymphovascular space involvement, large tumor size, and aggressive histology (papillary serous carcinoma, clear cell carcinoma, or carcinosarcoma) are additional criteria for surgical staging. Once the decision to proceed with surgical staging has been made, the surgeon must decide the route of surgery (laparotomy vs. laparoscopy). As demonstrated previously, laparoscopic reoperation for incompletely staged endometrial cancer is a feasible option with acceptable nodal yields in the hands of surgeons experienced in minimally invasive surgery. Given that nodal evaluation is similar for endometrial, cervical, and ovarian carcinoma, universal techniques for laparoscopic lymph node evaluation will be addressed in the last section of this chapter.

Ovarian Carcinoma

Referral guidelines published by the SGO recommend that women with suspicious pelvic masses "should be offered the opportunity of a preoperative consultation with a gynecologic oncologist."[1] Specific high-risk situations delineated

TABLE 5.1. SGO Guidelines for Referral to a Gynecologic Oncologist in Women with a Pelvic Mass.

Referral is recommended when:
- Evidence of advanced disease is present: pelvic mass with omental caking; presence of effusion, ascites.
- A clinically suspicious pelvic mass [large (>10 cm), complex, fixed, nodular, bilateral] is diagnosed.
- Premenarchal girls require surgical treatment for a pelvic mass.
- Postmenopausal women have suspicious ovarian masses or elevated tumor markers.
- Perimenopausal women have ovarian masses, particularly when associated with elevated CA-125. Elevations between 35 and 65 U/mL are associated with a cancer risk of 50% to 60%. A CA-125 >65 U/mL in a 50-year-old or older woman is virtually diagnostic of malignancy with a specificity of 98%.
- Young patients have a pelvic mass and elevated tumor markers (CA-125, α-fetoprotein [AFP], human chorionic gonadotropin [hCG]).
- Suspicious findings are present on imaging studies. The risk of malignancy in a postmenopausal woman with a unilocular mass without solid components is <1%, increasing to 8% in a multilocular mass and 70% in a mass with solid components.
- Complex masses with solid components or excrescences or otherwise suspicious for cancer are present.
- Suspicious pelvic masses are found in women with a significant *family or personal history* of ovarian, breast, or other cancers (one or more first-degree relatives).

Source: From Guidelines for Referral to a Gynecologic Oncologist: rationale and benefits. Gynecol Oncol 2000;78,S1–S13.

in this report are shown in Table 5.1. In addition, ACOG and the SGO published joint guidelines for referral of patients to a gynecologic oncologist for a newly diagnosed pelvic mass (Table 5.2).[21,22]

These recommendations are made given data suggesting that when patients with ovarian carcinoma are managed by a gynecologic oncologist, survival is superior to those managed in the absence of such specialists. Even with these recommendations, patients undergo surgical evaluation for adnexal masses with either no intraoperative evaluation of the mass or no surgical staging available or performed, which leads to the clinical dilemma of unstaged ovarian cancer when found on final pathology report in the postoperative setting.

Early studies in ovarian cancer demonstrated significant nodal metastatic potential, even when the disease appeared clinically confined to the ovary. As early as 1983, two reports surfaced evaluating nodal involvement in this disease. Utilizing restaging via laparotomy, peritoneoscopy, washings, and lymphangiography, Young et al.[23] found that 31 of 100 patients with apparent early-stage disease had metastases consistent with stage III disease. Chen and Lee[24] that same year reported in a prospective study of selective nodal biopsy in 61 patients with ovarian cancer that the incidence of paraaortic and pelvic node metastases was 38% and 15%, respectively. Moreover, almost one third of patients in their study with aortic nodal metastases had no evidence of pelvic nodal metastases. A similar study published in 1986 by Helewa et al.[25] showed that of 25 presumed early-stage ovarian cancers or borderline tumors undergoing surgical staging via laparotomy, 25% of invasive lesions were upstaged and 12% of borderline ovarian cancers were upstaged.

Soper et al.[26] reported the experience of reoperative laparotomy for presumed early-stage ovarian cancer at Duke University in 1992. Of 30 patients undergoing surgery, 30% had upstaging, with 20% of all patients proven to have stage III disease. In addition, two thirds of patients who were upstaged had metastases found only on washings, biopsies, or nodal evaluation. A similar study from the group at Memorial Sloan-Kettering Cancer Center published in 1996 evaluated 45 patients with presumed early-stage ovarian cancer incompletely staged who underwent subsequent laparotomy for staging at their institution.[27] In total, 16% of patients were upstaged at laparotomy, but the complication rate of an open approach was high at 33%.

Recent large series also suggest a high incidence of nodal involvement in ovarian cancer, with one study analyzing 276 patients systematically staged, showing that 44% of this population had evidence of nodal metastases, with 30% demonstrating pelvic nodal metastases and 40% paraaortic nodal metastases.[28] Even in patients with presumed stage I disease, nodal involvement was found in 13%, 33%, and 38% of stage IA, IB, and IC tumors, respectively. Cass et al.,[29] in a two-institution study of almost 100

TABLE 5.2. Society of Gynecologic Oncologists and American College of Obstetricians and Gynecologists Referral Guidelines for a Newly Diagnosed Pelvic Mass.

Premenopausal (<50 years)
- CA-125 levels >200 U/mL
- Ascites
- Evidence of abdominal or distant metastasis (by results of examination or imaging study)
- Family history of breast or ovarian cancer (in a first-degree relative)

Postmenopausal (50 years and older)
- Elevated CA-125 levels
- Ascites
- Nodular or fixed pelvic mass
- Evidence of abdominal or distant metastasis (by results of examination or imaging study)
- Family history of breast or ovarian cancer (in a first-degree relative)

Source: Data from Creasman WT. The Role of the Generalist Obstetrician-Gynecologist in the Early Detection of Ovarian Cancer, ACOG Committee Opinion 2002; Number 280; and Berman M, Randall-Whitis L. Management of Adnexal Masses. ACOG Practice Bulletin 2007; Number 83.

patients with disease apparently confined to only one ovary, showed that 15% of patients had lymphatic involvement, with the interesting finding that in patients who had bilateral pelvic node dissection and nodal metastases 30% had positive nodes found only in the contralateral nodes, and 20% had bilateral metastases.

Laparoscopic staging series for ovarian carcinoma have also demonstrated a high incidence of nodal involvement. After an initial case report by Reich et al.[30] reported management of early-stage ovarian carcinoma via laparoscopy in 1990, additional investigators reported their experience staging ovarian cancer with minimally invasive techniques over the next half-decade. Querleu[17] in 1993 reported on two ovarian carcinoma patients having infrarenal paraaortic lymph node dissection, with six and nine lymph nodes removed, respectively. The following year the same group reported on reoperation for staging in nine patients with ovarian or fallopian tube cancers with inadequate staging, with other procedures performed laparoscopically including omentectomy, appendectomy, pelvic lymphadenectomy, contralateral salpingo-oophorectomy, and laproscopic-assisted vaginal hysterectomy (LAVH).[31] Childers et al.[32] reported their experience in ovarian cancer in 1995, focusing on 44 patients undergoing laparoscopic second-look surgery and 14 patients undergoing laparoscopic staging for presumed early-stage disease. Fifty-six percent of second-look operations revealed persistent disease, and 57% of patients undergoing staging for presumed early-stage cancers had evidence of metastasis. That same year Pomel et al.[33] described their technique used to stage 10 patients with ovarian cancer using minimally invasive techniques in France and Canada. A decade later Spirtos et al.[34] reported the results of a feasibility study performed by the GOG evaluating laparoscopic staging for reoperation on 95 patients with uterine, ovarian, tubal, and primary peritoneal cancers who had been incompletely staged. Of patients undergoing complete endoscopic staging, as reported in this paper, 17 required laparotomy, and the bowel complication rate was 6%. It was concluded that "interval laparoscopic staging of gynecologic malignancies can be successfully undertaken in selected patients, but laparotomy for adhesions or metastatic disease and risk of visceral injury may be anticipated."

Laparoscopic reoperation for the patient with ovarian carcinoma can be employed in both the staging of patients who have recently undergone oophorectomy but had incomplete surgical staging (laparoscopic surgical staging with or without hysterectomy and contralateral oophorectomy) or patients who have completed adjuvant chemotherapy to determine if the patient has had a complete pathologic response to treatment (second-look laparoscopy). For incompletely staged patients, management includes either reoperation for surgical staging and resection of residual disease or administration of adjuvant chemotherapy. In patients with presumed early-stage disease (ovarian cancer confined to a single ovary with no evidence of extraovarian disease seen by the surgeon at oophorectomy), surgical staging is indicated to appropriately determine the stage and therefore prognosis of the cancer as well as to allow inclusion into clinical trials for appropriate candidates. Perhaps more important, however, is the benefit of omitting chemotherapy in stage IA or IB patients with grade 1 or 2 tumors for which there is no convincing survival advantage with adjuvant chemotherapy. For advanced-stage disease documented at time of oophorectomy (metastases in the abdomen), the decision to proceed with an interval surgery prior to chemotherapy administration is more complex. In patients with suspected resectable residual disease, reoperation is generally recommended given the survival advantage of an optimal cytoreduction. Most gynecologic oncologists approach this situation with laparotomy given the complexity of resecting multiple abdominal metastases laparoscopically. In patients with suspected unresectable residual disease, adjuvant chemotherapy is warranted.

Timing of staging surgery for patients with ovarian cancer diagnosed but incompletely staged may be important, as demonstrated by Lehner et al.[35] They evaluated whether delay in surgical staging had an impact on the stage of disease following laparoscopic excision of ovarian masses later found to be malignant in 70 patients identified via questionnaire in Austria. Interestingly, for patients who had interval surgery delayed by more than 17 days, the odds ratio of identifying advanced disease was 5.3 for borderline tumors and 9.2 for invasive ovarian cancers. These data suggest that if the decision is made to proceed with an interval staging surgery, it should be performed within 17 days of the initial operation. A survey of SGO members by Maiman et al.[36] revealed that when malignancy was found in an ovary removed laparoscopically that in 17% of cases, immediate laparotomy was performed as opposed to 71% of patients who underwent a delayed laparotomy with an average interval between the initial surgery and staging surgery being 4.8 weeks, well above the 17-day interval suggested by Lehner's study.

Regardless of timing between initial surgery and staging surgery, if the recommendation to proceed with surgical staging is made, the procedure should be performed with the intent of removing any ovarian or uterine tissue, omentum, pelvic and paraaortic lymph nodes, and peritoneal biopsies as well as any residual disease present. Whether to proceed with reoperation via laparoscopy or laparotomy depends on the surgeons training and biases, laparoscopic expertise, and patient factors. A large case-control multiinstitution study published by Chi et al.[37] compared the safety and efficacy in 50 patients diagnosed with clinically apparent early-stage ovarian or fallopian tube cancer. Of 20 patients undergoing laparoscopic staging and 30 undergoing staging via laparotomy, there were no differences in age, body mass index, omental specimen size, or number of lymph nodes removed. However, laparoscopically staged patients had lower blood loss, shorter hospital stays, and fewer complications with no conversions to laparotomy, although surgical time was greater. This study confirms that at least with highly skilled laparoscopic surgeons "patients with apparent stage I ovarian or fallopian tube cancer can safely and adequately undergo laparoscopic surgical staging."

Another large study published by LeBlanc et al.[38] in 2004 suggests that reoperation in this patient population is feasible using minimally invasive techniques. Over a decade this group evaluated 42 patients (35 with ovarian cancer and seven with tubal cancer, all incompletely staged) undergoing reoperation for staging of their malignancy using laparoscopy. All cases but one were completed via laparoscopy, and 19% of patients undergoing restaging were upstaged. Based on long-term survival data generated in this study, the authors concluded that laparoscopic evaluation could accurately detect patients with metastatic disease who need adjuvant chemotherapy and safely select those early-stage patients for whom no additional treatment is needed. This same group in an earlier study showed similar acceptability for laparoscopic evaluation of patients found to have clinical stage IA low malignant potential tumors of the ovary.[39] Reoperating in 30 patients with borderline tumors, the authors upstaged 27% of patients, with a reasonable complication rate of 7% (one superficial epigastric perforation and one abdominal wall hematoma). Additional data to support this approach, published by Daraï et al.[40] in 2007, showed that in 37 patients who underwent previous surgery for borderline tumors of the ovary undergoing reoperation for laparoscopic staging there were no conversions to laparotomy and 29% of patients had either residual disease or were upstaged.

Second-look surgery for ovarian cancer, although controversial and mainly utilized for evaluation of pathologic response to experimental therapy and at select centers, has been performed via laparotomy and laparoscopy. This procedure is performed in patients who have completed adjuvant therapy for ovarian carcinoma and demonstrate normalization of physical examination, marker CA-125, and radiologic findings (patients with a complete clinical response). A large series of 150 patients undergoing second-look laparoscopy from 1993 to 1998 was evaluated by Husain et al.,[41] and were found to have a 12% conversion rate to laparotomy and 2.7% rate of major complications. In 54% of these patients persistent cancer was found, and it was noted that this rate was similar to that published in prior studies evaluating laparotomy for second-look surgery. These findings were not in agreement with a French study published 2 years earlier that compared findings in patients who underwent an initial second-look laparoscopy followed immediately by laparotomy to evaluate for residual disease. Although laparoscopic findings of malignancy were confirmed in 100% of cases by laparotomy, in 14 cases where no disease was found at laparoscopic evaluation, two patients had disease confirmed at laparotomy (86% negative predictive value for laparoscopy).[42] The difficulty of the procedure in patients with prior surgery led these investigators to conclude that "the presence of severe postoperative adhesions is the main obstacle to an exhaustive, reliable, and safe laparoscopic second look." However, the most recent study on this subject[43] appears to support the findings of Husain et al. Evaluating 95 patients enrolled in phase II trials to determine complete pathologic response to therapy following primary cytoreductive surgery, laparoscopy was performed for the initial surgical second-look procedure, with immediate laparotomy performed in those patients with negative findings at laparoscopy. In this group's hands, a negative second-look laparoscopy was 91.5% predictive of a negative laparotomy, and laparoscopy was associated with a low complication rate. The authors concluded that "the small increase in sensitivity and negative predictive value afforded by laparotomy does not warrant the increased morbidity."

Cervical Carcinoma

Most published literature describing laparoscopic surgical staging for cervical cancer focuses on nodal evaluation prior to therapy in order to determine appropriate radiation fields or document metastatic disease. Although Lacey et al.[44] reported in 1978 on using laparoscopy to evaluate cancer of the cervix, it was not until 1991 that Querleu et al.[2] published the initial series of laparoscopic lymphadenectomy for the staging of cervical cancer in early-stage disease. In 39 patients, the mean nodal yield was 8.7, with no significant morbidity. Childers et al.[45] subsequently reported in 1992 on the role of laparoscopic lymphadenectomy in the management of cervical cancer, evaluating 18 patients either prior to radiation therapy or to determine candidacy for radical hysterectomy. Of eight patients undergoing laparoscopic node dissection prior to definitive surgery, an average of 31.4 nodes were resected. Five patients had immediate radical hysterectomy and three had the procedure abandoned due to involved nodes. The following year, Fowler et al.[46] at the University of Minnesota published on their preliminary experience in 12 patients in order to validate the laparoscopic approach as compared to laparotomy. Patients with cervical cancer undergoing a pretreatment nodal evaluation were first subjected to laparoscopic lymphadenectomy, followed by laparotomy to determine the comparative nodal yields. The authors demonstrated in patients undergoing pelvic and paraaortic lymph node dissection that 75% of all nodes were procured via laparoscopy (mean of 23.5 nodes), and that their yield improved with the last six patients versus the first six (85% vs. 63%, $p < .005$). Most importantly, no positive nodes were missed at laparoscopy.

Chu et al.[47] described in 1997 the experience at Chung Gang Memorial Hospital in China with respect to pretreatment laparoscopic staging of cervical cancer. Over 3 years they utilized operative laparoscopy to stage 67 patients diagnosed with invasive cervical cancer, with 39 early-stage patients having pelvic lymphadenectomy and 28 advanced-stage patients having only paraaortic nodes resected, with pelvic and paraaortic node yields being 26.7 and 8, respectively. Of the early-stage patients 34 were found to be node-negative and underwent radical hysterectomy within 2 days of staging; 10 of the advanced-stage patients had nodal disease, and only 57% of these were detected on preoperative computed tomography (CT) scan. Querleu's group[48] in France in 2000 described their laparoscopic staging experience in cervical cancer, utilizing the novel technique of an extraperitoneal approach, and assessing only patients with advanced stage or bulky tumors. For the 42 patients undergoing aortic and common iliac dissection, the operative time was 126 minutes, yield 21 nodes; 32% of all patients had nodal disease documented. Of those with involved nodes 60% died within 19 months compared to only 15% of node-negative patients.

Less has been published regarding reoperative surgery for staging and treatment of cervical carcinoma. Usually this is in the context of a "cut-through" hysterectomy (simple hysterectomy performed for invasive cervical carcinoma found postoperatively on pathologic evaluation), where treatment options include either radiation therapy with chemosensitization, preradiation surgical staging of nodal regions or nodal debulking, or parametrectomy with lymph node dissection for definitive surgical therapy. The first report of a laparoscopic reoperation following previous hysterectomy for cervical cancer with parametrectomy was by Magrina et al.[49] in 1999. They demonstrated the feasibility of laparoscopic radical parametrectomy and pelvic and aortic lymph node dissection in a patient with vaginal adenocarcinoma, with surgery successfully accomplished laparoscopically in 270 minutes. Lee et al.[50] followed this case report in 2003 with a series of three patients managed in Korea with operative laparoscopy following prior hysterectomy, two of whom had laparoscopic parametrectomy with pelvic and aortic dissection following simple hysterectomy for invasive cervical cancer. The authors deemed this surgery a "viable option for women with invasive cervical cancer . . . following a prior hysterectomy."

Larger series on reoperation in the context of simple hysterectomy for invasive cervical cancer were published by Fleisch et al.[51] in Arizona and Liang et al.[52] in China in 2005 and 2006, respectively. Each group reported six patients managed with laparoscopic parametrectomy and lymphadenectomy. In the Fleisch series, five patients had the unexpected finding of cervical cancer after prior hysterectomy, and one had vaginal cuff cancer following a prior hysterectomy. All patients had a laparoscopic-assisted parametrectomy/upper vaginectomy (LPUV), with mean operative time of 207 minutes, blood loss of 300 mL, and pelvic and paraaortic yields of 22 and nine nodes, respectively. In Liang's series, three patients had invasive cervical cancer found after laparoscopic extrafascial hysterectomy, two patients had cervical stump cancers following supracervical hysterectomy, and one patient had vaginal cuff carcinoma. Operative time was 180 minutes, blood loss 220 mL, and total lymph node yields ranged from 26 to 36. A recent case report also demonstrates use of this technique in the management of a small central vaginal recurrence of endometrial carcinoma.[53]

Although the ability to perform radical parametrectomy and lymph node dissection using laparoscopy has been documented, this technique has only been performed by a limited number of skilled surgeons. In addition, the clinical problem of simple hysterectomy performed in the context of invasive cervical carcinoma is fortunately rare, as most lesions are diagnosed preoperatively either by a visible lesion at pelvic examination or abnormal cervical cytology.

Therapeutic options for an incidental finding of cervical cancer at simple hysterectomy should be discussed only after a careful pathologic review of the hysterectomy specimen. In patients with stage IA1 disease and no lymphovascular space involvement, no further surgical therapy is required as this patient population has an excellent prognosis. For those patients with stage IA1 disease with lymphovascular space involvement or stage IA2-IIA disease, imaging studies with either positron emission tomography (PET)/CT or magnetic resonance imaging (MRI) should be considered to evaluate for the presence of local (pelvic or parametrial) or nodal metastases. In those patients with early-stage disease and no radiologic evidence of metastases, treatment options include either radiation therapy with chemosensitization or surgical evaluation with parametrectomy and nodal evaluation. Those patients who undergo surgical evaluation can then be stratified to either no further therapy if parametria and nodes are negative and Sedlis criteria demonstrated in GOG-92 are not met on the primary hysterectomy specimen or standard chemoradiation in the event of positive parametria or nodes.[54]

Laparoscopic Lymphadenectomy Technique

Regardless of technique, excision of nodal basins for staging of gynecologic cancer should include anatomic areas most likely to be involved by metastatic disease, and lymphadenectomy should include basins conventionally evaluated by the open technique. The route of surgery should not alter the lymph nodes evaluated. Pelvic nodal dissection should procure distal common iliac nodes, nodes overlying the external iliac artery and vein, and nodes in the obturator fat pad anterior to the obturator nerve. Aortic nodal dissection should include nodal tissue overlying the distal vena cava from the inferior mesenteric artery (IMA) to the middle right common iliac vessels on the right and between the aorta to the left ureter from the IMA and the left middle common iliac vessels on the left. Although the role of infrarenal aortic dissection (from below the renal vessels to the IMA) in endometrial cancer is controversial, this technique is gaining support for endometrial or cervical cancer with obvious metastatic disease and in ovarian carcinoma management.

Following the initial publication of Querleu et al.[2] suggesting laparoscopic pelvic lymphadenectomy in a population of cervical cancer patients was technically feasible, authors at multiple centers have confirmed that these procedures can be performed safely and with comparable nodal yields to laparotomy. Although exact surgical approach varies from institution to institution, this section focuses on the most common techniques reported in the medical literature for laparoscopic staging of gynecologic cancers. While most reports speak to laparoscopic nodal evaluation in the primary surgical disease setting, the methods described are identical to those used in the reoperative setting.

After Herd et al.[55] reported in 1992 on their experience developing an approach to laparoscopic paraaortic lymph node dissection in a pig model, Querleu[17] and Childers et al.[16] published papers in 1993 describing their experience with this technique in humans. Querleu described his technique in sampling lower paraaortic nodes in two cervical cancer patients and resecting infrarenal nodes in two ovarian cancer patients. The primary surgeon operated from the right side of the patient, with the monitor located at the patient's head and the assistant holding a camera port placed at the umbilicus facing cephalad. Surgical instruments were placed through two 5-mm ports 10 cm lateral to the umbilicus and an additional 10-mm port placed midway between the umbilicus and pubic symphysis. Using scissors, Manhes forceps, bipolar cautery forceps, and a suction irrigator and clip applicator, the senior surgeon operates through instruments directed by the left hand in the right lateral port and right hand in the infraumbilical port, while the assistant surgeon operates the camera with the left hand and left lateral port (retractor) with the right hand. Childers et al. reported on 61 patients undergoing laparoscopic paraaortic lymph node dissection for cervical, endometrial, or ovarian carcinoma, with a progression from right-sided procurement only to the addition of left-sided and eventually infrarenal nodes as their experience increased. A standard four-trocar technique was utilized, with the incorporation of an initial left upper quadrant trocar in patients with prior midline incision. Left-side dissection began with dissection of all adventitial tissue off of the IMA and aorta, promoting a safe plane of dissection below the IMA and sigmoid colon mesentery in which the assistant placed a grasper through a left lower quadrant trocar in order to reflect the left ureter, ovarian vessels, and small bowel out of harm's way. Nodes above the IMA were obtained on the right by dissecting and mobilizing the transverse duodenum off of the aorta and vena cava by blunt and sharp dissection and on the left by working cephalad to the IMA, clipping and transecting the ovarian artery, and transecting the bundle at the left renal artery. Surgeons in this series approached nodes contralateral to the side they were positioned on and used mainly monopolar scissors for dissection.

Spirtos et al.[19] outlined in 1995 an evolution in their technique to remove bilateral pelvic and paraaortic lymphadenectomy in 40 patients with gynecologic malignancies. Initially their approach was with a 10-mm umbilical trocar, two 5-mm trocars at the level of the iliac crest bilaterally, and a 10-mm suprapubic and 12-mm supraumbilical trocar. Dissection was performed through endoshears or the argon beam coagulator placed through the lowest midline port, with irrigation and grasping managed through the lateral ports. After performing bilateral pelvic lymphadenectomy, attention was directed to the right common and aortocaval region, where the ureter was mobilized and nodes resected to the inferior mesenteric artery after mobilizing peritoneum above and to the left of the IMA and reflecting the duodenum superiorly with an endo-Babcock. Left paraaortic nodes were procured after skeletonizing the IMA distally 6 cm from the origin and reflecting the IMA anteriorly and visualizing the left ureter as the lateral margin of the dissection. Modifications in their technique over time included endo-Babcock insertion through the supraumbilical port with reflection of the IMA anteriorly and superiorly to achieve left-sided aortic exposure (with eventual full dissection and reflection of the third portion of the duodenum as well), reversal in the order of node dissection (paraaortic nodes were resected first starting with the 21st patient), and moving the camera from the umbilical to the suprapubic port and the monitor from caudad to the head of the table for the aortic node dissection.

Possover et al.[20] prospectively evaluated in 1998 their experience with 150 patients undergoing laparoscopic pelvic and paraaortic lymph node dissection. They incorporated a technique using two surgeons, with the right-sided surgeon performing left pelvic and paraaortic lymphadenectomy, and the left-sided surgeon addressing the contralateral pelvic and aortic nodal basins. The sequence of dissection was right paraaortic, left paraaortic, left pelvic, and lastly right pelvic. Monitor placement was above the patient's right shoulder for the right paraaortic lymphadenectomy, to the left of the patient's left shoulder for left paraaortic lymphadenectomy, and caudad for the pelvic node dissection. In addition, the camera was oriented such that the aorta and vena cava appeared horizontal on the monitor, and nodes were removed by an endo-bag through a 10-mm left upper quadrant trocar, which was also utilized in bowel manipulation. Extent of aortic dissection was to the level of the right ovarian vein in endometrial or cervical cancer (or to the renal vessels when metastatic nodes were encountered), and a full infrarenal dissection including resection of bilateral infundibulopelvic vessels in cases of ovarian cancer.

A similar technique was later reported in series from New York City and Oklahoma City, each spanning about 5 years of clinical experience and each reporting approximately 100 patients laparoscopically staged with a variety of gynecologic cancers. Dottino et al.[56] in 1999 reported on 94 patients undergoing laparoscopic staging, utilizing two 5-mm trocars placed 2 cm medial to the anterior superior iliac spine, a 10/11-mm supraumbilical trocar, and a 12-mm suprapubic trocar.[56] Dissection was performed using endo-shears and monopolar cautery, with methods similar to those previously described with exceptions being the primary surgeon for paraaortic dissection operating from the patient's right side and with the camera usually in the supraumbilical port. Scribner et al.[57] in 2001 reported a similarly large series of 103 patients with planned laparoscopic bilateral pelvic and paraaortic lymph node dissection, and although the technique is not delineated in detail in this paper, the node counts were similar in patients with procedures completed via laparoscopy as compared to those who had conversion to laparotomy.[57]

As compared to transperitoneal laparoscopic lymphadenectomy, extraperitoneal laparoscopic lymph node dissection has been touted as superior in that adhesion formation in the peritoneal cavity is minimized. Following initial porcine model reports of this procedure, investigators began demonstrating that the extraperitoneal technique was feasible in humans.[58–60] This procedure has been most widely applied to pretreatment laparoscopic lymphadenectomy for cervical carcinoma, with Querleu et al.[48] reporting 53 such patients undergoing staging for bulky or advanced cervical lesions. They demonstrated that the extraperitoneal approach was possible, with potential significant advantages in reducing intraperitoneal adhesions and thereby bowel complications in a patient population undergoing subsequent radiotherapy. However, given that reoperative staging for gynecologic cancer usually entails a peritoneal evaluation, this technique is of limited benefit in the reoperative setting.

Robotic Reoperative Surgery and Lymphadenectomy

Utilization of robotic assistance for laparoscopic surgery in gynecology was first reported in a human by Falcone et al.[61] in 1999 in performing a tubal reanastamosis. Since that initial report, series of patients undergoing other robotic gynecologic procedures including hysterectomy, sacral colpopexy, myomectomy, staging, and radical hysterectomy have been reported[61–69] (Fig. 5.2).

Reynolds et al.[66] reported in 2005 on their preliminary experience addressing robotic-assisted laparoscopic staging of gynecologic malignancies at University of Michigan. Reoperative staging was used in four of eight patients, including two patients with incompletely staged endometrial carcinoma and one each with unstaged fallopian tube and ovarian carcinoma. In addition, two patients underwent primary staging of endometrial cancer and one primary staging of ovarian cancer including laparoscopic hysterectomy, pelvic and periaortic lymphadenectomy, omentectomy, and peritoneal biopsies. The authors concluded that "robot-assisted laparoscopic staging is a feasible technique that may overcome the surgical limitations of conventional laparoscopy."

Since 2006, our group has approached reoperative surgery for staging of incompletely staged cancers of the endometrium, ovary, cervix, and fallopian tube with robotic minimally invasive techniques.[70] In our first year, 14 of 118 patients undergoing robotic surgery for gynecologic conditions had reoperative surgery for staging of gynecologic cancers. We have found this technique to be superior to the traditional laparoscopic approach, with advantages including improved visualization, instrument dexterity and precision, as well as scaling.

As opposed to traditional laparoscopy, there is no need to move monitors for the paraaortic vs. pelvic lymph node dissection with robotic surgery, as has been described in this chapter. The primary surgeon sits at the surgical console and is afforded high-definition binocular three-dimensional optics and autonomous control of all camera and instrument movements utilizing manual manipulators and foot pedals. Our approach is to place a camera port 3 to 5 cm supraumbilical approximately 3 to 5 cm to the right of the midline. Instrument port placement includes a robotic trocar placed 9 to 10 cm to the left and slightly below the camera port through which Maryland bipolar forceps are placed, an additional left lateral trocar ("the 4th arm") 9 to 10 cm lateral to the left port through which a fenestrated grasper is placed, and a right trocar 9 to 10 cm to the right and slightly below

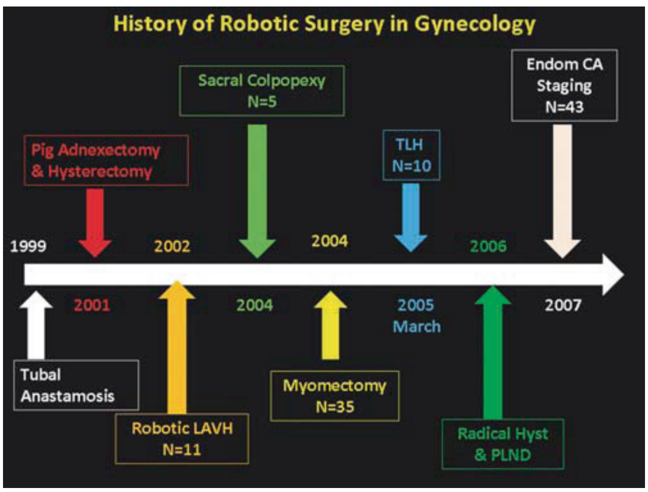

FIGURE 5.2. History of robotic surgery in gynecology. CA, cancer; LAVH-laparoscopically-assisted vaginal hysterectomy; PLND-pelvic lymph node dissection; TLH-total laparoscopic hysterectomy.

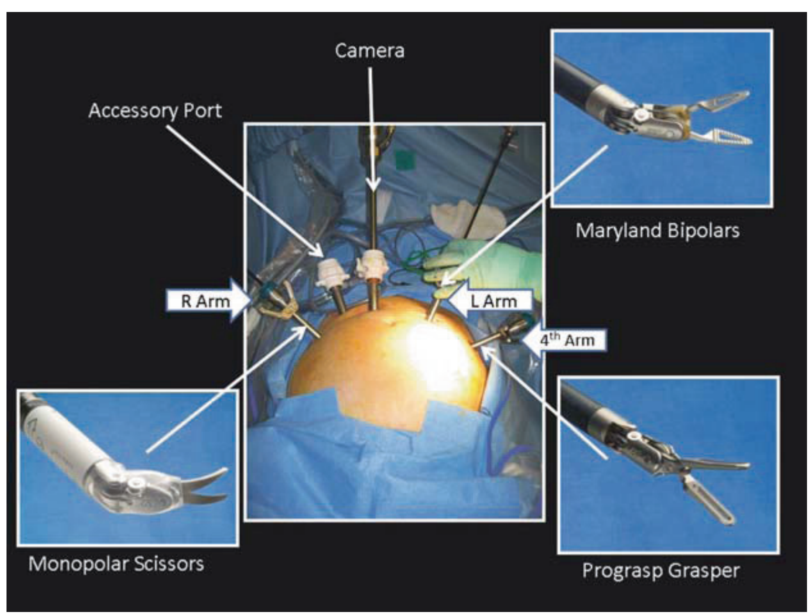

FIGURE 5.3. Robotic port placement. Following placement of three robotic ports and two conventional ports (one camera port and one assistant port), robotic arms are docked to each respective port, and the primary surgeon operates from a console using actuators that manipulate surgical instruments and the camera using a computer interface.

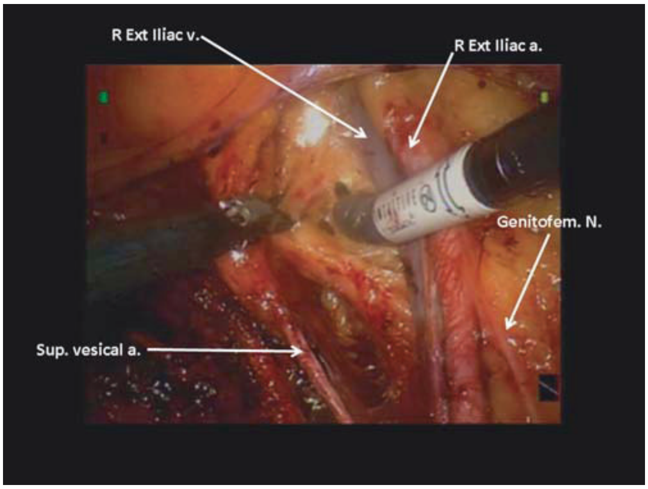

FIGURE 5.4. Right pelvic lymph node dissection. The nodal bundle is reflected medially off the external iliac vein and obturator internus muscle, in order to identify the obturator nerve lying dorsally within the obturator space. Once the nerve is identified, distal and proximal pedicles are identified and the nodal bundle is carefully dissected off the obturator nerve and superior vesical artery. Note the genitofemoral nerve in the right foreground.

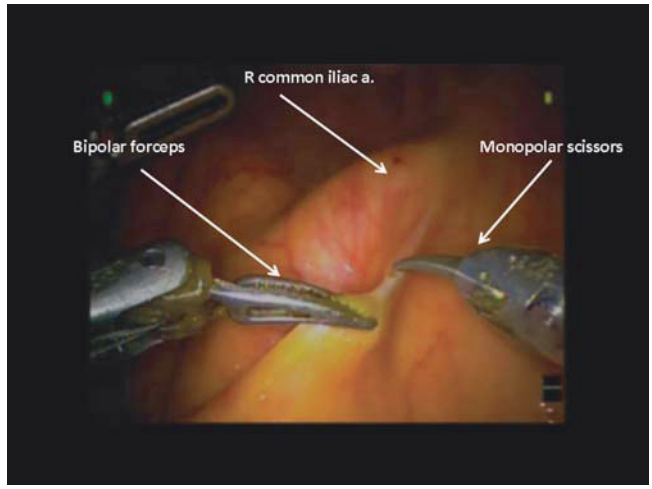

FIGURE 5.6. Initiation of right paraaortic dissection. The *right* paraaortic lymphadenectomy is begun by incising the peritoneum over the *right* common iliac artery as show. This facilitates identification of pertinent structures prior to dissection including ureter, psoas muscle, and inferior vena cava. Bipolar Maryland forceps are used for grasping and cautery of vessels and lymphatics while monopolar scissors allow meticulous dissection.

the camera port through which a Metzenbaum monopolar scissors is placed (Fig. 5.3).

The autonomous and immersive experience eliminates the need for a seasoned surgical assistant, with the assistant seated to the right of the patient passing sutures, reflecting bowel, providing irrigation, and removing nodes through a right upper quadrant 10- to 11-mm trocar placed just below the costal margin. Figures 5.4 to 5.10 depict our surgical approach.

Our preliminary experience and that of other investigators suggests that robotic surgical staging is associated with lower blood loss and shorter hospital stay, but longer operative times when compared to open procedures, as has been demonstrated by the GOG Lap2 protocol, which compared laparoscopic management of endometrial cancer with that by laparotomy.[71,72] However, it remains to be seen if the surgical advantages cited by robotic surgery are associated with better clinical outcomes as compared to a traditional laparoscopic approach. Data from Boggess et al.[73] suggest that the robotic approach may be associated with better nodal yields for endometrial cancer as compared to traditional laparoscopy.

In summary, robotic surgery has been utilized for a variety of gynecologic procedures including reoperative

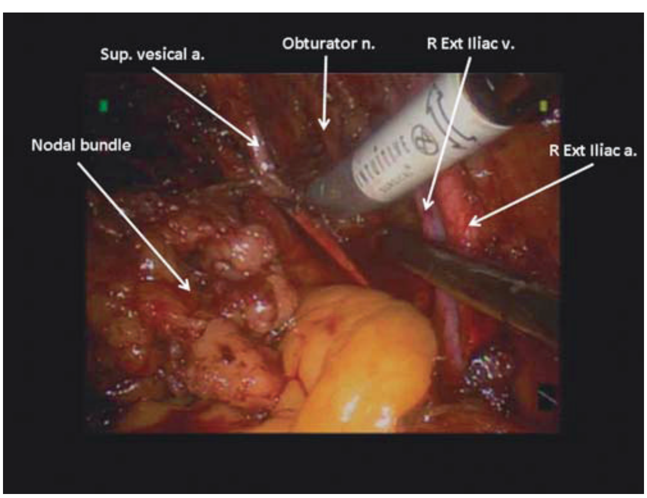

FIGURE 5.5. Obturator space following dissection. The nodal bundle has been dissected off the obturator nerve and is being reflected medially off the superior vesical artery, and pertinent structures in the obturator space can be seen.

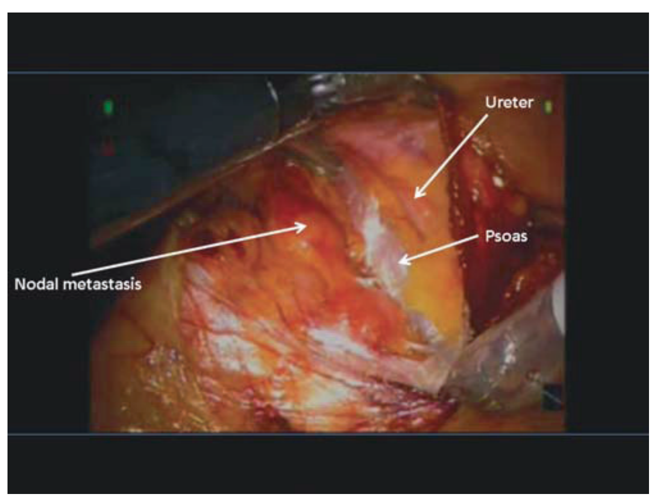

FIGURE 5.7. Right paraaortic dissection. The ureter has been reflected laterally after developing a cleft between the psoas muscle and ureter to allow safe resection of metastatic bulky nodes overlying the lower vena cava and aorta.

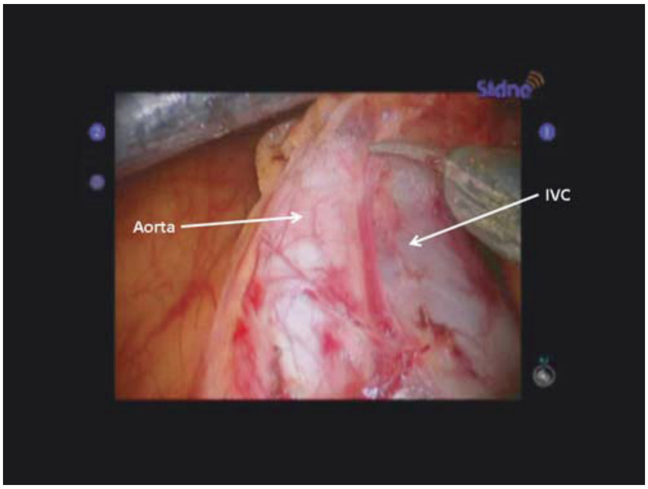

FIGURE 5.8. Right upper paraaortic dissection. Following dissection of lower aortic and caval nodes, attention is directed cephalad whereupon nodes are dissected up to the inferior mesenteric artery or renal vessels. IVC, inferior vena cava.

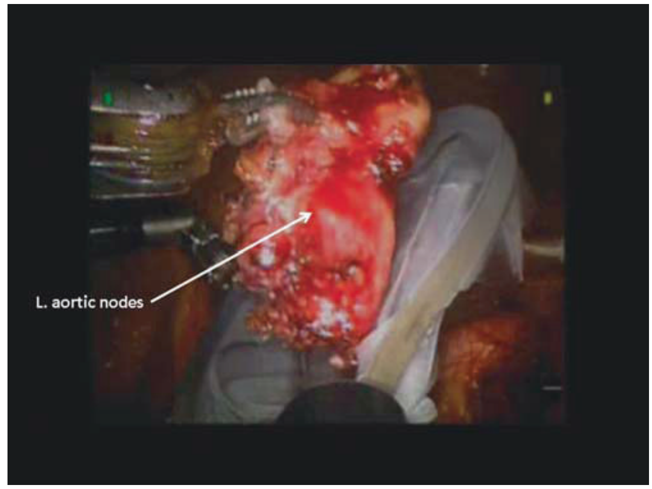

FIGURE 5.10. Nodal bundles are removed via an endo-pouch to prevent port contamination.

staging of incompletely staged malignancies, and may offer significant advantages to a traditional laparoscopic approach. If the feasibility of robotic surgical staging of gynecologic malignancies is proven in multiple centers, this technique could become rapidly incorporated into gynecologic oncology practice, including reoperative surgery, as has been shown in the urologic field for radical prostatectomy.[74]

Conclusion

Minimally invasive surgery has been increasingly utilized for primary staging and reoperative staging for incompletely staged gynecologic cancers since its introduction as a surgical technique in gynecologic oncology in the early 1990s. As technology and instrumentation has improved

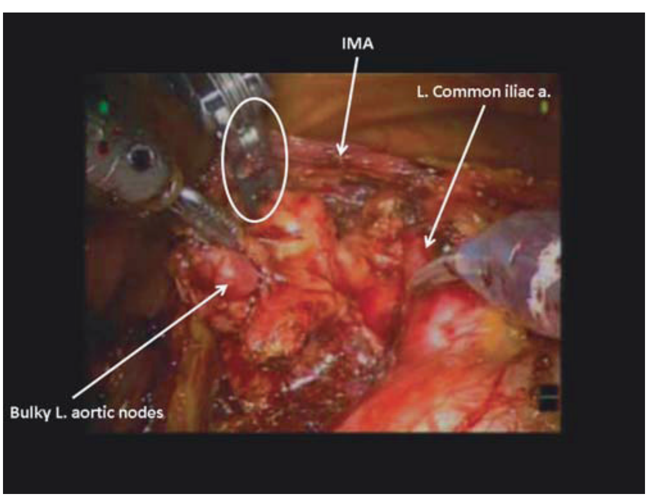

FIGURE 5.9. Left aortic dissection. With the inferior mesenteric artery and sigmoid colon and ureter reflected laterally with a retractor (*oval*), the involved left aortic nodes can be safely resected. IMA, inferior mesenteric artery.

since the nascent era of this specialty, so has adoption and incorporation by gynecologic oncologists worldwide. Endometrial cancer staging appears to be the most widely accepted application of laparoscopic techniques for gynecologic cancer, and many gynecologic oncologists now consider the minimally invasive route as the standard of care for treatment of this disease.

As data accumulate confirming the benefits of a laparoscopic approach to gynecologic cancer including less blood loss, equivalent or improved nodal yields, and improvements in postoperative quality of life, these techniques will likely find increased acceptance by clinicians and patients. Reoperative staging for gynecologic cancers including endometrial and ovarian cancers where the primary organ (uterus or ovary) has been excised but appropriate surgical staging was not performed is an ideal application of this technology. Often, patients are faced with undergoing another major surgical procedure while they are recovering from a laparotomy or laparoscopy that led to the diagnosis of cancer. Staging with minimally invasive techniques on the heels of a recent surgical procedure may afford multiple benefits, including most importantly a more rapid recovery to face adjuvant therapies if indicated.

The degree to which robotic surgery will become a standard laparoscopic technique in gynecologic oncology remains to be seen. Potential advantages in patients undergoing reoperative staging include the ability to lyse dense adhesions and restore altered anatomy with better precision and control. Regardless, laparoscopic approaches to primary and reoperative settings in gynecologic cancer with or without robotic assistance will likely replace open procedures as more trainees complete fellowships in the field with experience with these techniques.

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6

Reoperation for Endometriosis and Ovarian Remnants

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Surgery for endometriosis and ovarian remnant syndrome represents some of the most challenging and complex procedures faced by pelvic surgeons. Although infrequently encountered by medical specialists other than gynecologists, the procedures needed to extirpate a retained ovary or free the pelvis of endometriosis often require the coordinated efforts of gynecologic oncologists, urologists, and colorectal surgeons. This chapter focuses primarily on the pathology, etiology, diagnosis, and surgical management of these two challenging conditions.

Endometriosis

Endometriosis is one of the most common gynecologic conditions, affecting as many as 10% of women of reproductive years.[1] Despite this, little is known regarding its pathophysiology and genetic etiologies. Part of this hindrance lies in the fact that endometriosis is a diagnosis made solely by surgery. Although in its simplest terms endometriosis is the presence of ectopic endometrial glands and stroma outside of the uterine cavity, the clinical manifestations and management can be very complex, divergent, and difficult. Women with endometriosis typically present with dysmenorrhea, chronic pelvic pain, or infertility. Primarily affecting the peritoneal surfaces, endometriotic implants can be limited or diffuse, superficial or deeply infiltrating. They can involve any of the pelvic organs, with preferential involvement of the ovaries (44%) and posterior cul-de-sac peritoneum (34%), but can also involve the bowel (4%) and bladder.[2] Depending on the patient's age, her desire for future fertility, extent of disease, the organs involved, and the nature of the implants (deeply infiltrating and obliterating versus superficial), various surgical and nonsurgical approaches must be taken to provide adequate treatment.

Historically, there have been four classic explanations for development of endometriosis: retrograde menstruation, differentiation/metaplasia of the peritoneum, loss of detoxification mechanisms, and dysregulated hormonal pathways. Over the last decade or so, attempts have been made to further define these mechanisms through genetics. A growing body of epidemiologic data suggests that endometriosis is inherited as a complex genetic trait. Interactions between these genes and environmental factors determine the phenotype of disease that is manifested.[3–5] One of the most promising gene products investigated is aromatase, which is involved in estrogen synthesis.[6] Endometriotic tissue has been noted to have increased levels of aromatase and decreased espression of 17β-hydroxysteroid dehydrogenase, both or which result in increased levels of estrogen and stimulation of endometriotic growth.[7] In the past, medical therapies for endometriosis have included gonadotropin-releasing hormone (GnRH) agonist, progesterone, and danazol, which have been inconsistent in their success. They often are associated with significant toxicities that impact quality of life and merely suppress disease rather then eliminate it. Given the potential role of aromatase in the proliferation of endometriosis, the development of aromatose inhibitors, such as Arimidex, is a very attractive therapeutic modality that is now being investigated.[8,9]

Treatment

Despite advances in medical therapy for endometriosis, surgery remains the mainstay of treatment. This is not based on any high-level clinical evidence, as a randomized controlled trial comparing medical versus surgical management has not been performed. The surgical procedure used to eliminate endometriosis is tailored to the location and nature of the disease and to the patient's age and her future fertility desires. When confined to the ovaries (endometriomas), ovarian cystectomies or oophorectomies have been employed successfully to treat the endometriosis. If the lesions are small (<5 mm) and superficial then ablative procedures with CO_2 or potassium titanyl phosphate (KTP) laser or mono- or bipolar cautery can be used

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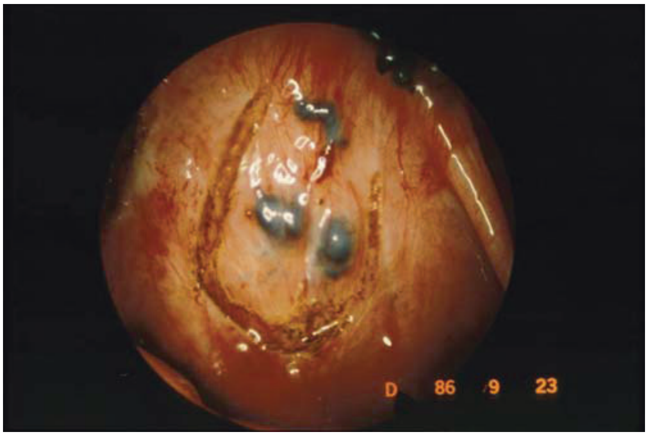

FIGURE 6.1. This mid–cul-de-sac cluster of lesions is circumscribed laparoscopically with a CO_2 laser in superpulse. (With permission of Dan Martin, MD, University of Tennessee Health Science Center, Memphis, TN, www.MemFert.com.)

(Fig. 6.1).[10,11] When deep, infiltrating endometriosis is found to involve the pelvic organs, more radical surgical maneuvers, such as bowel or bladder resections, may be necessary. These more radical surgical procedures often require a multidisciplinary team of surgeons to obtain the best outcomes. Though patients often present with symptoms suggestive of deep, infiltrative endometriosis (i.e., pain) new imaging techniques such as magnetic resonance imaging (MRI) or endoscopic rectal ultrasonography can often delineate deeply infiltrative endometriotic lesions or involvement of the bowel. By MRI, deep lesions typically have low to intermediate signal intensity with punctate regions of high signal intensity on T1-weighted images. T2-weighted images show uniform low signal intensity, and can demonstrate enhancement on contrast-enhanced images.[12] When excising endometriotic implants, a tissue margin of several millimeters (2–4 mm) is necessary as microscopic disease may be present in normal-appearing adjacent peritoneum.

Given that the majority of women affected by endometriosis are young and wish to preserve their fertility, conservative surgery that preserves the ovaries and uterus is typically the goal. These surgeries are often performed via open laparotomy, but there is a growing literature that suggests that even more radical procedures can be performed laparoscopically.[13–18] This is the case for both primary surgical management and for recurrent endometriosis. Across the board, almost all studies evaluating the efficacy of surgical management of endometriosis report an improvement of symptoms and quality of life.[14,15] Improvement in fertility and subsequent pregnancy is a little more controversial. Pregnancy rates after laser vaporization or electrocautery of all stages of endometriosis range from approximately 30% to 60%. Crude pregnancy rates after expectant management of laparoscopically diagnosed mild to moderate endometriosis is roughly 50%, thus raising the question of the impact of conservative surgery for mild stages of disease. When more extensive disease is present, surgery has a greater impact on pregnancy outcomes, raising the crude pregnancy rates from roughly 35% to 60%.[19,20] These future pregnancies are most likely to occur within the first 2 years after surgery. Despite these improved rates of pregnancies, duration of infertility and patient age are likely more important predictors of subsequent pregnancy than is the extent of disease or surgical procedure.

Recurrence

Despite removal of all disease, endometriosis or related symptoms can recur. The rate of recurrence ranges from approximately 15% to 35%.[21] Clinical features that seem to influence the rate of recurrence include age, radicality of surgery, and postsurgery pregnancy. Older age, more radical surgery, and postoperative fertility are all associated with a lower rate of recurrence. The current endometriosis classification system, the revised American Fertility Society (rAFS) classification, has not always been predictive of failure, symptomatic recurrence, or probability of pregnancy. This is not surprising since the rAFS relies on descriptive analysis of lesions (potentially underestimating deep penetrating lesions) and was devised to predict infertility outcomes, not symptomatic relief. Some authors, however, would suggest that rAFS score is predictive of recurrence.[14,21] When women are reoperated for recurrent symptoms, up to a third have no evidence of endometriosis either macroscopically or histologically.[14]

Complications of Surgery

Given the distribution of endometriosis and the infiltrative process, the normal anatomy of the pelvis is often distorted. A thorough understanding of the anatomy of the pelvis is essential for avoiding injury to vital structures such as bowel, ureter, and blood vessels. Entering the retroperitoneal space often allows unencumbered access to these vital structures and allows completion of the planned surgery. To enter the retroperitoneum, the round ligament is divided and retracted laterally and medially. With the ovary and ovarian vessels retracted medially, the peritoneum lateral along the psoas muscle and iliac vessels is opened posteriorly parallel to the ovarian vessels to the pelvic brim. At this point, the ureter can be seen entering the pelvis passing over the bifurcation of the internal and external iliac vessels. The ureter then travels along the medial leaf of the pelvic peritoneum usually parallel to the anterior branch of the hypogastric artery. It continues down to the ureteric tunnel, at which point it passes underneath the uterine artery. By separating the ureter from the medial leaf down to this level and gently retracting it laterally, one can resect endometriosis-involved sidewall peritoneum. At this point, the pararectal and paravesical spaces can be opened. The pararectal space is bordered by the cardinal ligament anteriorly, internal iliac vessels laterally, rectum medially, and sacrum posteriorly. The paravesical space is bordered by the cardial ligament posteriorly, superior vesical artery medially, obturator internus muscle laterally, and pubic symphysis anteriorly.

Ureteral injuries occur in 0.5% to 2.5% of women undergoing gynecologic surgery.[22] Typical sites of injury include near the pelvic brim, at the level of the uterine artery, and lateral to the vaginal cuff. The blood supply to the ureter comes from a plexus of vessels that form a sheath around the ureter. This plexus is fed medial to lateral above the pelvic brim (renal artery) and lateral to medial below it (common iliac, uterine, and internal iliac arteries). Disruption of this plexus and separation of the ureter from the peritoneum can lead to vascular compromise and delayed injury to the ureter. Injury to the ureter can also occur by crush injury, cautery damage, or complete transection. Repair of ureteral injuries is beyond the scope of this chapter but can be accomplished by ureteroneocystotomy or ureteroureterostomy, or by direct repair (over a stent). Occasionally, endometriosis will grow and encase one or both ureters. Fortunately, this involvement does not directly invade the ureteral wall. The area of involvement can be opened and carefully dissected away from the wall of the ureter. When reoperating for pelvic endometriosis involving the bowel and pelvic sidewall, we make liberal use of ureteral stents to allow more rapid and precise identification of the ureters. Although most studies have not shown a reduction in ureteral injury with stents, their presence often shortens the operative time and allows rapid identification of ureteral injury should it occur.

Rectal Involvement with Endometriosis

Patients suspected of rectal involvement with endometriosis have pelvic pain as the major presenting symptom. This can be in the form of severe dysmenorrhea or dyspareunia, especially with deep penetration. Rectal bleeding is the classically described symptom of rectal endometriosis, but only rarely do the implants invade deeply enough to actually be the cause of bleeding. On physical examination, tender nodularity may be palpated involving the cul-de-sac or rectovaginal septum. Colonoscopy or rigid sigmoidoscopy may reveal extrinsic compression or fixation of the bowel. While lesions rarely invade the mucosa, the mucosa may be distorted or tethered by muscular or submucosal involvement. Sigmoidoscopy showing no intraluminal lesion is also of value in ruling out colorectal malignancy as the etiology of the patient's symptoms. Another diagnostic modality that has been advocated in improving accuracy of diagnosis and depth of invasion of endometriosis of the rectum is endorectal ultrasound.[23,24] Our experience with this modality has been limited by the significant discomfort experienced by our patients when the probe is introduced.

It is helpful if the colorectal specialist is able to see the patient in advance of surgery, both to rule out malignancy of the large bowel and to plan appropriate bowel preparation and positioning of the patient on the operative table. The preoperative discussion mentions the small possibility of a stoma (colostomy or ileostomy) associated with these complex and difficult operations. Our preference is also to become involved early in the course of the operative procedure before too much dissection has occurred.

When endometriosis obliterates the posterior cul-de-sac or is deeply infiltrative of other pelvic structures, radical surgical procedures are often needed to rid the pelvis of the disease. The cul-de-sac is the most common site of significant involvement of the large bowel. The peritoneum in this area is frequently obliterated by endometriosis and scar with fusion of the rectum, posterior uterus, and posterior vagina. The uterosacral ligaments are commonly involved and become shortened, pulling the uterus posteriorly and making dissection of the rectovaginal plane quite difficult.

Our approach to removal of endometriosis involving the anterior rectum and the cul-de-sac is to begin the dissection lateral to the sigmoid, developing a plane just medial to the ureter. Once the ureter has been identified and preserved, the dissection can proceed into the presacral areolar plane, elevating the rectum from the sacral hollow. After mobilizing below palpable disease to soft rectum, the dissection can then move laterally, dividing the avascular attachments of the rectum. Since the cul-de-sac is the most difficult part of the dissection, it is approached last, after developing the more normal planes and identifying the anatomy. We often dissect bluntly between the rectum and vagina below the areas of involvement. This then allows dissection of the areas of attachment between the rectum and the gynecologic organs. It may be necessary to divide one or both uterosacral ligaments posterolaterally to allow more anterior mobility of the rectum and uterus. It is often necessary to resect the involved ligaments as well as a portion of the vaginal muscularis en-bloc with the rectum to completely remove the disease. The rectosigmoid may be telescoped down into the pelvis by the dense fibrosis and endometrial tissue. Once the cul-de-sac disease has been mobilized, the rectum can often be elevated from the pelvis for an easier than expected anastomosis. It is not necessary to obtain wide margins in the rectal resection, but the surgeon should reach soft pliable bowel both above and below the areas of involvement. The resection can be either a full-thickness disk excision or a segmental resection. We have not favored trying to "peel off" the endometriosis in an extramucosal plane. This bias is a result of what seems like a significant rate of recurrence requiring reoperation when this technique has been used. The submucosal plane is also quite vascular, making the identification of margins unclear. The relatively small opening made in the rectal wall by a full-thickness disk excision often seems to become much larger before it is closed. This circular defect is typically closed transversely with a single, inverting layer of absorbable suture. If segmental resection is performed, the anastomosis can be performed using a circular stapler inserted from the anus, or using hand-sewn techniques. The line of closure of the rectum often lies well below the peritoneal reflection and therefore away from other structures that might adhere and cause further pain and infertility.

The aggressive resection of extensive endometriosis involving the rectum and cul-de-sac has been performed by one of the authors (H.R.B.) in well over 250 patients. A review of symptomatic relief was conducted in one series of 130 patients. In that group, a crude pregnancy rate of 49%

was achieved. Relief of pelvic pain, dyspareunia, and rectal bleeding was achieved in 94% of patients who had their ovaries removed and 77% of those who had a conservative procedure.[25] The vast majority of these operations are performed open, not laparoscopically. It is our bias that much of the pelvic disease can only be detected by palpation. If laparoscopy is to be used for these operations, we would encourage a hand-assisted technique. Multiple papers have described laparoscopic resection for pelvic endometriosis, but several have involved lesions of the intraabdominal colon.[26–28] Multiple series report complications such as rectovaginal or colovaginal fistula, a complication that has not occurred in our series.[29–31] Prolonged operative times averaging 6 hours have been reported as well.[31]

Ovarian Remnant Syndrome

Although uncommon, a well-described and difficult surgical issue is the ovarian remnant syndrome. This syndrome results from remnants of ovarian cortex left behind after a technically challenging bilateral salpingo-oophorectomy, and is similar clinically to the residual ovarian syndrome that results after the bilateral tubes and ovaries are purposefully left in-situ after a hysterectomy. Multiple small series have been reported in the literature evaluating both of these syndromes, noting an incidence of roughly 3% to 5%.[32–34] For the purposes of this discussion, the remainder of the chapter focuses on ovarian remnants. Clearly, any predisposing condition that complicates initial surgery increases the risk of failing to extirpate all ovarian tissue. These conditions may include increased vascularity leading to poor hemostasis, extensive adhesions, or ovarian pathology, such as endometriosis or pelvic inflammatory disease, that distorts normal anatomy. Ovarian cortex may be left on the pelvic sidewall when the adherent ovary is bluntly mobilized from a scarred pelvis.

Diagnosis

Clinical diagnosis of ovarian remnant syndrome is often difficult and must be included in the differential diagnosis of any woman who supposedly had a bilateral salpingo-oophorectomy. Typical symptoms include dyspareunia and chronic pelvic and low abdominal pain (defined as a duration >1 month), occurring in 50% to 75% of patients, pain radiating to the legs or back (21%), urinary tract symptoms (12%), malaise, weakness, fevers, nausea/vomiting (14%), cyclical vaginal bleeding (8%), and painful defecation (6%).[35] The pain typically is cyclic and described as anywhere from sharp/stabbing to a dull ache. These symptoms usually begin within weeks to 5 years of bilateral salpingo-oophorectomy, although they can occur more than 10 years after surgery.[33] The early onset of symptoms (<5 years) tend to be more frequent in women under age 40 than those over 40 and may reflect the role of continued ovulation and sexual activity in this age group.[35] At the most extreme, there have been multiple reports of ureteral and bowel obstructions caused by a remnant ovary. Definitive diagnosis is made, however, when a woman with the history of a bilateral salpingo-oophorectomy undergoes surgery for a presumed ovarian remnant and has ovarian tissue identified on final pathology.

Physical Examination

Physical examination at the time of presentation may or may not be helpful. Roughly 50% to 75% of patients present with a palpable mass or definite thickening on pelvic exam.[32,34–36] Palpation of the mass often elicits reproducible pain. Imaging, particularly with ultrasound or MRI, is helpful in defining the location, size, and surrounding structures of both palpable and nonpalpable masses. Other imaging such as barium enema may help define the extent of involvement of surrounding structures and better define the necessary surgical procedure.[37] One author suggested the use of clomiphene citrate 10 days prior to imaging to stimulate the ovaries to generate cysts prior to imaging and aid in their identification.[38] Additionally, elevated steroid levels (estrogen, progesterone) or normal premenopausal gonadotropin hormone assays (follicle-stimulating hormone [FSH], luteinizing hormone [LH]), can identify residual functioning ovarian tissue.[34]

Management

The management options for ovarian remnant are few. The primary treatment of choice is surgical excision with a wide-enough margin to remove all active tissue. This can be approached by an open operation or laparoscopically.[39] Alternative methods include castrating doses of pelvic radiation or medroxyprogesterone, danazol, or GnRH antagonist to suppress ovulation.[40,41] Regardless of the method chosen, close follow-up is needed to detect a recurrence. This follow-up should include a history, physical exam, serum LH, FSH, and estradiol.

As was the case with endometriosis, surgery to remove a remnant ovary can be extremely difficult and associated with significant morbidity. The estimated complication rates range from 15% to 30%.[34] These injuries can include enterotomy, large-bowel injury, cystotomy, ureteral injury, anemia, and thromboembolic event. Typically, surgery for ovarian remnant is accomplished via a laparotomy, but laparoscopy is gaining some favor.[39] Blunt dissection should be avoided, as it increases the risk of leaving ovarian cortex and persistent problems with remnant ovary. Given the close proximity of the ureter to most ovarian remnants, this structure is often intimately involved with the residual ovarian tissue. To help identify it, preoperative cystoscopy with ureteral stent placement may be helpful. Likewise, an extraperitoneal approach to the ovarian tissue may be preferable in the face of extensive adhesions.

To approach an ovarian remnant surgically, the pelvic peritoneum is incised lateral to the ovarian vessels and then opened anteriorly and posteriorly. The pararectal and paravesical spaces are dissected in their entirety. The ureter is clearly identified, freed from its attachment to the medial leaf of the pelvic peritoneum, and mobilized laterally. The ovarian vessels are ligated cephalad to the pelvic brim/aortic bifurcation. Once ligated, the ovarian vessels are dissected free down into the pelvis, and the residual ovarian tissue is removed with the surrounding normal-appearing peritoneum. The reason for a high ligation of the ovarian vessels and resection of surrounding normal peritoneum is to help ensure that no active residual ovarian tissue is left along the vascular pedicle. The residual ovary can be located almost anywhere; however, the most common site to find the residual ovarian tissue is near the angle of the vaginal cuff; thus, the bladder, ureter, and bowel can all come into play.

Ovarian remnant syndrome does recur despite aggressive attempts at removing all residual ovarian tissue at the time of the first operation for the ovarian remnant. The estimated incidence is 5% to 10%. Presentation and management are the same as previously discussed.

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7

Pelvic Exenteration for Recurrent Pelvic Cancer

Pamela Paley and Chirag Shah

The first half of the 20th century ushered in an era of refinement in anesthetic and perioperative management that encouraged a more aggressive approach to extirpative surgery for malignancy. In 1948, Brunschwig was the first to publish the feasibility of en-bloc resection of the pelvic viscera. Subsequently, Brunschwig and Daniel[1] reported their series of 592 pelvic exenterations. Despite a large number of cases, allowing these pioneers to gain a fairly robust familiarity with the procedure, surgical complications were frequent, mortality was substantial, and survival was limited. This initial series of pelvic exenteration demonstrated an operative mortality of 23% and a 5-year survival of only 17%.[2] Thus, from these early reports a clear paradigm emerged; patients in whom complete tumor resection was not feasible gained no survival benefit with an exenterative procedure. With continued refinement of preoperative and operative management, as well as more stringent patient selection criteria, the past five decades have witnessed a substantial improvement in outcome. Most recent institutional series now report operative mortality under 5%, with 5-year survival approximating 50% (Table 7.1). The procedure is now widely accepted as the treatment of choice for a small, select subset of women with recurrent malignancy when it affords the only chance for cure.

The most frequent indication for this procedure typically has been recurrent cervical cancer, but it has also been utilized for cancers of the urethra, bladder, colon and rectum, endometrium, vulva, and vagina. In the largest most recent study published by Goldberg and colleagues,[3] greater than 90% of pelvic exenterations performed were for recurrent cancers of the cervix, and this is consistent with earlier reviews. Of course, only a fraction of patients with recurrent cervical cancer are candidates for the procedure. Morley et al.[4] chronicled the experience at the University of Michigan over a 20-year period, and determined that of the 1000 patients with recurrent disease, only 20% met their criteria for attempting pelvic exenteration. Additionally, only 50% of these 200 patients actually had resectable disease at the time of laparotomy. Therefore, in their series, only 10% of patients with recurrent disease, 100 patients, underwent some form of pelvic exenteration.

Current recommendations for the primary treatment of invasive cervical cancer include either primary surgery or radiotherapy. Historically, pelvic exenteration had been employed for the treatment of advanced primary cervical cancer. However, Rutledge and Burns[5] demonstrated a survival rate in stage IV lesions of 28% with up front radiation therapy. Accordingly, the procedure is no longer employed for this purpose, except occasionally in vulvar cancer[6] and nongynecologic lesions. Some 40% of women with invasive cancer of the cervix experience a recurrence, but only a very small percentage will have central pelvic recurrences that are amenable to and fit the criteria for surgical resection. Patients who received primary surgical therapy and then experience a recurrence can often be salvaged with radiotherapy. The 5-year survival rates, 22% to 44%, are comparable to pelvic exenteration without the significant mortality and morbidity.[7,8] The pelvic failure rate in one large series of women receiving irradiation alone as primary therapy was noted to be 19%; however, only 7% of the patients in this series had central recurrences that were amenable to pelvic exenteration.[9] Isolated central recurrences of cervical cancer remain the classic and most common indication for this radical extirpative procedure, but in the current era of chemoradiation, they are becoming increasingly less common.

Additional indications for pelvic exenteration include fistulization and radiation necrosis of the vagina, bowel, and bladder. The increased use of adjuvant radiation and chemotherapy has led to increased early survival of women with gynecologic malignancies.[10] However, there are more women now with no evidence of disease who require surgical management of the complications of their adjuvant therapy.[11]

Total pelvic exenteration involves removal of the bladder, rectum, and female pelvic organs (vagina, uterus, fallopian tubes, and ovaries). Modifications of this procedure include anterior and posterior exenteration. The reconstructive aspects of the procedure include urinary conduit formation utilizing small or large bowel as well as the

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TABLE 7.1. Surgical Mortality and 5-Year Survival Rates after Pelvic Exenteration.

	N	*Surgical mortality (%)*	*5-year survival rate (%)*
Brunschwig (1965)	535	16.0	20.1
Rutledge (1977)	296	13.3	48.3
Averette (1984)	92	24.0	37.0
Morley (1989)	100	2.0	61.0
Magrina (1997)	133	6.7	41.4
Sharma (2005)	48	4.2	33.0
Berek (2005)	75	0.0	54.0
Goldberg (2006)	103	1.0	47.0
deWilt (2006)	42	4.2	33.0

creation of a neovagina in certain cases for the preservation of sexual function (see below). The 21st century has seen the continuation of the technologic advances of this procedure as we attempt to make it a safer, more reliable option for women with recurrent pelvic cancer.

Patient Selection

Given the morbidity of this procedure, patient selection is imperative to its success. In the original 1948 series published by Brunschwig, any woman with recurrent cervical cancer was eligible for pelvic exenteration. Accordingly, of 22 cases, five patients died of the procedure. In 1969, Barber,[12] who had trained and learned the procedure from Brunschwig, published the first attempt at defining preoperative criteria to select patients for exenterative surgery. These time-honored guidelines have been strengthened and refined by subsequent series, but for nearly four decades remained largely undebated.

Patient selection begins with the initial visit. If a patient is suspected of having a recurrent pelvic cancer, the evaluation should begin with a thorough history and physical. Candidates should be not only medically fit for exenterative surgery, but also psychologically prepared to undergo the procedure. Before the advent of modern diagnostic imaging, most authors agreed that a history of the "triad of trouble"[13] often suggested unresectable pelvic sidewall disease. This triad consists of (1) ureteral obstruction; (2) sciatic nerve pain, suggesting neural sheath involvement at or near the lateral pelvic sidewall; and (3) unilateral lower-extremity edema, implying venous or lymphatic compromise of the iliac vessels. In many cases an examination under anesthesia may be necessary to sufficiently palpate the disease. Tru-Cut transvaginal needle biopsies are performed to histologically establish the presence or absence of recurrent disease.

Once recurrence is documented the evaluation should include ascertainment of extrapelvic disease. Historically, chest radiography and lymphangiography had been performed for this purpose. However, with the advancement of more sophisticated imaging modalities there has been a dramatic shift in the search for distant metastases. Computed tomography (CT) and magnetic resonance imaging (MRI) have been routinely used for this purpose. And increasingly, positron emission tomography (PET) with or without CT has been shown to be advantageous for this purpose. Unger and colleagues[14] were able to demonstrate 100% sensitivity and 85.7% specificity of PET to detect recurrent disease in women with cervical cancer. The sensitivity and specificity of detecting recurrence in asymptomatic women was 80% and 100%, respectively. Other reports have confirmed these findings, documenting a sensitivity and specificity of 81.0% to 90.3%.[15] One study in South Korea found that preoperative PET modified the planned treatment modality in 65.5% of women with recurrent cervical cancer.[16] This technique shows much promise in its ability to further define candidates for this extensive physical and psychological undertaking.

The most well-established prognostic factor is interval to recurrence. Morley et al.[4] reported a 2-year survival of only 44% when the interval from primary therapy to the time of recurrence was less than 1 year, 60% if recurrence was within 1 to 10 years, and 95% for patients with a disease-free interval greater than 10 years. Although Barber[12] initially reported an increased preoperative mortality associated with age greater than 65 years, more recent studies have contested these early findings. In a report published by the group at M.D. Anderson, the 5-year survival and operative mortality rates were not significantly different between those older than 65 years old and those younger than 65.[17] Furthermore, subsequent series have supported similar morbidity in women exceeding 70 years of age.[18] With improved perioperative management, physiologic age is likely of greater importance in patient selection than is chronologic age.[18–20]

Numerous preoperatively ascertained clinicopathologic factors have been studied as possibly predictive of survival to help guide decisions regarding proceeding with exenterative surgery. Tumor size has been shown to be of significance. Shingleton and colleagues[21] demonstrated that survival was superior in women with small, central recurrences less than 3 cm. The location of the tumor is relevant as well; and indisputably, evidence of preoperative sidewall fixation portends a poorer survival. However, the historical factors typically associated with a worse prognosis, such as tumor grade, primary stage, treatment modality, and histologic subtype have been shown to be of less importance.[2,21–23] Squamous cell lesions are the most frequently seen histology in most series. These lesions spread more often by direct invasion and typically along the tissue planes, and therefore tend to stay localized for longer periods of time. However, other histologies are not a contraindication to the procedure when the extrapelvic disease evaluation is negative.

Obesity is not an absolute contraindication to the procedure, although it has been associated with increased complications.[23] Most patients undergoing this procedure are treated in a tertiary care center, and ancillary expertise in the perioperative management of obese patients is of great assistance. Other medical and psychological factors should be evaluated on an individual basis. A thorough assessment of the cardiopulmonary, renal, and nutritional status of the patient must be completed. Preoperative anesthesia evaluation for surgical clearance is often helpful. Appropriate consults services should be involved early in the decision-making process.

The final decision in terms of patient selection is made at the time of surgery. If there is any chance the lesion can be resected, and the patient is medically cleared for surgery, the operating room has been referred to as the "court of last resort".

Counseling

Counseling of the patient is of great importance in the patient selection process and in the type of procedure to be undertaken. The patient must understand the great risk to her life from the procedure itself as well as the dramatic changes it will have on her body. But she must also understand that pelvic exenteration often provides the only therapy with curative potential as a result of her recurrent pelvic cancer.

As we have seen, the mortality and morbidity associated with this radical surgery has decreased with time. Some of the decrease can be attributed to advances in the reconstructive phase of the surgery. The improvements in perioperative management and the resulting decrease in mortality have also allowed for more complex reconstructive efforts to take place. Educating the patient and counseling her regarding her choices are imperative for the success of the procedure and the patient's quality of life.

Bricker et al.[24] were the first to introduce the ileal conduit for urinary diversion as an alternative to the "wet" colostomies that had been fashioned in the early period of this procedure. The urinary conduit was a major advance, but it still required an additional appliance to be worn by the patient. Conduits add to the poor body image and difficult with sexual adjustment that women often face at the conclusion of this procedure. As early as 1969, however, attempts were being made to achieve continence in the urinary conduit. The Kock pouch[25] was the first major advance utilizing a detubalarized bowel reservoir to achieve a functionally continent reservoir. It utilized nipple valves to achieve continence, and the pouch was a low-pressure reservoir. This procedure did not gain wide acceptance, however, as it is technically challenging, time-consuming, and sacrifices a significant length of small intestine.

The Indiana pouch,[26] described in 1987, utilized the ileocecal valve to achieve continence and augmented it with placation of the ileal lumen. The cecum was utilized as the low-pressure reservoir. The Indiana procedure was simpler and less time-consuming. It was modified by Penalver and colleagues[27] in 1989, and the resulting Miami pouch is the most widely utilized for continent urinary diversion in women undergoing pelvic exenteration presently. In the initial series, 86% of patients achieved continence, and the complication rates were comparable to those seen in incontinent diversion techniques. Hartenbach and associates[28] at the University of Minnesota validated the low complication rates seen in women who underwent continent urinary diversion using the Miami pouch, noting an anastomotic leak in less than 10% of patients and stone formation in less than 5%. Finally, a recently published long-term follow-up by Penalver et al.[29] demonstrated excellent results with the Miami pouch; only 4.5% of women required reoperation for treatment of complications. Women undergoing continent urinary diversion have been shown to have a significantly improved quality of life, and appropriate candidates should be counseled accordingly.

Advances have been made in the restoration of functional vaginal anatomy as well. The discussion should include the patient and her partner with respect to their desired sexual function. Involvement of a psychologist, psychiatrist, or sex therapist can be beneficial. Few studies have evaluated sexual function in women who choose to undergo neovagina creation, and rates of utilization have typically approximately 50%.[3,30,31] The most likely indicators of postoperative sexual function are prior sexual activity and residual tumor.[32]

Recently Goldberg and colleagues[3] found that 70% of patients with neovaginal reconstruction had functional vaginas, but only 50% of these patients were utilizing them. Even with anatomic success with vaginal reconstruction, self-consciousness and disturbed body image negatively impact sexual activity. Many of these women also struggle with lack of pleasure, and the psychological stress of their primary diagnosis coupled with fear of recurrence. Support from partners and providers is of great value, and counseling should continue in the postoperative period with a multidisciplinary approach.

Neovaginal creation also occupies the dead space cavity created by en-bloc pelvic resection. A variety of methods have been identified: split-thickness skin grafting, omental grafting, the use of sigmoid colon, and myocutaneous flaps.[33,34] The most commonly used myocutaneous flaps are gracilis myocutaneous (GM) and rectus abdominis myocutaneous (RAM) flaps. Myocutaneous flaps have been shown in multiple studies to decrease complications including fistula formation, small bowel obstruction, and postoperative infection.[35–38] Gracilis myocutaneous flaps have been shown to significantly decrease surgical morbidity[39]; however, Cain and colleagues at the University of Washington demonstrated significant flap necrosis in nine of 24 patients with GM flaps. Additionally, Soper and associates[40] at Duke University found a demonstrable increase in flap loss in patients with GM as compared to RAM flaps, and a lower overall incidence of flap-specific morbidity in patients undergoing reconstruction with RAM flaps. Given the growing body of evidence supporting the use of RAM flaps, this method of reconstruction is becoming the standard of care in vaginal reconstruction. The goals of this reconstructive effort are to promote wound healing, decrease pelvic dead space, restore the pelvic floor, and reestablish normal sexual function and body image.[41]

Patients also need to be counseled with respect to primary low colorectal anastomosis using an end-to-end anastomosis (EEA). Hatch and associates[42] described success using this approach with complete healing rate of 85% when an omental J-wrap was utilized. Anastomotic leaks were increased in patients whose rectal stump was less than 6 cm. Berek and coworkers,[43] describing their experience at UCLA, now routinely utilize primary reanastomosis with creation of a J-pouch, 81% of their patients had primary reanastomosis.They have witnessed lower fistula formation and improved patient satisfaction. The only current concerns, however, relate to an increased risk of recurrence described by Goldberg et al.[3] at Albert Einstein. Five of their first 11 patients (45%) with negative surgical margins and lymph nodes at the time of surgery who underwent low colorectal reanastomosis had early recurrent disease in the vicinity of their rectal anastomosis. The authors have since abandoned performing this procedure at their institution.

Perioperative Management

Typically, patients are admitted the day before surgery. Anesthesia and consult services can see the patient at this point if they have not done so previously. The majority of the patient evaluation for surgery should take place prior to admission. All patients usually undergo mechanical bowel preparation. The patient should meet with a stomal therapist if available for marking and for educational purposes. Laboratory assessment should be tailored to the patient's individual medical needs. At our institution we typically type and cross the patient for four to six units of packed red blood cells. Central venous access is routinely obtained by the anesthesiologist preoperatively. Additionally, most patients are choosing to undergo regional anesthetic with epidurals to supplement their general anesthetic. Postoperative infusions with epidural bupivacaine have been shown to reduce pain and opioid requirements.[44] It has also been hypothesized that the decreased narcotic use could improve the return of postoperative gastrointestinal function, although this has not been documented in gynecologic surgery.

Preoperative antibiotic prophylaxis for surgical site infection is ordered on admission on call to the operating room, with regimens differing among institutions and formularies.[45–47] Deep venous thrombosis has been shown to be a major concern following gynecologic surgery. Patients have sequential compression devices placed preoperatively for use during surgery to prevent venous thromboembolism (VTE). Clarke-Pearson and colleagues[48,49] at Duke demonstrated in multivariate regression that cancer, history of deep venous thrombosis, and age greater than 60 years were significant causes of failure of intermittent pneumatic compression devices. The rate of thromboembolism was 3.2% for patients with two or more of these risk factors as compared to 0.6% for those with none. In terms of intraoperative risk factors, a duration of anesthesia of greater than 3 hours was also shown to be of prognostic significance. Mean operative times for pelvic exenteration vary on reconstructive efforts undertaken, but the most recent series describe mean operative times of 7 to 8 hours.[38,43] Therefore, we can conclude that patients with recurrent pelvic cancer undergoing pelvic exenteration are at high risk of VTE, and careful attention to perioperative prophylaxis is extremely important.

Surgical Techniques

Exploratory Laparotomy

Once the anesthetist has completed general and/or regional anesthesia, the surgical team may proceed with central venous catheter placement. At this time the patient is placed in the standing lithotomy position, with yellow-fin or Allen stirrups. The skin is shaved with an electric clipper, not a sharp razor as this has been associated with increased risk of infection in genitourinary surgery.[50] A vertical midline skin incision is then made, and the abdomen is opened from symphysis pubis to the mid-epigastrium. Lysis of adhesions is performed as needed so that a thorough upper abdomen, lower abdomen, and pelvic exploration can be performed. The surgeon should palpate the diaphragmatic surfaces, all organs, and lymph-node–bearing areas. Any ascites should be collected, and if they are not present, cytologic washings should be sent for analysis. The Buchwalter or similar retractor is then placed. If there are areas of concern for recurrent malignancy, they should be biopsied and sent for intraoperative frozen section.

Periaortic Lymphadenectomy

The peritoneum over the lower aorta is incised after packing of the bowels with laparotomy sponges. The dissection should begin at the bifurcation of the aorta, developing the nodal bundle cephalad. Careful attention should be paid to hemostasis, and hemoclips or cautery should be utilized, especially overlying the thinner-walled inferior vena cava. An extensive periaortic lymphadenectomy to the renal vessels is typically not required for recurrent pelvic cancer. If there is any evidence of metastatic disease on histologic review, the procedure should be aborted in most cases.

Pelvic Lymphadenectomy and Assessment of Resectability

The common iliac nodes should similarly be evaluated. One pelvic sidewall is evaluated followed by the other. The round ligament should be ligated and divided, followed by opening of the broad ligament. The anterior and posterior leaves are carefully dissected with cautery to expose the retroperitoneum. The avascular spaces including the paravesical, paravaginal, pararectal, and presacral spaces are then developed (Fig. 7.1). The paravesical space is manually exposed by sweeping the bladder medially and caudally away from the pubic symphysis. The pararectal space can be identified by bluntly freeing the medial leaf of the broad ligament from the pelvic sidewall. The dissection should extend to the levator muscles, obturator internus fascia, and arcus tendineus. At this point the surgeon should be able to palpate the neoplasm and determine if the pelvic sidewall is involved by placing a thumb and forefinger in the paravesical and pararectal space. An assessment of the extent of the neoplasm and an estimate of surgical margins should take place followed by biopsies of any areas that may not be amenable to resection.

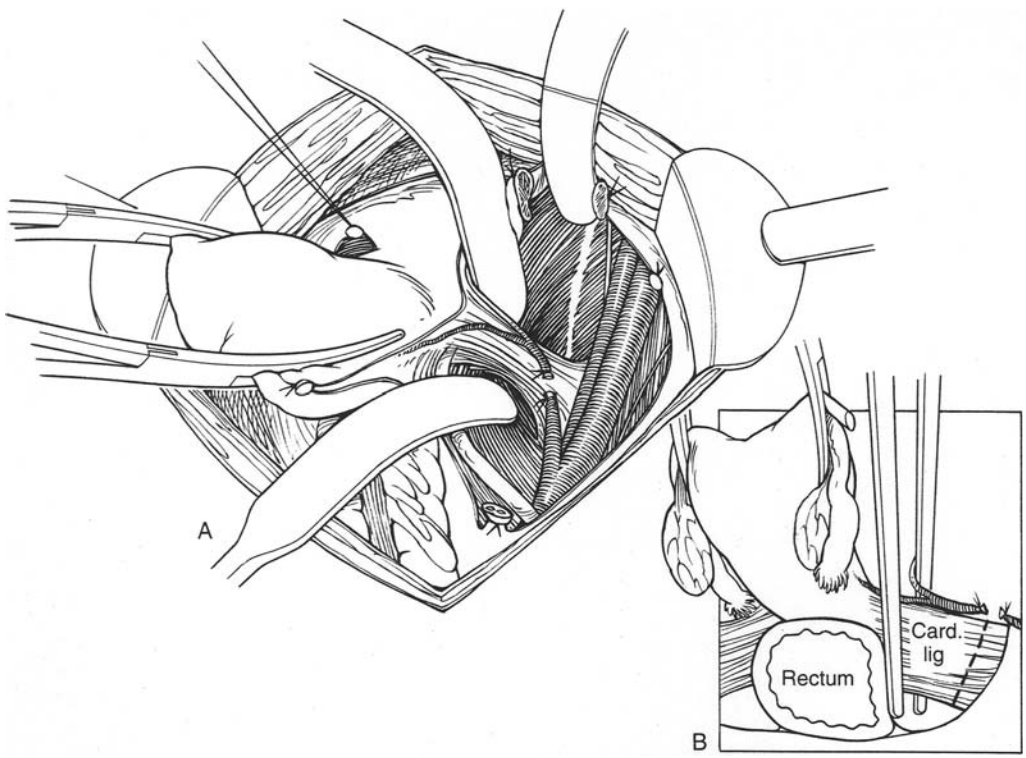

FIGURE 7.1 . Developing the spaces of the retroperitoneum. The paravesical and pararectal spaces can be visualized.

The pelvic lymph nodes can then be sampled and sent for frozen section. If all the nodes and biopsies are negative at this point, a decision can be made about the respectability of the tumor. If it is deemed resectable by the surgeon, the exenterative phase is begun. Leading up to this point of the procedure, nothing has committed the surgical team to exenteration. Contraindications would include evidence of gross or microscopic abdominal disease, positive periaortic lymph nodes, or the presence of malignant disease beyond possible surgical margins. The prognosis for patients with sidewall involvement has historically been quite poor, with 5-year survival ranging from 0% to 15%.[51] Recent advances in the use of electron beam intraoperative radiation therapy (IORT) have improved survival with better local control. Disease-specific survival has been shown to be 43% to 48% using IORT,[51,52] and it may provide long-term survival potential with patients previously thought to have a poor prognosis.

Hockel[53,54] in Germany has developed an alternative surgical salvage therapy in a subset of patients with sidewall involvement: the laterally extended endopelvic resection (LEER), which has been performed in patients who have mesenteric sidewall disease. Hockel feels that recurrent pelvic cancer fixed at the pelvic wall typically does not infiltrate the adjacent striated muscle. Accordingly, he was able to achieve a 5-year survival probability of 49%, although the patients median follow-up was only 20 months and the sample size was quite small—36 patients. The procedure is quite morbid and time-consuming, involving resection of the internal iliac vessel system, endopelvic portion of the obturator internus muscle and the coccygeus, iliococcygeus, and pubococcygeus muscles on the affected side. Mean operative time was 14.4 hours, with 3700 mL of blood loss.

Abdominal Exenterative Phase

Once the decision to proceed has been made, the selected procedure must be tailored to the individual patient. Total, anterior, or posterior exenteration depends on the involvement of the bladder, bowel, or constellation of the patient's symptoms. However, care must be taken to circumscribe the entire neoplasm. In most cases an en-bloc removal of the specimen is attempted. The medial leaf of the broad ligament is opened up to the pelvic brim if not already done so during the lymphadenectomy. The ureter is then dissected from the peritoneum and freed to allow the necessary length for reconstructive efforts. Once adequate length is obtained with respect to the planned conduit formation, the ureters are ligated and transected as distally as possible above the level of the neoplasm.

If the ovaries are still present, the infundibulopelvic ligaments are also isolated, clamped, ligated, and transected bilaterally. At this point the next vascular structure to be identified and ligated is the anterior division of the hypogastric artery. This is performed on both sides as well. A malleable retractor can then be placed in the paravesical and pararectal space to isolate the cardinal ligaments. Straight Heaney clamps can be used to develop pedicles successively to reach the levator ani muscle. The use of the Endo-GIA device (Autosuture, Norwalk, CT) has significantly improved efficiency and hemostasis in ligating these fibrovascular pedicles (Fig. 7.2). The use of this device and other staplers contributes to time conservation, and

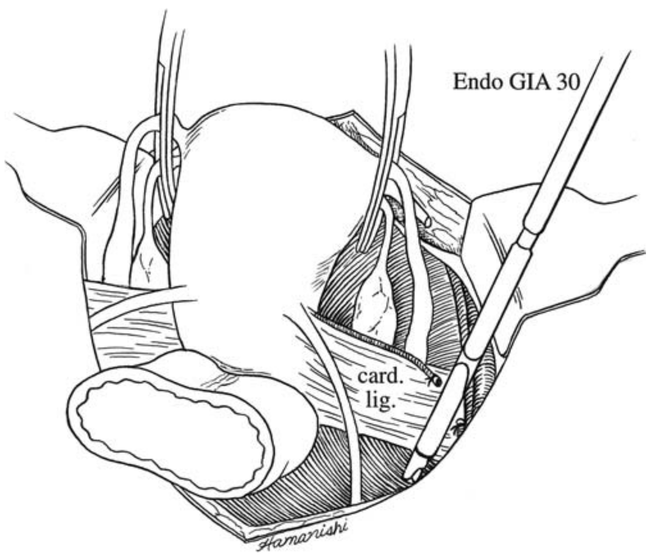

FIGURE 7.2. The Endo-GIA stapling device (Autosuture, Norwalk, CT) can be used to ligate these fibrovascular pedicles with improved hemostasis.

factors into the decreasing morbidity associated with this procedure.

The sigmoid colon mesentery should be identified several centimeters above the level of tumor involvement and then opened in a clear space. Any vessels of the sigmoid arcade and superior rectal vessels can be isolated and ligated as needed. Once a window in the mesentery is obtained, the GIA stapling device can be used to divide the sigmoid colon. The peritoneum of the sigmoid colon mesentery is incised. The arcade is preserved as much as possible to improve the blood flow to an anastomosis if performed. Historically, the vessels have been clamped, ligated with 3-0 silk suture, and transected. Increasingly, we are using the LigaSure (Valleylab, Boulder, CO) vessel sealing system for its improved hemostasis and time-conservation. The presacral free space is clearly identified in this fashion, and with blunt dissection the rectosigmoid colon can be freed to the level of the levator ani at the pelvic diaphragm.

Attention is then turned to the anterior in a total pelvic exenteration, and the bladder is freely mobilized from the retropubic space. Any lateral attachments to the bladder are transected, thereby connecting the paravesical space with the space of Retzius. Electrocautery is usually sufficient and effective in bladder mobilization. The decision-making at this point revolves around whether an adequate proximal margin can be obtained, and if so a supralevator exenteration can be performed. Magrina and associates[55] grouped exenterations into three classes: I, supralevator; II, infralevator; and III, with vulvectomy. They found no difference in morbidity or survival based on the type of exenteration. In supralevator exenteration a perineal phase is typically not required, and the rectum can be divided with a reticulating TA-55 device at the level of the levator ani. The EEA stapling device is typically used to complete the rectosigmoid reanastomosis 6 cm or more from the anal verge. This has been demonstrated to decrease the risk of anastomotic breakdown.[56] Some choose to reinforce the reanastomosis with additional sutures, and an omental J-flap can also be transposed to provide vascular support to the anastomosis. Patients who have had extensive irradiation or a difficult anastomosis may benefit from a protecting, diverting colostomy, although this is not necessary in all cases.

Perineal Exenterative Phase

If there is tumor extension distal to the levator sling, an infralevator resection with vulvectomy is typically required. A second surgical team is employed for this aspect of the procedure. The perineal incision is tailored to the individual patient, attempting to preserve as much of the vulva as possible while maintaining adequate surgical margins. The team in the abdominal cavity begins by dividing the levator ani muscle at the arcus tendineus. The second team proceeds cephalad, transecting and ligating the lateral attachments of the vagina to the level of the paravaginal space. If the anus is to be removed as in a total or posterior exenteration without reanastomosis, the dissection should proceed toward the coccyx incorporating the anococcygeal ligament until the presacral space is reached. In the case that the rectum is to be preserved for anastomosis, the focus is on developing the rectovaginal space, identifying the rectal pillars up to the level of preservation, and clamping and transecting them.

The urethral meatus is identified, and a subpubic dissection is similarly performed to free the specimen anteriorly in an anterior or total pelvic exenteration. The tissue pedicles are clamped and transected to the level of the space of Retzius. This circumferential approach is continued cephalad until the specimen is freed and can be delivered through the pelvis.

Reconstructive Phase: Conduit Formation

Reconstructive efforts post–pelvic exenteration can range from minimal to quite complex. The surgical teams similarly may range from gynecologic oncologists to urologists and plastic surgeons. Institutional differences and an individual surgeon's personal preference will dictate the level of reconstructive efforts undertaken by the primary team. It is important for the reconstructive efforts to be fully coordinated prior to the initial skin incision. The type of myocutaneous flap that is to be utilized may dictate the location of stomal placement, and it is important for the teams to outline the surgical plan pre- and perioperatively.

Once the exenterative phase is completed, urinary conduit formation is begun. The urinary conduit is widely regarded as a major advance in reconstructive surgery; however, it requires an additional external appliance for the patient to care for. The development of the continent urinary reservoir has improved patient quality of life and body image. The two types that are most commonly used are the continent ileal urostomy or Kock pouch,[25] and the ileocolic reservoir, Indiana,[26] and Miami[27] pouches. Kock developed the functionally continent ileal urostomy in 1969 by detubularized a segment of bowel. The bowel once detubularized a b c

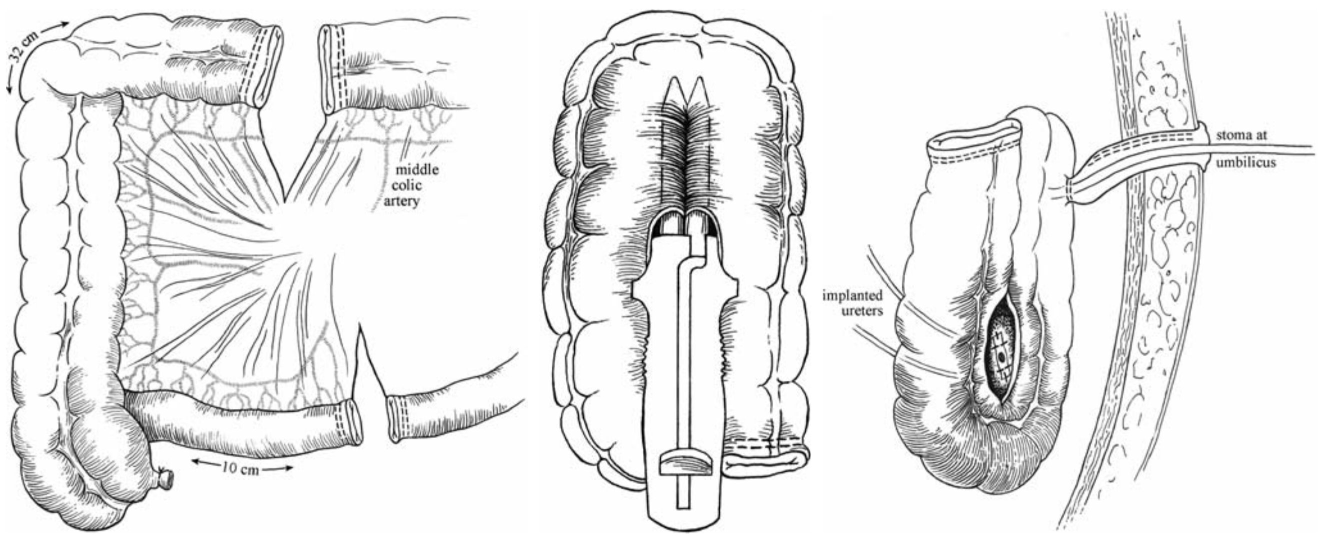

FIGURE 7.3. (**A**) Ten centimeters of distal ileum and the ascending and proximal transverse colon are isolated and mobilized. The appendix is removed, if present. (**B**) The 32-cm segment of colon is folded on itself in a U-shaped configuration. The PolyGIA device is fired from two small colotomies in the center of each colonic segment. The stapler is fired twice from the center toward each end of the reservoir, resulting in detubularization of the pouch. (**C**) In this transverse view of a nearly completed Miami pouch, the ureters have been implanted, and the efferent ileal segment has been tapered with the stoma matured at the umbilicus.

no longer was a high-pressure system as a result of peristaltic contractions. The intestine is split along the antimesenteric border, folded twice, and sewn back together. The discordant contractions now functionally cancel one another out, creating a new low-pressure reservoir (Fig. 7.3). He then utilized intussuscepted nipple valves to establish continence and prevent reflux. Unfortunately, the creation of these nipple valves is difficult and time-consuming. The average operative time for this procedure has been described to be approximately 3 hours. Additionally, the procedure sacrifices a significant length of small intestine, which may not be feasible in a previously irradiated patient.

The major advance in the Indiana pouch was the use of a patch of ileum to form a nontubular bowel segment and decrease the pressure in the cecal reservoir. In this conduit the ileocecal valve provides continence and is augmented by placation of the ileal lumen. The procedure was modified by the group at Miami, and this modification is the one most commonly used at this time. The first step is to isolate the right colon along with 10 to 15 cm of terminal ileum. The GIA staplers are used to transect the transverse colon and ileum, and they are anastomosed in the usual fashion. The isolated right colonic segment is opened along its entire length on the antimesenteric border with electrocautery. It is then folded in half, and then the back wall can either be sewn with a 3-0 running absorbable suture or stapled closed (Fig. 7.3). A simplified method for detubularization utilizing the GIA-80 absorbable suture stapler has been described as a means to preserve colon and improve efficiency.[57] The ureters can then be brought through the posterior wall of the pouch, spatulated, and sutured in place with fine absorbable suture. Ureteral stents are usually placed prior to reimplantation, either 8F Silastic pediatric feeding tubes or single-J stents, depending on the surgeon's preference.

The anterior aspect of the pouch can be closed with absorbable or delayed absorbable sutures. The terminal ileal segment is brought through the skin to become the stoma, and the ileum is tapered with the GIA stapler, increasing the pressure to improve continence. Two to three silk purse-string sutures are then used to imbricate the ileocecal valve, providing continence and preventing reflux into the ureters. The patient can then catheterize herself with a red rubber catheter as needed.

If the patient is not planning on having a continent diversion, sigmoid or ileal conduits can be fashioned depending on the fields of radiation and intraoperative assessment of radiation damage. It is important also to use an area of the ureter for anastomosis that is relatively unaffected by radiation. In an ileal conduit, the ureter usually needs to be tunneled through the bowel mesentery. Once the ureters are spatulated to the isolated bowel segment, the conduit is brought through the skin. A rosebud stoma is matured at the completion of the procedure in the usual fashion.

Continent urinary diversions are typically well tolerated, and although they tend to have greater complications, most are easily managed.[58] Given the improvements in surgical technique they can be safely offered to many patients. In fact 97% of patients would rather undergo reoperation to revise a reservoir rather than wear an appliance.[28]

Vaginal Reconstruction

Neovaginal reconstruction can be performed with either a vertical (VRAM) or transverse (TRAM) unilateral rectus abdominis myocutaneous flap. The decision is based primarily on surgeon preference and the patient's anatomy. The VRAM flaps require an ellipse of skin and adipose tissue that is 10 to 12 cm by 5 to 8 cm horizontally, and

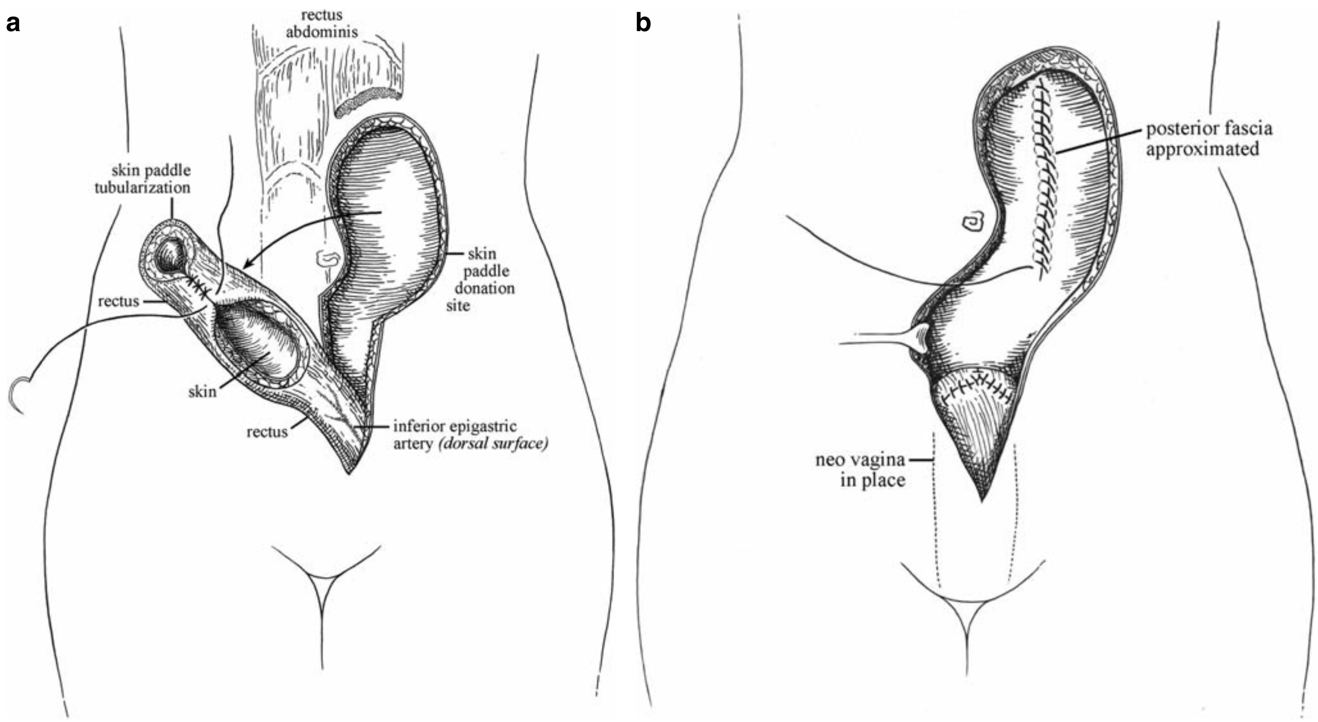

FIGURE 7.4. (**A**) Once the VRAM flap has been raised with a caudad pedicle, the skin island is tubularized. (**B**) After tubularization, the VRAM flap is rotated 180 degrees and delivered into the defect.

the TRAM flaps require 12 to 15 cm horizontally to 7 to 10 cm vertically[40] (Fig. 7.4). Mobilizing the skin island off the anterior fascia such that there is a smaller fascial defect is preferable, typically less than 5 cm. The rectus muscle is divided at the cephalad end, and dissected off the posterior sheath usually above the level of the arcuate line to preserve the posterior rectus fascia. At this stage it is advisable to loosely attach the fascia of the flap to its skin so that there is less shearing of the perforating vessels.

The muscles should then continue to be separated from the anterior and posterior sheath caudal to the pubic symphysis. The inferior epigastric vessel pedicle must be carefully preserved. Occasionally the vascular pedicle must be mobilized to allow the flap to be rotated into the pelvis, and it is important that there is no tension on the pedicle. The skin island is then folded and tubularized with absorbable suture. Once the flap is rotated into the pelvis, the distal end is sutured to the introitus. Additional sutures are employed to loosely connect the rectus to the levator plate. Jackson-Pratt closed suction drains are placed in the pelvis at the conclusion of the procedure prior to the fascial closure. An omental J-flap can help protect the rectosigmoid anastomotic site if present. A vertical mass closure of the anterior and posterior fascia is preferred, but synthetic mesh can be utilized if the donor-site defect cannot be closed primarily.

Postoperative Care

The improvements in surgical technique described above, such as the routine use of surgical staplers and better understanding of perioperative care, undoubtedly have contributed to the decline in surgical mortality and morbidity witnessed in pelvic exenteration. Regardless, the extensive blood loss and duration of surgery often necessitate admission to the intensive care unit for hemodynamic monitoring. The patients often require multiple skilled care, including drains, stomas, and total parenteral nutrition (TPN). The patients may have poor nutritional status as a result of their malignancy prior to admission, and TPN should be continued until there is adequate oral intake. The assistance of a registered dietician or nutrition consultant can be of great value.

Routine prophylactic measures include VTE prophylaxis with sequential compression devices and subcutaneous heparin or low-molecular weight heparin. Early ambulation is encouraged, as well as incentive spirometry. Prophylactic antibiotics are continued for 24 to 72 hours, and if there is contamination by bowel contents, broad-spectrum antibiotics for 5 to 7 days may be advisable. Antibiotic therapy should continue for the duration that the patient's ureteral stents remain in place.

The urinary and colostomy stomas should be assessed daily for perfusion status, and all continent urinary conduits are placed to suction drainage with saline flushes intermittently to prevent accumulation with mucus. The urinary diversion can be evaluated typically 2 weeks postoperatively with bilateral ureteral stentogram and pouchogram if continent diversion has been performed. If there is no evidence of dye extravasation, the stents can be removed at this time. Early postoperative involvement of an enterostomal therapist is beneficial in helping educate the patient about stomal care. Additionally, if the psychologist or sex therapist has seen the patient preoperatively as part of the multidisciplinary team, it can be helpful to have the therapist revisit the patient as discharge approaches.

Postoperative Complications

Morley et al.[4] described postoperative complications in 49 of 100 patients who underwent exenteration in their original series. Most series report complication rates ranging from 25% to 50%.[2,13,43,59] Morrow et al.[56] summarized the more frequently occurring complications: pelvic sepsis (10%), wound sepsis and dehiscence (12%), urinary fistula or obstruction (6%), intestinal leak (8%), small bowel obstruction (5%), pulmonary embolus (1.5%), and postoperative hemorrhage.[56] Soper and colleagues[60] observed gastrointestinal or genitourinary surgical complications in 38% of their patients, of whom 29% required reoperation for these complications. Factors associated with greater complication rate included previous irradiation and urinary diversion. The use of myocutaneous flaps has been associated with decreased postoperative morbidity.[61,62]

Goldberg and associates[3] in the most recent series reported febrile morbidity as the most common complication observed in 71% of patients. The second most common complication was urinary tract infection or pyelonephritis in 36%, and this complication was significantly more common in patients undergoing continent diversion. There was no difference in anastomotic leaks between patients undergoing ileal conduit diversion and those undergoing continent diversion. Finally, they noted four patients with postoperative deep venous thrombosis (DVT) and no pulmonary embolus, attributing this to present-day use of anticoagulant prophylactic therapies.

The complication rate associated with continent diversion has consistently been found to be elevated in relation to other forms of urinary conduits; the most frequent complications are obstruction, anastomotic leaks, ureteral stenosis, and stone formation.[3,58,63] However, Hartenbach and coworkers[28] at the University of Minnesota have demonstrated that nonsurgical management strategies can be effective, including balloon dilation of the ileocecal valve for stenosis, stomal dilation, ureteral stenting, and endoscopic lithotripsy for stone formation. Given the improved patient satisfaction observed and approaches to managing the complications, it is a worthwhile addition to reconstructive efforts in women undergoing pelvic exenteration.

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8 Reoperation for Bladder Cancer

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Bladder cancer remains a significant health problem, with 67,160 new cases expected in 2007.[1] Bladder cancer disproportionately affects men and persons greater than 65 years of age. This year 50,040 men and 17,120 women will be diagnosed; 9630 men and 4120 women will die from their disease.[1] Bladder cancer is a complex disease, imparting a wide range of cancer risk to patients, resulting in a wide spectrum of treatments. Nearly 70% of tumors present at an early stage[2] (Ta, Tis, or T1), the majority of which may be initially treated with transurethral resection with or without intravesical chemotherapy or immunotherapy depending on tumor and patient characteristics. Reoperation for early-stage bladder cancer generally results from complications from the endoscopic resection, covered fully in Chapter 17 of this text.

Muscle invasion of the bladder (≥T2) occurs in 20% to 25% of new cases of bladder cancer and puts the patient at significant risk for nodal and distant metastases accounting for the vast majority of cancer-specific deaths.[1,3,4] Standard treatment includes radical cystectomy with resection of neighboring organs depending on tumor extent and patient performance status. In high-risk patients, chemotherapy may be delivered in the neoadjuvant or adjuvant setting. A local treatment alternative to cystectomy is radical radiation with or without systemic chemotherapy. Reoperation in the setting of muscle invasive disease may be necessary to manage short and long-term complications of radical cystectomy and associated urinary diversion or if tumor recurrence develops.

Although the 90-day mortality of radical cystectomy has improved substantially, approaching 8%,[2] the combined short- and long-term morbidity is much higher at 30% to 50%.[5] Most complications are readily treated with supportive measures and observation. Still, in less than 2% to 3% of cases, patients may require operative intervention to treat postoperative bleeding, intestinal obstruction, and pelvic abscess potentially related to unrecognized intestinal injury or intestinal fistulas, which are all covered in this text. The urinary diversion may be complicated by intestinal anastomotic leak (Chapter 2), urinary fistulas (Chapter 16), perforation of the urinary pouch, ureteral stricture or leak, stomal stenosis or prolapse, peristomal hernia, or the development of urinary tract stones. Reoperation related to urinary diversion is covered in Chapter 17.

After cystectomy, the overall 10-year recurrence free survival is 59%, with urothelial recurrence (3%) seen less frequently than pelvic (9%) or distant (18%) recurrence.[3] Unlike the management of pelvic or distant recurrence, treated primarily with systemic chemotherapy, the approach to urothelial recurrence is largely surgical, depending on the extent of disease. This chapter focuses on reoperation for bladder cancer after radical cystectomy, with specific attention to the management of urothelial recurrence.

Nephroureterectomy for Upper Tract Recurrence After Cystectomy

Although radical cystectomy is a well-established and effective treatment for transitional cell carcinoma (TCC) of the bladder, urothelial carcinoma is often multifocal and upper tract recurrences (UTRs) can occur in 2% to 8% of cases.[6–8] Patients with UTR may present with a variety of symptoms, including gross hematuria, flank pain, filling defects on upper tract imaging, and, less frequently, pyelonephritis and weight loss. The majority of relapses occur within 22 to 40 months after cystectomy.[6–9]

In an effort to identify early-stage, potentially curable UTR, surveillance strategies have been developed that include patient history, physical examination, serum chemistries, abdominal and upper tract imaging, and urinary cytology obtained from voided specimens in patients with orthotopic diversion and stomal specimens in patients with cutaneous diversions.[10] The frequency of surveillance is dictated by the patient risk, primarily determined by pathologic staging. If UTR is detected, the treatment option is largely surgical, although systemic chemotherapy may be required for tumors with nodal or distant metastatic spread. This section reviews surveillance modalities, risk factors, and treatment strategies and outcomes of individuals with UTR. A detailed operative description of open nephroureterectomy, still considered the gold standard for treatment of UTR, is also included.

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Surveillance

Upper tract surveillance strategies after cystectomy aim to detect tumor recurrence and complications of the urinary diversion. Although several surveillance strategies have been proposed, a stage-specific approach is generally followed. Upper tract imaging, urine cytology, and history and physical examination are performed at regular intervals with higher stage patients evaluated more frequently, particularly in the initial 2 years after cystectomy.[11,12] Using this approach, Balaji et al.[6] identified over 40% of patients with UTR after cystectomy, including three of seven asymptomatic patients diagnosed with imaging and four of seven with urinary cytology. Huguet-Perez et al.[7] identified 55% of UTRs in a similar population of patients. Although these studies demonstrate the importance of postcystectomy surveillance, UTR may still elude these surveillance efforts, remaining undetectable until patient signs or symptoms develop.[13]

Traditionally, intravenous pyelography (IVP) has been the primary imaging modality for upper tract surveillance, providing 71% to 85% sensitivity in cancer detection.[14] Evidence of TCC is typically demonstrated as filling defects identified after urinary excretion of intravenous contrast material (Fig. 8.1). However, the specificity of IVP is low since filling defects are nonspecific and are poorly visualized in the setting of obstruction or compromised renal function resulting in poor excretion.[15] Recent technologic advances in computed tomography (CT) imaging have provided a high-quality alternative to the IVP. The CT urogram provides high spatial resolution of the upper tracts and a more detailed examination of the renal parenchyma and collecting system, identifying ureteral thickening, hydronephrosis, and tumor extension beyond the urinary tract.[14,15] Its increased sensitivity (86–90%) in detecting upper tract disease, even in the setting of a nonfunctioning or obstructed kidney, has made it the diagnostic test of choice.

Magnetic resonance imaging (MRI) urography is actively under investigation as an alternative to CT for those patients with contrast allergies or poor renal function.[10] This modality offers multiplanar imaging capacities and intrinsic high soft tissue contrast for dynamic tumor contouring and delineation of soft tissue relationships (Fig. 8.2). Coronal and three-dimensional images with gadolinium contrast are particularly useful for dynamic assessment of the renal vasculature in arterial and venous phases and of the renal parenchyma during corticomedullary and nephrographic phases. MRI can also reveal extraparenchymal tumor invasion and distant metastasis. However, due to the susceptibility of MRI to artifact, lower spatial resolution, and inability to detect urinary tract calcifications, calculi, and air, CT remains the first-line imaging tool for upper tract tumors in those patients without contraindications to intravenous contrast material.[15]

On the whole, upper tract monitoring detects 38% to 56% of all UTRs in asymptomatic patients,[8,10,16–18] and although the use of imaging has not been explicitly demonstrated to decrease mortality, many continue to use routine surveillance imaging based on reported cancer

FIGURE 8.1. Transitional cell carcinoma in a right lower pole calyx (*arrow*). (From Browne RF, Meehan CP, Colville J, et al. Transitional cell carcinoma of the upper urinary tract: spectrum of imaging findings. RadioGraphics. 2005;25(6):1609–27, by permission of Radiological Society of North America.)

FIGURE 8.2. Polypoid enhancing mass in the posterior aspect of the middle left renal pelvis with marked peripelvic wall thickening on T2-weighted imaging, suspicious for transitional cell carcinoma. (Courtesy of University of Michigan, Ann Arbor).

detection rates. Ureteroscopy and biopsy are ultimately used to confirm UTR, though upper tract access in the setting of prior ureterointestinal anastomosis may be challenging since it can be difficult to locate the ureteral orifice, and ureteral angulation may impede scope advancement.

Nonradiographic adjuncts to patient monitoring are an important part of surveillance. Fifty to eighty percent of patients with UTR present primarily with hematuria, other physical symptoms, or a positive urinary cytology, despite periodic imaging.[6,7,9] The use of urine cytology as a screening tool is well established. In small observational studies, cytology has detected UTRs in 57% to 80% of patients.[1,19] Although urine cytology has a high specificity of 72% to 95%, it suffers from a low sensitivity of 28% to 60%, which varies widely depending on tumor grade.[6,14,20] The sensitivity for high-grade cancers is greater (70–100%) than for low grade tumors (40%).[21] Moreover, accuracy increases when the specimen is collected directly from the upper tract by brushing or by passive collection of urine from the ureter, since these specimens often contain sloughed papillary fragments of tumor rarely found in voided urine.[22] While urine cytology is nearly always incorporated into the surveillance plan for UTR, its limited sensitivity has led to the utilization of other diagnostic tests.

Of the available urinary assays developed to detect urothelial carcinoma, the NMP22 (Matritech, Inc., Newton, MA) and fluorescent in situ hybridization (FISH; UroVysion Kit, Abbott Molecular Inc., Des Plaines, IL) assays have been most promising in detecting recurrent bladder cancer. The NMP22 test is a quantitative enzyme-linked immunosorbent assay (ELISA) that measures elevated amounts of nuclear mitosis apparatus protein in urine. These nuclear matrix proteins (NMPs) comprise portions of the nuclear structure, organize chromatin, regulate critical aspects of mitosis, and are released into the urine during cell death. Levels of NMP are elevated in patients with active TCC of the bladder.[19,23] The sensitivity and specificity (57% and 90%, respectively) compare favorably to the sensitivity (42.9%) and specificity (93.2%) of urine cytology.[24] In a prospective study of 668 patients by Grossman et al.,[23] the combination of cystoscopy and the NMP22 assay detected 99% of recurrent bladder cancers versus 91.3% with cystoscopy alone. In addition to improving sensitivity and detection rates, NMP22 has the advantage of providing quick results at a low cost, as a point-of-service office-based test.

The urinary FISH test uses fluorescently labeled centromeric and locus-specific DNA probes to detect chromosomal abnormalities in exfoliated cells in the urine, specifically looking at chromosomes 17, 3, 7, and all 9p21 aberrations. The specificity is generally high (70–96%) and rivals that of urine cytology.[25,26] The sensitivity for Ta tumors is 65%, for Tis is 100%, and for T1 to T4 is 95%. This technique is much more sensitive for detecting invasive disease, as nearly all tumors ≥T1 have multiple chromosomal alterations. FISH may also allow for earlier detection of tumors in certain cases when the urine cytology is still negative.[26,27]

Risk Factors

To optimize surveillance, identification of individuals at higher risk for recurrence is necessary. Several clinicopathologic factors have been identified as risk factors for UTR, including associated carcinoma in situ (CIS) and tumor involvement of the distal ureter or prostatic urethra.[7–9,28] In a retrospective study of 235 patients treated with radical cystectomy for bladder cancer, five (2%) suffered UTR after a median follow-up of 42 months.[9] Three of the five patients had prostatic urethral involvement ($p \leq .01$), making this the only significant variable associated with UTR. In this cohort, bladder CIS and distal ureteric TCC were not predictors of UTR, likely due to a small sample size, limited statistical power, and a very small number of events. Nonetheless, these factors have been reportedly relevant in other studies. In a case series of 430 patients, Kenworthy et al.[8] reported a significant association between UTR and CIS in the distal and intramural ureter, while Balaji et al.[6] demonstrated a 63% rate of CIS in patients with UTR in their review of 529 patients, which included 16 patients with recurrence in the renal pelvis or ureter. Both studies support the importance of CIS as a risk factor for UTR.

A prior history of superficial TCC in patients who undergo cystectomy may also be an important risk factor for UTR. Huguet-Perez et al.[7] retrospectively analyzed the tumor and recurrence characteristics of 568 patients treated with radical cystectomy for bladder cancer. Patients were followed at least 5 years or until death. Of the 26 (4.4%) patients who developed UTR, 20 had a prior history of "superficial" disease (defined as Ta, Tis, T1), versus only six who had primary muscle invasive TCC. Overall, nine of 77 (11.7%) patients with primary invasive disease and a component of "superficial" disease experienced recurrence, compared to six of 392 (1.5%) patients with primary muscle invasive cancer alone. The authors concluded that patients with a prior history of "superficial" TCC had a higher rate of UTR, and should be monitored carefully with annual radiographic imaging to detect future UTR. Neither pathologic stage nor tumor multiplicity were implicated as risk factors for recurrent disease in this study or in other series reported by Kenworthy et al.[8] and Balaji et al.[6]

Other factors independent of tumor histology may also influence UTR. Environmental exposures, specifically smoking, have been linked to urothelial recurrence. In a retrospective review of 286 smokers, ex-smokers, and quitters, Fleshner and colleagues[29] observed that continued smoking was associated with a diminished time to recurrence (relative risk 1.40; 95% confidence interval [CI], 1.03–1.91), with smokers recurring at a median time of 8.9 months vs. 13 and 12 months for quitters and ex-smokers, respectively. Additionally, continued smokers exhibited diminished survival free of adverse events (defined as progression development of or other urinary tract TCCs) on univariate analysis ($p = .009$), and this trended toward significance on multivariate analysis ($p = .06$).

Treatment

When considering options for management of UTR, it is important to consider patient comorbidities and preference in selecting the optimal method of treatment. Historically, all UTR of the ureter and renal pelvis was treated with open nephroureterectomy.[30] However, minimally invasive and organ-preserving surgical techniques have achieved broad acceptance, providing a diverse range of treatments for patients. Factors such as tumor size, grade, stage, and multifocality become paramount in decision-making, and organ preservation is possible for those patients with solitary kidneys or bilateral disease.[10] Stage, however, remains the most important prognostic factor in upper tract disease, and therefore one of the most important variables influencing treatment decisions.[14,31]

Nephron-Sparing Techniques

For selected patients with compromised or threatened renal function or bilateral UTR, nephron-sparing management may be employed to avoid the morbidity and mortality of renal dialysis. Endoscopic treatment with fulguration and laser ablation can be effective against primary low-grade, noninvasive upper tract tumors, though it is used less often for UTR after cystectomy due to difficult access of the ureteral orifice and poor working visibility associated with smaller endoscopic channels.[10] In experienced hands, though, this approach is feasible.[32]

Technical limitations of ureteroscopy have prompted the use of percutaneous nephroscopic approaches to upper tract tumors, permitting larger working channels and often improved resection capability compared to ureteroscopic management.[32] However, when utilizing this approach, seeding of the nephrostomy tract is a potential risk and must be considered. Moreover, given the overall tumor progression rates of 20% to 55%[33] after percutaneous therapies, these treatments should be reserved for patients with low-grade noninvasive tumors, the operably ineligible, or those who refuse nephroureterectomy.

Percutaneous upper tract chemotherapy or immunotherapy is another conservative therapeutic option for patients seeking organ preservation. Thalmann et al.[34] evaluated 37 operably ineligible patients with UTR treated with weekly bacillus Calmette-Guérin (BCG) via antegrade instillation through a nephrostomy tube for 6 weeks. The median overall survival was 42 months, median recurrence-free survival was 21 months, and progression-free survival was 34 months. Forty-eight percent of patients treated for upper tract CIS had no sign of disease recurrence within the follow-up time. For papillary and solid tumors, 87% of the patients undergoing adjuvant BCG therapy had recurrence or progression within 10 months, suggesting that BCG therapy could not prevent these specific recurrences. Only one patient with preexisting severe renal insufficiency ultimately required dialysis. Complications included BCG inflammation in one patient and septicemia in two; there were no episodes of tumor seeding of the percutaneous tract. Thus, antegrade BCG therapy is a feasible option in selected patients with CIS of the upper urinary tract.

Segmental resection or total ureterectomy with ileal interposition are alternative nephron-sparing options for patients with tumors limited to the ureter. In the optimal setting, disease should be low grade and of a sufficiently low volume to permit adequate surgical margins. Furthermore, the existing diversion must be amenable to augmentation and there must be available bowel access for interposition. There is an increased risk of metabolic complications resulting from the use of additional bowel segments as well as continued risk of renal pelvic recurrence. Thus, this therapeutic option has significant limitations and is not the treatment of choice for most patients. Partial nephrectomy represents another conservative surgical option, though this can be associated with tumor spillage and incomplete resection, again making this a less favorable option reserved for patients with a solitary kidney.

Open Nephroureterectomy

Open nephroureterectomy remains the standard treatment for UTR after primary radical cystectomy in patients with organ-confined, high-grade disease.[10] Although laparoscopic nephroureterectomy has become the standard approach for primary upper tract disease, reducing morbidity and recovery time,[35,36] UTR after cystectomy generally necessitates open nephroureterectomy due to the technical challenges posed by fibrosis.

Operative Technique: Open Nephroureterectomy After Radical Cystectomy and Ileal Conduit Diversion

Open nephroureterectomy for UTR after cystectomy is complicated by the degree of scarring generated from prior open surgery. This is primarily encountered during the distal ureteral dissection, but can also be met during the dissection surrounding the kidney at sites of prior percutaneous surgery or in patients surveyed with repeated and recent ureteroscopy. In planning for surgery, a bowel preparation is self-administered by the patient on the eve of the procedure. Intravenous antibiotics are administered prior to anesthetic induction. An orogastric tube is placed for optimal gastric decompression. Urinary collection and monitoring is facilitated by the placement of a drainage catheter in the urinary diversion loop (Fig. 8.3 inset). Oftentimes, there may be an existing preoperative ureteral stent placed on the affected side, which will also aid in ureteral identification and dissection.

The patient is placed in a supine position with a roll or bump placed under the side of recurrence (Fig. 8.3). All pressure points should be adequately padded with rolls or foam. The table is flexed to further open the retroperitoneal space. Patient positioning may vary with the type of diversion, site of recurrence, and patient habitus. For example, in a thinner patient with a right-sided recurrence, the patient can be positioned to provide access to both the upper tract and urinary diversion through one incision (Fig. 8.3A). Conversely, a left-sided recurrence nearly always requires two separate incisions to access the upper tract and ileal conduit (Fig. 8.3B). One lengthy incision from the flank to the

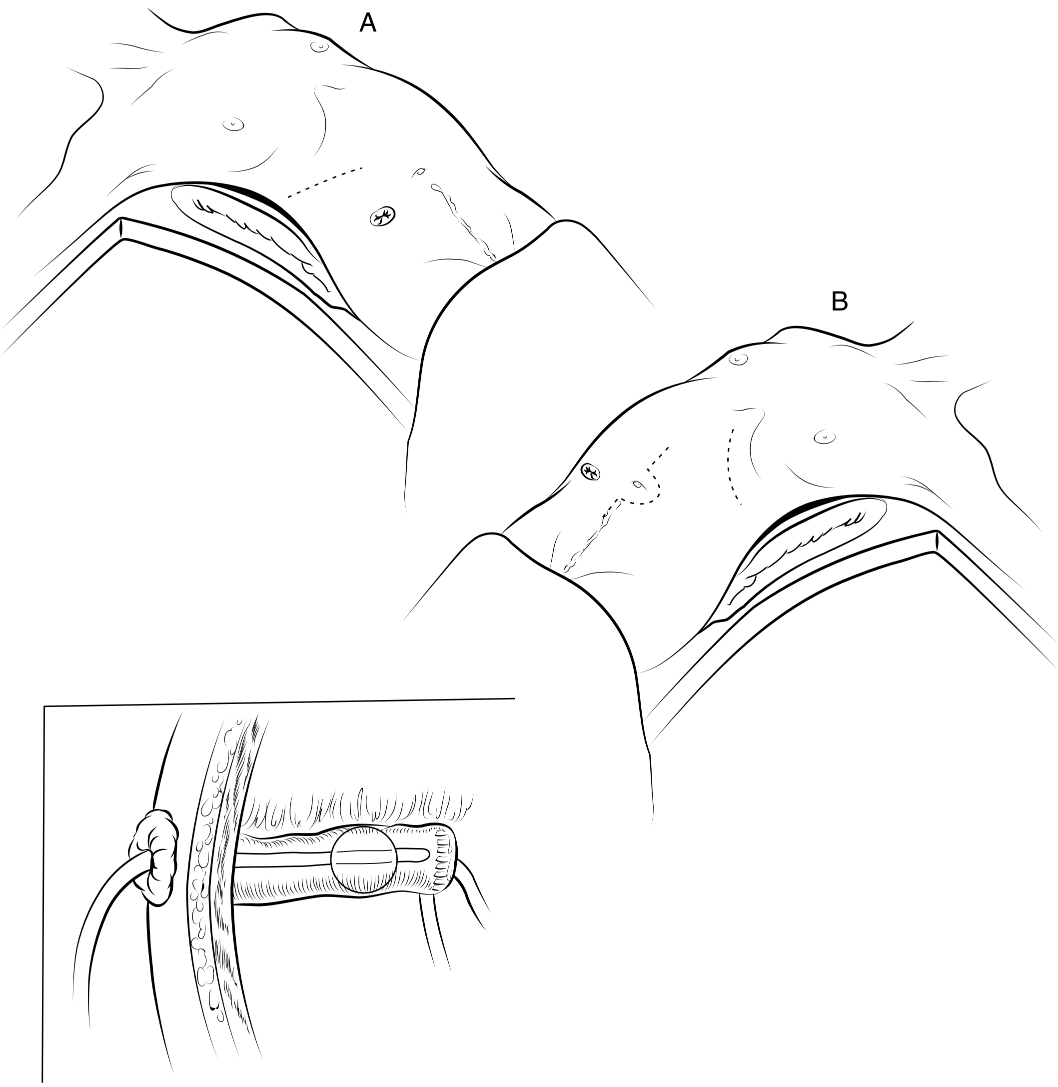

FIGURE 8.3. (**A**) Right-sided approach in patient with ileal conduit; the modified flank incision extends anteriorly from the 11th rib. (B) Left-sided approach in patient with ileal conduit; the two incisions include a subcostal and vertical midline incision extending the prior cystectomy incision. Inset: A catheter is inserted into the stoma to facilitate identification of the ileal loop and to collect urine.

infraumbilical midline is an alternative, though in the author's experience, patients have a more expedient recovery with the two-incision approach. In patients with orthotopic diversion, the ureteral anastomoses will often be encountered lower in the pelvis, unless a chimney was created initially, in which case dissection of the ureters from the superior aspect of the chimney can mimic that of an ileal conduit.

The patient is prepped and draped from the nipples to the pubic symphysis. A left subcostal incision is made and the peritoneum is entered. The lateral peritoneum is incised and the colon is mobilized medially (Fig. 8.4), exposing Gerota's fascia. The Buchwalter retractor is essential for optimal exposure and is placed to facilitate mobilization of the kidney and isolation of hilar vessels.

The colon is retracted superomedially in order to further develop an avascular plane between the posterior peritoneum and Gerota's fascia (Fig. 8.5). The kidney is then mobilized. Fibrosis can be encountered during the dissection of the perirenal tissues if the patient has had a percutaneous nephrostomy tube, multiple ureteroscopic interventions, indwelling ureteral stents, or prior upper tract therapy such as BCG. A previous percutaneous nephrostomy tube can additionally be associated with a fibrous tract commonly located at the superolateral kidney, generally requiring sharp division (Fig. 8.6).

The inferior pole of the kidney is freed of fibrofatty attachments, and the ureter is isolated and encircled with a vessel loop. Previous ureteral procedures may have left portions of the ureter encased in thick inflammatory tissue. The superior aspect of the kidney is mobilized further, with care to spare the adrenal gland unless a sizable upper pole tumor exists. Perforating vessels near the adrenal fat are controlled with cautery or hemoclips.

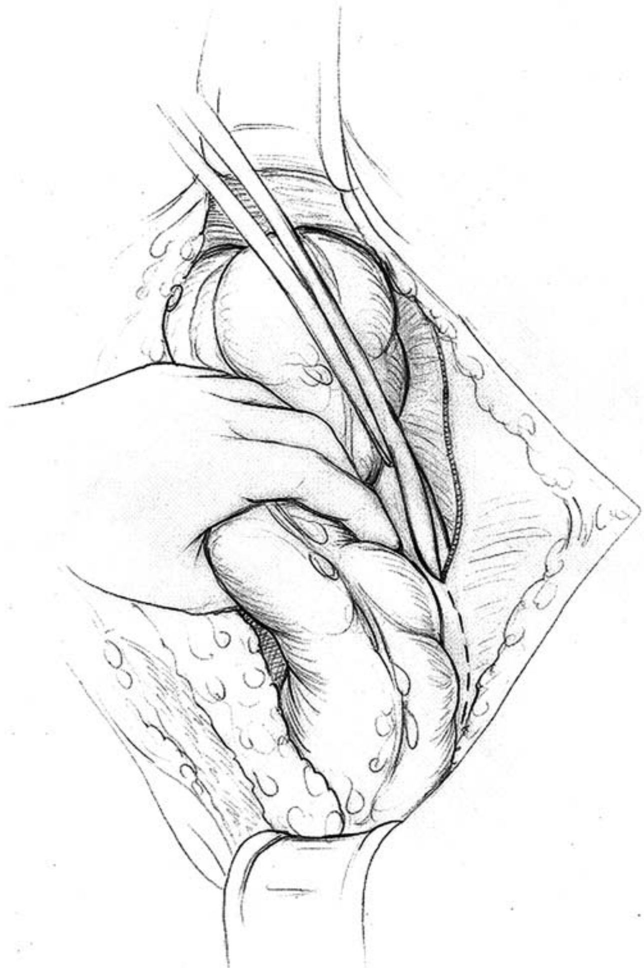

FIGURE 8.4. In preparation for left nephroureterectomy, the lateral peritoneum is incised and the colon is mobilized medially to expose the kidney.

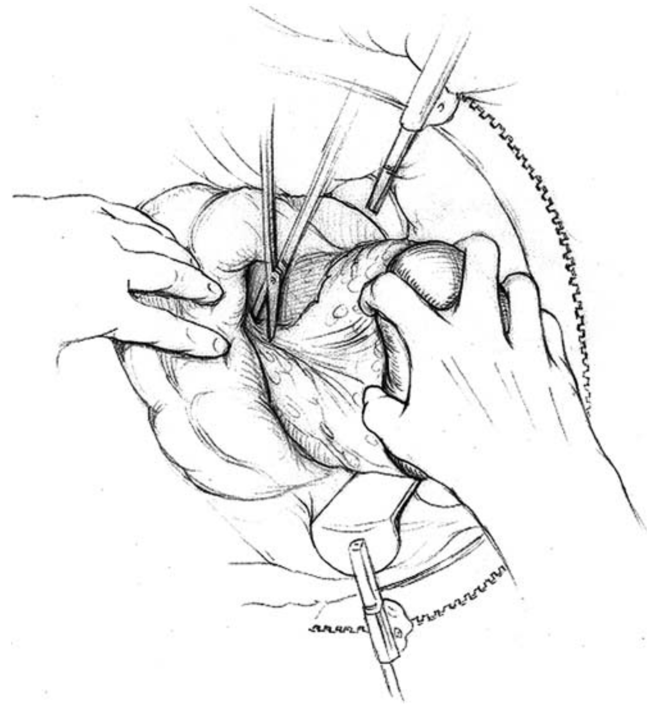

FIGURE 8.5. After obtaining adequate exposure with a self-retaining retractor, the posterior peritoneum is sharply mobilized to expose Gerota's fascia. In the figure, lateral countertraction is placed on the kidney to facilitate dissection.

The gonadal vein is identified and traced upward toward the left renal vein (left-sided tumor) or the vena cava (right-sided tumor), where it is doubly ligated and divided. During a left-sided procedure, the adrenal and lumbar veins will also require ligation in order to provide optimal vascular control. Attention is turned to the hilum to identify the main renal vessels. The renal artery and any large branches are identified, ligated with silk ties, and divided (Fig. 8.7). It is important to identify any secondary renal artery branches before dividing the renal vein. On the right, the artery may be approached anteriorly, though a large tumor may necessitate an interaortocaval approach. Attention is then turned toward ligation of the renal vein, which is doubly ligated and divided with silk ties. The remaining perirenal and pararenal soft tissue attachments are divided to allow the kidney to be elevated from the wound. The only remaining attachment is the ureter. At this point, indigo carmine can be given by the anesthesiologist to facilitate later identification of potential urinary leakage from the contralateral ureter.

The ureter is identified and dissected down to its entrance posterior to the left lateral border of sigmoid mesentery (Fig. 8.8). A combination of sharp dissection, cautery, and hemostatic clips facilitate this dissection. Distal mobilization of the left ureter can be challenging due to dense scarring from previous tunneling beneath the sigmoid mesentery into the right retroperitoneal space. As the dissection approaches the mesentery, the retractors will need to be adjusted for improved exposure. A periumbilical incision is made to gain access to the ileal conduit and the right retroperitoneal space (Fig. 8.3B); the peritoneum is entered carefully. At this point, multiple adhesions will be encountered given the prior cystectomy, and these are taken down sharply. The indwelling Foley catheter within the ileal conduit can be useful in directing the surgeon to the butt end of the loop and the ureteral anastomoses. Careful sharp dissection is then required to fully mobilize the retromesenteric segment of ureter as it traverses anterior to the common iliac vessels into the right retroperitoneal space, finally entering the butt of the conduit.

Even during a right-sided dissection, it is important to identify both ureters, as they are often implanted into the diversion in close proximity (Fig. 8.9). Sharp dissection of the ureter of interest is used to perform ureterolysis from surrounding substantial fibrosis, paying specific attention to leave an adequate amount of periureteral adventitia. A stent placed preoperatively can aid in identification of the ureter. A clip is placed across the distal ureter to avoid extravasation of residual urine when the ureter is ligated. The ureter is then dissected out with a small surrounding cuff of ileum, and the entire kidney and ureter are removed as one specimen. The defect in the ileal mucosa is then closed with interrupted 3-0 Vicryl sutures (Fig. 8.9, inset).

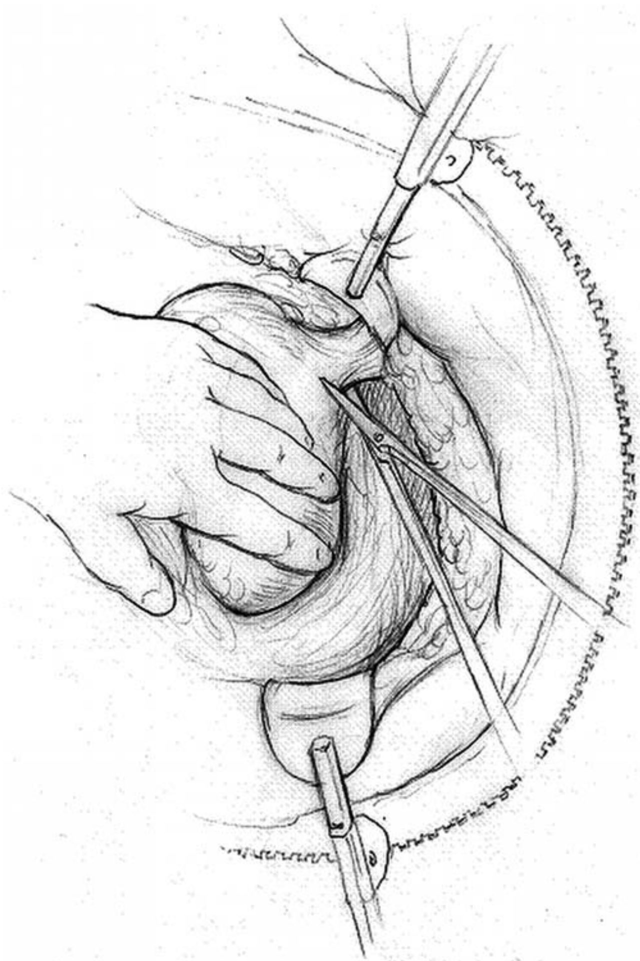

FIGURE 8.6. During posterolateral dissection, a fibrous tract is often encountered after previous percutaneous intervention. The tract is divided sharply.

The wound is irrigated copiously, and careful inspection is made to identify any injuries to the bowel or contralateral ureter, noting extrusion of indigo carmine. A Jackson-Pratt drain is placed to identify and manage a potential postoperative urinary leak.

Complications

In general, the surgical treatment of UTR is associated with a low risk of early surgical complications. Recently, Roupret and colleagues[32] compared three approaches—open nephroureterectomy, ureteroscopic therapies, and percutaneous treatments—to primary upper tract tumors. Complications occurred in eight of 54 (14.8%) patients undergoing nephroureterectomy; three (6%) had hemorrhage requiring transfusion and five (9%) developed renal failure. Ureteroscopic procedures resulted in complications in three of 27 (11%) patients; two (7%) had ureteral perforation and one (4%) experienced significant bleeding. Of those undergoing percutaneous procedures, two of 16 (13%) suffered complications; one (6%) involved a colon injury and one (6%)

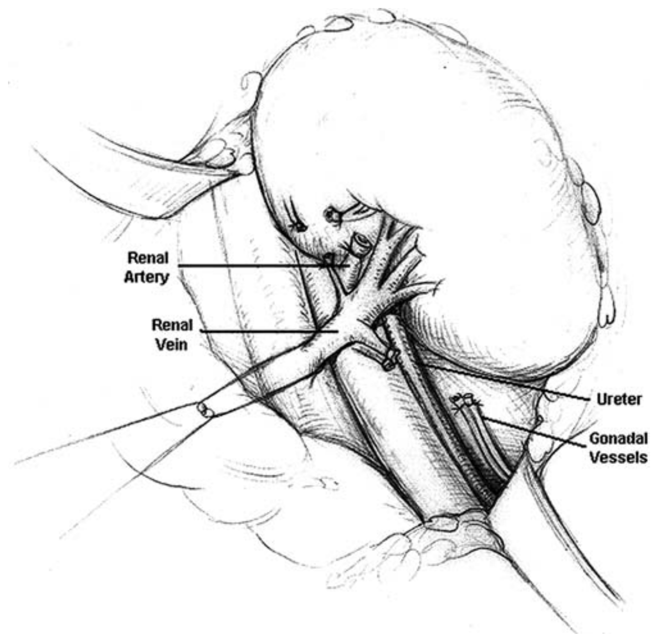

FIGURE 8.7. Renal hilum. As illustrated, the renal artery, adrenal vein, and gonadal vessels have been ligated. The ureter has been isolated, and the renal vein is encircled with a vessel loop.

involved bleeding requiring transfusion. Other small studies have estimated major complication rates after open nephroureterectomy between 7.3% and 27%.[37,38]

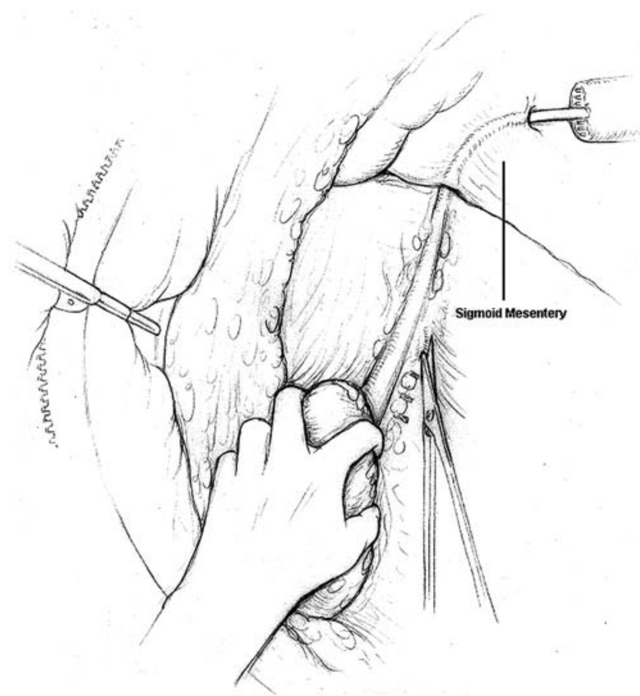

FIGURE 8.8. Cephalad-to-caudad view: dissection of the left ureter from surrounding fibrotic tissue after nephrectomy. The left ureter is sharply dissected to the level of the sigmoid mesentery.

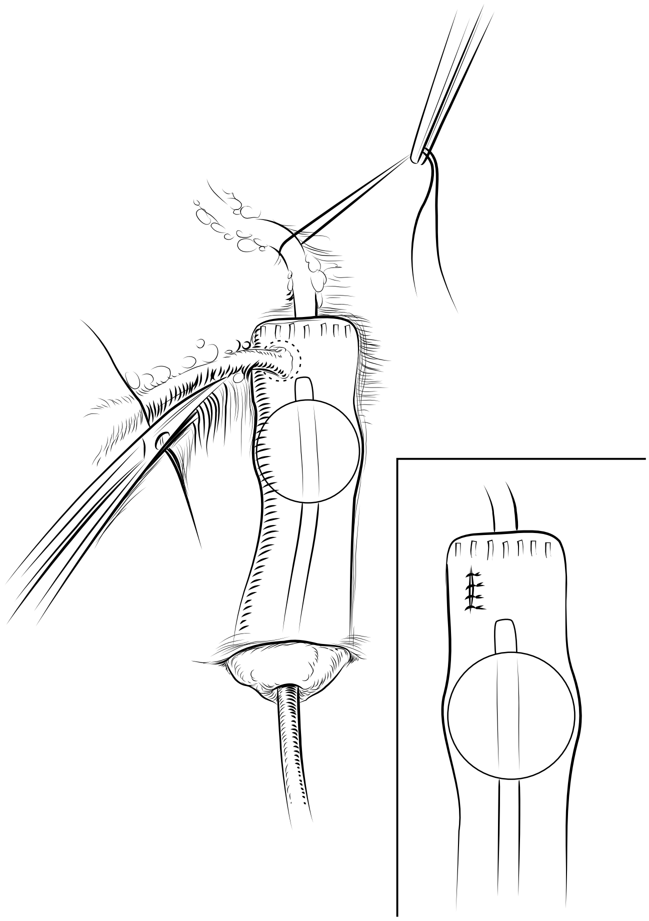

FIGURE 8.9. Sharp dissection of the distal ureter at the butt end of the loop, with a small cuff of ileum excised (*dashed line*). The contralateral ureter should be identified (*inset*). Closure of the ileal conduit after nephroureterectomy with fine absorbable sutures.

In the setting of UTR, additional complications may occur depending on the complexity of the initial urinary diversion, the degree of adhesion and fibrosis encountered, and the general medical condition of the patient. Wound infection and dehiscence occur more frequently in the repeat midline incision, and unidentified bowel or ureteral injury is certainly possible in the field of prior surgery. As patients have planned bowel preparations, a small intraoperative injury to the bowel can almost always be repaired primarily. Depending on the tumor size, injuries to the pancreas and spleen can occur on the left and may require partial or total removal of the affected organ, respectively. Liver injuries can generally be managed conservatively. It is prudent to involve consulting surgical services for complex repairs.

Survival Outcomes

Survival from UTR is largely dependent on tumor stage. Although patients with primary tumors of the upper tract enjoy an overall 75% 5-year disease-specific survival,[39] those with UTR after cystectomy have a much less favorable prognosis. Patients undergoing nephroureterectomy have a median survival of 10 to 26 months,[6,8] while surgically inoperable patients survive a median of only 3 months. Because of the small number of patients with UTR, clinical outcomes have been reported in case series, most with fewer than 25 patients.[6,28,40] Observations from these series demonstrate death from UTR in 69% to 100% of patients within 30 months of diagnosis. We appreciate the limitations of these observations, yet the findings cannot be ignored. In the study by Zincke et al.,[40] only three of 14 patients with UTR were alive after 5 years of follow-up; all had stage I disease. In the Memorial Sloan Kettering series, 12 patients with UTR underwent open surgical therapy; seven (58%) had locally advanced disease (≥pT3a with or without lymph node involvement).[5] Overall prognosis for these patients is poor. Improved survival outcomes require diagnosis of UTR at an early stage, supporting the concept of rigorous surveillance of high-risk patients.

Urethrectomy for Urethral Recurrence After Cystectomy

The incidence of urethral recurrence after radical cystectomy ranges from 7% to 10%,[17,41,42] while the incidence of concomitant urethral malignancy at the time of radical cystectomy varies from 1.2% to 4%.[43–45] Although case series have reported urethral recurrences 10 to 15 years after cystectomy,[46] most occur within the first 3 years.[16,31,47] Like UTR, successful management of urethral recurrence requires detection of early-stage tumors. Risk stratification permits intensive surveillance in high-risk patients and relaxed surveillance in others.

Historically, the management of high-risk patients was controversial, with advocates for prophylactic urethrectomy at the time of cystectomy debating those in favor of delayed urethrectomy performed after evidence of truly recurrent urethral tumor. In contemporary patients, the prophylactic urethrectomy has largely been abandoned to avoid overtreatment of a majority of patients who would never suffer recurrence. This approach necessitates adequate surveillance and cancer detection strategies with effective salvage treatment options for tumors that evade surveillance. Unfortunately, treatment of locally advanced urethral recurrence is often complex, requiring a multidisciplinary approach. In this section, risk factors, surveillance and management of urethral recurrence are described, along with a detailed operative summary for total urethrectomy after radical cystectomy in men.

Presentation

In the postcystectomy patient, recurrence in the retained urethra portends a poor prognosis when a symptomatic presentation is observed, such as urethral bleeding or a painful mass.[16] Other worrisome symptoms include urethral drainage, urinary retention, gross hematuria, and low pelvic or penile pain. In patients with orthotopic diversion, a change in voiding habits may also occur.

Although the majority of patients present with symptoms, a significant proportion will be identified by urethral wash cytology. Clark et al.[16] retrospectively examined 1054 patients who underwent radical cystectomy; 47 (4%) patients had a urethral recurrence. Symptomatic recurrence was observed in 24 of 42 (57%) evaluable patients; 21 had bloody discharge and seven had pain or a palpable mass. Four patients with an orthotopic neobladder presented with a change in voiding pattern. Thirteen (31%) patients were entirely asymptomatic with recurrence detected by an abnormal cytology.

Risk Factors

Several risk factors for urethral recurrence have been identified to better define the indications and timing of urethrectomy. Tobisu et al.[48] investigated 169 male patients who underwent cystectomy; 18 (10.7%) experienced a urethral recurrence. In a multivariate analysis, significant risk factors associated with urethral recurrence included papillary disease ($p < .01$), multiple tumors ($p < .05$), and tumors at the bladder neck ($p < .01$), prostatic urethra ($p < .01$), and prostate gland ($p < .01$). The risk of urethral recurrence more than doubled with each additional risk factor. Other studies have identified the greatest risk factor as prostatic involvement, which portends a 12% to 37% risk for urethral recurrence, compared to a 1.5% to 6% risk in patients without prostatic involvement.[39,41,44,49] Prostatic stromal invasion is clearly more ominous than either ductal or mucosal involvement.[17,49] Stromal invasion is associated with the highest risk of urethral recurrence (21–64%), while patients with ductal extension experience a 10% to 25% risk. Those with superficial prostatic urethral involvement experience only a minimal increase in risk of recurrence over those with no prostatic involvement of TCC.[39,44,49]

The presence of CIS in the bladder may also be a risk factor for urethral recurrence, though an overall low incidence (3–7%[44,48]) of recurrence has been observed in patients with CIS of the bladder at the time of cystectomy. While several case series have found associations between urethral recurrence and CIS in the bladder,[50] bladder neck, and prostatic urethra,[47,51] others have not.[41,49]

Ultimately, intraoperative findings have proven to be the most valuable predictor of future urethral recurrence. In a prospective study of 118 patients undergoing radical cystectomy and orthotopic neobladder formation, Lebret et al.[52] found no urethral recurrences in 97 patients with a negative intraoperative frozen section of the urethral margin, irrespective of other tumor characteristics such as site or grade. Only intraoperative frozen section positivity, and not positive disease on preoperative lateromontanal prostatic biopsies, predicted urethral recurrence. Consequently, the presence of cancer on the intraoperative frozen section of the distal urethral stump has become a contraindication for orthotopic urinary diversion after cystectomy.

In female patients, the incidence of urethral involvement with TCC is similar to the incidence in males, approximating 2% to 13%.[42,53] Stein et al.[53] pathologically reviewed 67 specimens of female patients who had undergone cystectomy with concomitant urethrectomy. After considering several histologic parameters related to the primary bladder cancer, the strongest predictor for urethral involvement was tumor at the bladder neck ($p < .00012$); 25% of the 67 cystectomy specimens had tumor at the bladder neck, and 53% of this subset had concomitant urethral involvement. These data suggested that female patients without tumor at the bladder neck were at very low risk for urethral recurrence. A similar finding was demonstrated by Stenzl et al.,[42] who observed urethral tumor involvement in seven of 356 female patients undergoing cystourethrectomy. All had concomitant bladder neck involvement. Trigonal involvement was also associated with concomitant urethral tumor ($p < .035$). Given the small number of events, stage, multicentricity, number of tumors, presence of CIS, and duration of disease did not correlate with urethral tumor involvement.

Surveillance

The identification of high-risk patients should direct more aggressive urethral surveillance. Early detection is critical to successful treatment and survival. Urethral wash is currently the best method to detect urethral recurrence. In a male patient, a urethral cytologic wash can be obtained by inserting a minimally lubricated 14-French catheter to the level of the membranous urethra, and flushing with 100 mL of 0.9% normal saline (Fig. 8.10). The catheter is withdrawn slowly and removed while continuing to flush as all irrigant is collected in a container at the level of the meatus.[54] A positive urethral wash necessitates urethroscopy of the retained urethra.

Hickey et al.[55] demonstrated 100% sensitivity and specificity of urethral wash cytology in detecting recurrence in 72 male patients treated with cystectomy and followed with urethral wash. Still, while urethral wash is adept at detecting recurrence, it may not provide survival benefit over detection of recurrence based on patient symptoms. In a retrospective series of 24 patients treated with urethrectomy for postcystectomy recurrence, Lin et al.[56] observed similar survival for patients with recurrence detected by positive urethral wash cytology ($n = 17$) or by symptomatic hematuria or urethral discharge ($n = 7$). In this small study, there was no statistically significant difference between the two groups when controlling for the primary bladder tumor stage.

A multimodality surveillance protocol after cystectomy is advised, based on evident risk, with intervention for either local symptoms or positive urethral wash. Multiple surveillance guidelines have been developed to identify tumor recurrences, ranging from observation until the onset of symptoms, to routine urethral wash and urethroscopy. Our recommended surveillance schedule for male cutaneous diversions includes urethral washes biannually for 3 years and then annually until the fifth year for moderate- and high-risk patients. For low-risk patients, an annual urethral wash is obtained. For patients with

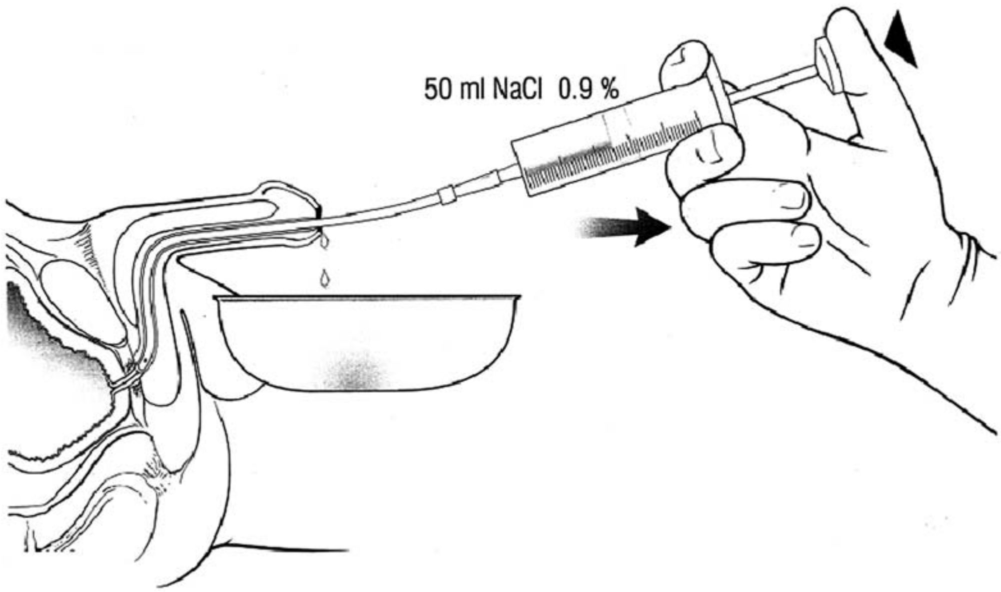

FIGURE 8.10. Method of obtaining urethral wash for cytology to detect urethral recurrence. (From Varol C, Thalmann GN, Burkhard FC, et al. Treatment of urethral recurrence following radical cystectomy and ileal bladder substitution. J Urol. 2004;172[3]:937–42, with permission.)

orthotopic diversions, voided urine cytology should be obtained biannually for 5 years and then annually. In contemporary practice, abdominal imaging, including CT or MR urography, is used in conjunction with physical exam and cytology to identify pelvic and distant recurrence.

Treatment

Conservative Therapy

Treatment options for localized urethral recurrence vary substantially based on tumor characteristics and the functional status of the patient. Options include intraurethral agents, local transurethral resection, and total urethrectomy with meatal excision. The use of intraurethral BCG has been described by Varol et al.[54] as a urethral-sparing approach for patients with urethral recurrence after orthotopic diversion. Six weekly BCG treatments are delivered intraurethrally using a Foley catheter. The catheter is modified for urethral perfusion by ligating the portion distal to the balloon for watertightness. Five additional irrigation holes are created proximal to the balloon (Fig. 8.11). The catheter is inserted and inflated with 10 mL of water and then placed to traction. The BCG solution is infused under 20 cm H_2O via standard drip for 75 minutes (Fig. 8.12). The modified catheter is then removed, and 25 mL of the BCG solution is introduced directly into the urethra with a catheter tip syringe and a 14-French catheter. This solution is retained for 25 minutes using a penile clamp, and this latter infusion is repeated with the remaining 25 mL of solution.

Of Varol's initial cohort of 371 patients who underwent cystectomy and orthotopic diversion, 15 had a urethral

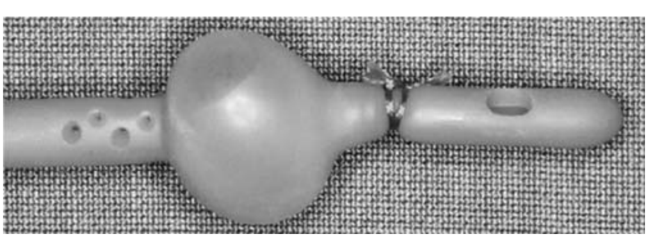

FIGURE 8.11. A 14-French catheter is ligated distal to the balloon. Irrigation holes are created proximal to the balloon. (From Varol C, Thalmann GN, Burkhard FC, et al. Treatment of urethral recurrence following radical cystectomy and ileal bladder substitution. J Urol. 2004;172[3]:937–42, with permission.)

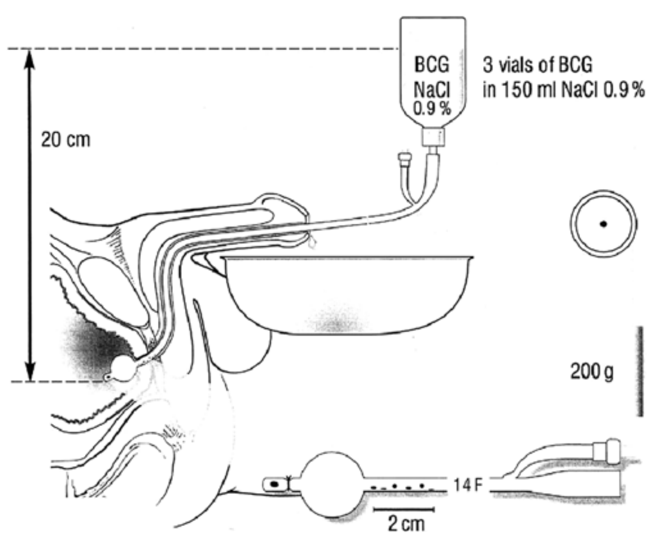

FIGURE 8.12. Urethral perfusion: 100 mL of bacillus Calmette-Guérin (BCG) is infused via drip infusion. (From Varol C, Thalmann GN, Burkhard FC, et al. Treatment of urethral recurrence following radical cystectomy and ileal bladder substitution. J Urol. 2004;172[3]:937–42, with permission.)

recurrence; 10 were treated with intraurethral BCG therapy. Five of six patients with urethral CIS were free of disease at 6 months after the initial BCG course, though secondary failures occurred. Four of the original 10 patients had evidence of papillary or invasive urethral recurrence after BCG; two underwent secondary urethrectomy and two developed metastatic disease. Other conservative therapeutic strategies have been considered for urethral recurrence including transurethral fulguration,[57] intravesical chemotherapy,[16,57] and endoscopic resection.[18] Overall, there is limited experience with endoscopic management or intraurethral therapy, and one must be cautious in considering approaches with unproven efficacy that may delay definitive and potentially curative therapy, particularly in the setting of high-grade disease. Such treatments have been investigated in very small numbers of patients and should be reserved for highly selected individuals.

Urethrectomy

In patients with localized urethral recurrence, total urethrectomy remains the definitive treatment and should be advocated, particularly in those with invasive disease. To gain local control, the treatment of locally advanced tumors with periurethral extension may necessitate the use of neoadjuvant or adjuvant chemotherapy and/or radiation in addition to surgical resection, depending on resectability and voiding status at the time of presentation. Although the multimodal approach may improve resectability and result in a small number of complete responses,[58,59] significant improvements in survival have not been realized, evidenced by the treatment of primary urethral malignancies.[60–63]

Operative Technique: Urethrectomy After Radical Cystectomy

Total urethrectomy after cystectomy can be a complex operation depending on the patient circumstance. In males who have been treated with cutaneous diversion, the proximal urethral dissection may be hampered by poor exposure, pelvic scarring, and adherent small bowel. In male or female patients with recurrence after orthotopic diversion, the urethrectomy must be performed with concomitant revision of the diversion to either a continent or incontinent cutaneous diversion based on patient factors. In this setting the surgeon must be prepared for a variety of reconstructive options.

Male Patients with Ileal Conduit Diversion

After administration of preoperative antibiotics, placement of sequential compression devices, and induction of general anesthesia, the patient is positioned in an extended lithotomy position (Fig. 8.13). The hips and knees should be flexed at 60 degrees. Special attention to adequate padding avoids peroneal nerve injuries or compartment syndrome. The genitals and perineum are fully prepped and draped. A catheter or urethral sound is placed to facilitate the urethral dissection (Fig. 8.13 inset).

A vertical midline incision is made in the perineum; alternatively an inverted Y-shaped incision can be utilized, providing greater exposure to the bulbar urethra (Fig. 8.13 inset). The incision is taken down through skin and subcutaneous tissue. The bulbospongiosus muscle is identified and then divided with a combination of electrocautery and sharp dissection, exposing the bulbar urethra. A self-retaining retractor can be positioned for further exposure. The authors prefer the Lone Star Retractor System (Lone Star Medical Products Inc., Stafford, TX) for this procedure.

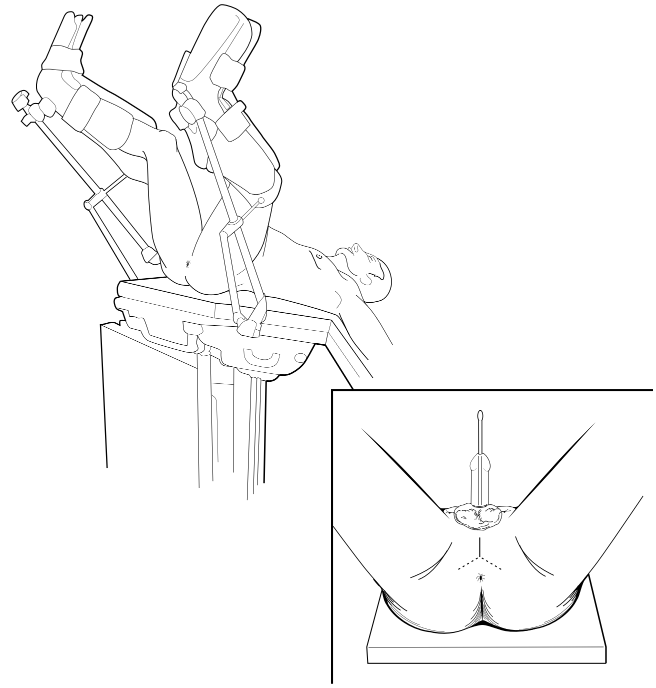

FIGURE 8.13. Exaggerated dorsal lithotomy position for urethrectomy. Inset: Midline vertical perineal incision, with optional bilateral extension of incision (*dashed line*). A male urethral sound delineates the urethra.

The corpus spongiosum is sharply dissected from the cavernosal bodies and encircled with a Penrose drain, providing urethral traction (Fig. 8.14). The dissection is continued along the junction of the corpus spongiosum and the supporting attachments. Further dissection of the urethra distally will result in inversion of the glans into the perineal field (Fig. 8.15). The penis is then returned to its anatomic position. Excision of the meatus and glanular urethra is performed by making a circumferential incision around the meatus and extending it along the ventral surface of the glans (Fig. 8.16A). The urethra is dissected from the glans (Fig. 8.16B), and is ultimately retracted into the perineum. The glans is closed in two layers of interrupted 4-0 monocryl sutures (Fig. 8.16B inset).

Attention is then turned to dissection of the bulbar urethra. Surrounding tissues are dissected down to the retropubic space. During mobilization of the posterolateral urethra, the bulbar urethral arteries are identified and ligated with small hemostatic clips (Fig. 8.17). The remaining attachments can then be divided. To identify the most proximal portion of the urethra, a rigid cystourethroscopy can illuminate the blind-ending urethra. Care must be taken to dissect just beyond this segment to ensure that

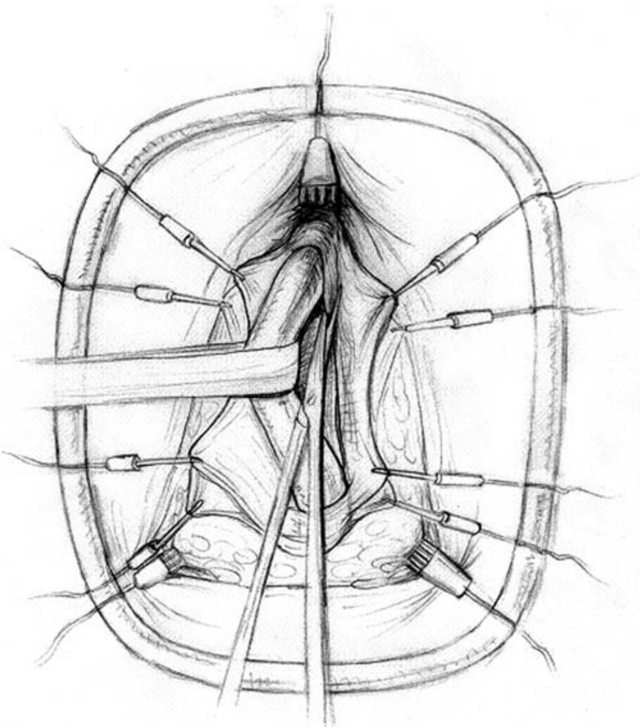

FIGURE 8.14. Mid-urethral dissection: perineal exposure is achieved with a self-retaining retractor. The urethra is retracted with a Penrose drain to aid in dissection.

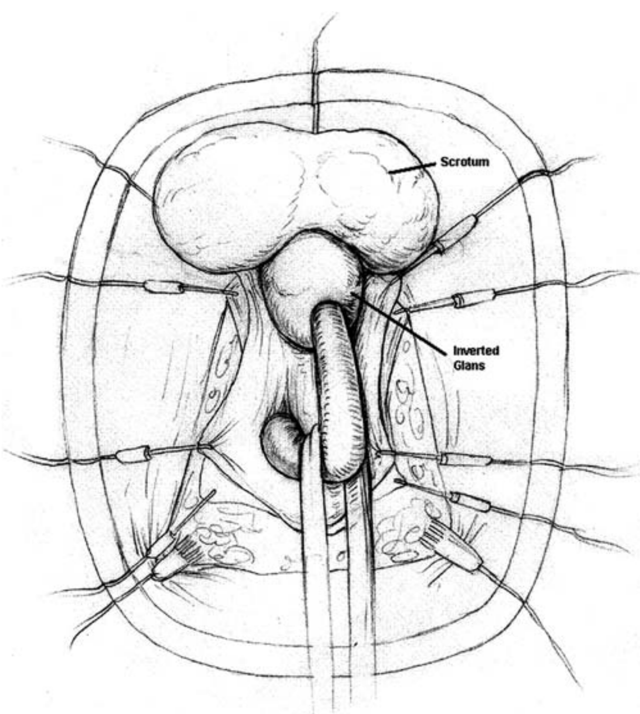

FIGURE 8.15. Distal dissection of the urethra with inversion of the glans through the penile skin; the urethra is retracted with a Penrose drain and dissected distally to the junction with the glans.

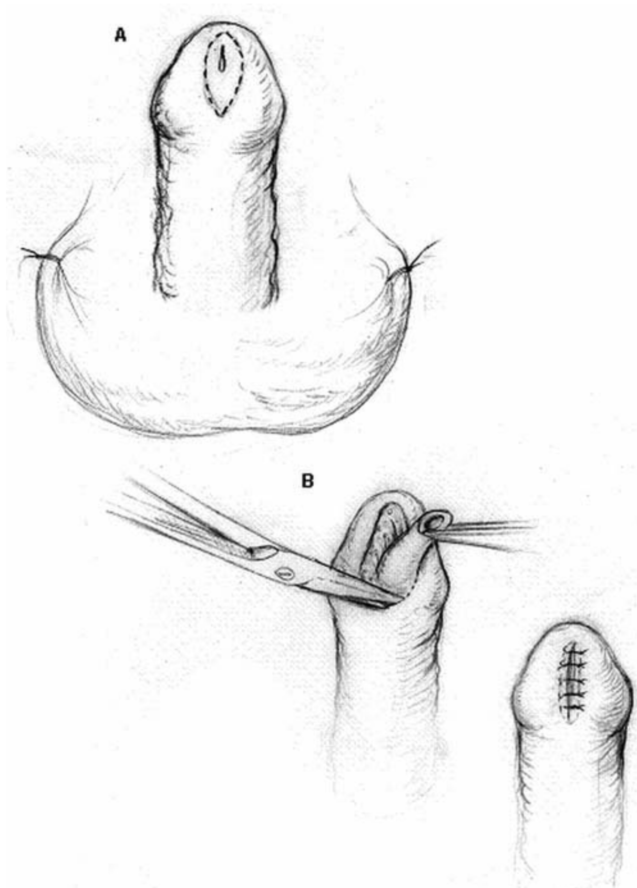

FIGURE 8.16. (**A**) The urethral meatus is sharply circumscribed in an elliptical fashion. (**B**) Sharp dissection of the meatus and distal urethra is facilitated by traction on the distal urethra with a stay suture or clamp. (**B** inset) The glans is reconstructed with interrupted fine absorbable suture in two layers.

the entire urethra has been resected, while avoiding injury to adherent small intestine along the proximal urethral stump in the pelvis. An intraoperative frozen section of the proximal urethra is recommended to confirm the absence of residual disease and a negative margin. The entire urethra is then removed through the perineal incision. Small defects in the cavernosal bodies are closed with figure-of-eight fine suture.

The wound is irrigated copiously, and a Penrose drain is left in the perineal bed. The bulbospongiosus muscle and dartos layers are reapproximated with interrupted 2-0 Vicryl sutures. The perineal skin incision is closed with interrupted 3-0 chromic sutures (Fig. 8.18). Bacitracin ointment and a light pressure dressing are placed over both the perineal and penile incisions. The drain is removed in 24 to 48 hours.

Male or Female Patients with Orthotopic Neobladder Diversion

The fate of an orthotopic urinary diversion in situations of urethral recurrence depends on the extent of urethral involvement. If an isolated urethral recurrence is distal and has features of a low grade, noninvasive lesion, it may be

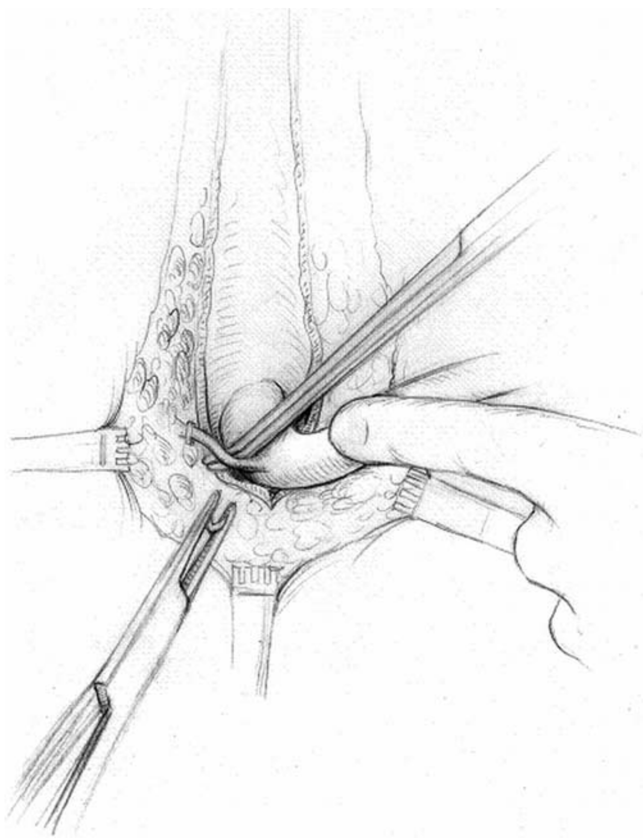

FIGURE 8.17. Dissection of the proximal bulbar urethra requires ligation of the bulbar urethral arteries. The limited exposure and deep working field necessitate clip application.

amenable to endoscopic resection or subtotal urethrectomy, thus salvaging the orthotopic diversion. However, for proximal invasive lesions, total urethrectomy is recommended. If total urethrectomy is required, the orthotopic diversion must be converted to a cutaneous diversion. Multiple factors are considered in determining whether a

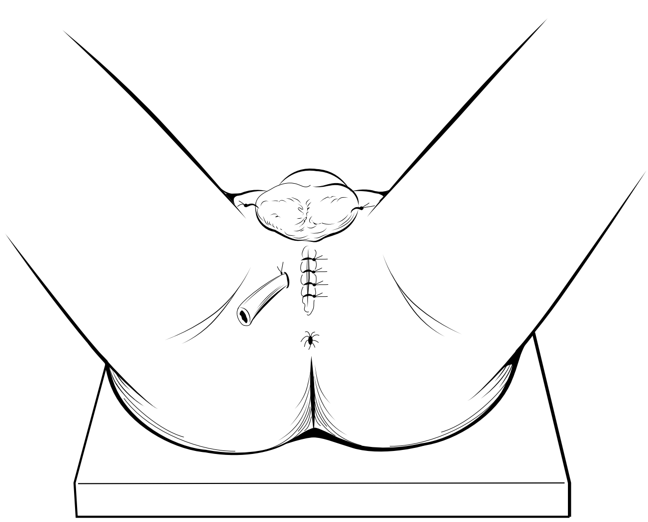

FIGURE 8.18. The incision is closed with two layers of absorbable suture. A Penrose drain is left in the perineal space.

continent cutaneous diversion will be feasible. Prior bowel excision, metabolic derangements, patient performance status and dexterity, extent of recurrent disease, and patient motivation must all be considered. If continent diversion is not feasible, the orthotopic neobladder is revised into an incontinent cutaneous diversion.

Total Urethrectomy with Conversion to Incontinent Cutaneous Diversion

Prior to surgery, an appropriately placed stomal marking is made in consultation with an enterostomal therapist. In addition, the bowel is prepared in the event that inadvertent bowel injury occurs. After the administration of general anesthesia, the patient is placed in a modified dorsal lithotomy position permitting access to the abdomen and perineum. All pressure points are padded and the standard preparation and draping is applied. In males, the initial technique for total urethrectomy is performed in similar fashion to that described above (Figs. 8.13 to 8.17). After the membranous urethra and bulbar urethra are mobilized, attention is then turned toward the pelvis. Note that the location and size of the urethral lesion may require earlier abdominal exposure.

A midline incision is made from umbilicus to pubic symphysis, and carried through the subcutaneous tissue and fascia until the peritoneum is entered. Adhesions are taken down sharply. A Buchwalter retractor is used for optimal exposure. The previous enteroenterostomy and mesentery to the neobladder are identified and dissected free of adhesions. The neobladder should be mobilized from the anterior abdominal wall and pelvic sidewalls to the level of the urethral anastomosis, sharply dissecting the neobladder from the rectum without injury. Concomitant sharp circumferential dissection from both the abdominal and perineal wounds will permit continuity between the two fields, permitting en-bloc retraction of the neobladder neck and entire urethra into the pelvis. The neobladder neck and urethra are then excised, completing the total urethrectomy.

In women, since the urethra is much shorter, the mobilization of the neobladder and neobladder neck should be approached initially. The existing vaginal wall can generally be spared during this dissection. Afterward, the perineal resection of the urethra can be performed. A circumferential incision is made surrounding the urethra and mass.[64] Sharp dissection is continued proximally and laterally until a palpable margin has been achieved around the mass. Concomitant antegrade and retrograde dissection from the abdominal and perineal fields, respectively, will ultimately permit continuity between the fields, and the neobladder neck and urethra can be retracted into the pelvis, en bloc. The neobladder neck and urethra are then excised.

The neobladder is then converted into an incontinent cutaneous diversion. The neobladder is opened at its inferior border and the ureteral orifices are identified from within the neobladder. Single-J ureteral stents can be placed at this point, allowing for ureteral identification during the remaining dissection and urinary diversion in the immediate postoperative period. Revision of a fibrotic or strictured ureteral anastomosis may be required, but is generally not necessary in the authors' experience. However, minor ureterolysis may be needed to reduce angulation. Excess portions of the antimesenteric neobladder are excised using an absorbable stapler. In creating the "conduit," care is taken to maintain the neobladder mesentery with its associated intestinal segments and to avoid the creation of an oversized *loop*. The revised conduit should not be a pouch that will simply overflow when filled. Reinforcement of any areas of leakage can be accomplished with 3-0 Vicryl suture.

A quarter-sized aperture is then made overlying the previously marked abdominal stoma site. The subcutaneous fat is retracted with a Kocher clamp and excised at the level of the anterior rectus fascia. A cruciate incision is made in the fascia, and a 2-0 chromic tacking stitch is placed at each of the four fascial corners. A transabdominal tunnel entering the peritoneum is bluntly developed to accommodate two fingers. Care is taken to align the stoma and tunnel to avoid angulation. The *conduit* is brought through the tunnel using a Babcock clamp and is secured to the fascia using the preplaced tacking sutures. A stoma is then matured in a rosebud fashion using 3-0 chromic sutures to appose the skin edge and full-thickness bowel margin, including serosa. The conduit is tacked to the lateral peritoneum to prevent entrapment and obstruction of migrating small intestine. A Jackson-Pratt or other closed suction drain is left in the pelvis.

Subtotal Urethrectomy with Perineal Urethrostomy

The patient is positioned in an extended lithotomy position, and the genitals and perineum are prepped and draped in standard sterile fashion. Rigid cystoscopy is performed to confirm the proximal extent of the urethral recurrence. A 2-cm proximal margin must be achieved and still have ample urethral length for the urethrostomy. Placement of a Foley catheter facilitates urethral manipulation during the dissection. A midline perineal incision is made, and the bulbospongiosus muscle is divided. The urethra is then dissected from the corpora cavernosum, as described previously (Figs. 8.14 to 8.16).

The proximal urethra is divided with a 2-cm margin from the most proximal urethral lesion. This proximal margin is sent for frozen section. Further resection of the proximal urethra may be needed to ensure a negative margin. Care is taken to maintain an ample urethral stump for creation of the perineal urethrostomy. The urethral stump is then brought through a 1-cm perineal defect. The urethra is spatulated anteriorly and the urethrostomy is constructed using interrupted 3-0 monocryl suture apposing full-thickness urethra and skin.[65] A 20-French Foley catheter is left in place along with a transperineal Penrose drain. The perineal and meatal incisions are closed as previously described. The drain can be removed in the first or second postoperative day provided there is minimal output, and no evidence of draining hematoma or urine leak. The Foley catheter is removed in 7 days.

Complications

Complications are uncommon after urethrectomy, but can include bleeding, perineal hematoma, and wound infection. In addition, the lithotomy position may result in peroneal nerve palsies and compartment syndromes if pressure points are not properly padded. In a case series by Spiess et al.,[66] the rate of complication for delayed urethrectomy was 21% including postoperative ileus, incisional hernia, deep venous thrombosis, and pneumonia. Postoperative complications related to orthotopic conversion appear to be similar to those encountered after the initial cystectomy procedure, with bleeding, infection, and ileus or small bowel obstruction observed most frequently.

Survival

As with UTR, tumor stage is the most important predictor of survival in patients with urethral recurrence. In a cohort of 1054 cystectomy patients, Clark et al.[16] studied 47 (4%) patients with urethral recurrence. In this cohort, the most significant predictor of overall survival was the stage of the urethral tumor, categorized as "superficial" versus "invasive." Overall median survival was 28 months. Patients with superficial TCC of the urethra (CIS or pTa) had a median survival of 59 months versus 17 months ($p = .017$) for patients with invasive disease. Others have found the pathologic stage from the original cystectomy to be the greatest determinant of disease-free survival after urethrectomy.[56] The evidence in the literature is limited, and the ultimate importance of urethral or bladder pathology in predicting survival after urethral recurrence remains to be delineated. Nevertheless, it is clear that despite a low incidence of urethral recurrence, the prognosis for patients with invasive urethral tumors is generally poor; thus, prompt diagnosis of these lesions is critical to identify early-stage curable tumors.

Completion Cystectomy for Recurrence After Partial Cystectomy

Despite the emergence of continent urinary diversions after radical cystectomy, bladder preservation therapy or partial cystectomy continues to be a viable treatment option for a select subset of patients with bladder cancer. This treatment allows for wide, full-thickness excision of the tumor and overlying peritoneum without complete removal of the bladder. For those who meet strict selection criteria, this option awards the benefits of lower operative morbidity, less hospital time, continued potency, pathologic staging, and maintenance of native urinary tract function. Although recurrence-free survival can approach those undergoing radical cystectomy, in well-selected patients, the risk of local recurrence is still significant. In the setting of locally recurrent tumor, salvage therapy with completion cystectomy offers the greatest survival advantage.

Patient Selection

Historically, optimal candidates for partial cystectomy had solitary tumors at the dome, posterolateral wall, or within a diverticulum capable of being excised with a 2-cm surgical margin without the need for ureteral reimplantation. Patients with no prior history of prior radiation, and with a reasonable expectation for bladder function postprocedure were also favored. Those with previous CIS or with locally advanced disease (stage T3 and above) were felt to be poor candidates due to a higher rate of recurrence. Relative contraindications to partial cystectomy included poor tumor location (trigone, bladder neck, prostate, or upper tract) and tumor multifocality that might threaten bladder capacity after complete tumor excision. Estimates suggest that only 6% to 10% of patients presenting with muscle-invasive bladder cancer are truly eligible for partial cystectomy.[67]

In contemporary studies, the 5-year overall, disease-specific, and recurrence-free survival rates after partial cystectomy are estimated to be 67%, 87%, and 39%, respectively, highlighting the continued threat that the bladder urothelium poses to the patient and the need for continued surveillance.[68,69] In patients with bladder recurrence, management depends upon tumor stage and may include transurethral resection (TUR) followed by BCG for those with high grade noninvasive tumors, completion cystectomy for those with invasive disease, and systemic therapy for those with locally advanced tumors or those with nodal or distant metastases. Continued bladder preservation is not recommended in patients with local recurrence after partial cystectomy, and salvage radical cystectomy is required in 4% to 15% of patients.[70] Nonetheless, chemoradiation may be required in elderly or surgically inoperable patients with localized recurrence.

Operative Technique of Completion Cystectomy

The patient undergoing completion radical cystectomy is prepared similarly to the patient undergoing primary radical cystectomy. The patient has a bowel preparation the day prior to surgery and is seen by enterostomal therapy for preoperative stomal marking should cutaneous diversion be desired or necessary. The patient is placed in a supine position with table flexion as needed depending on individual body habitus. A vertical midline incision is made from the umbilicus to the pubic symphyis typically overlying the prior incision for partial cystectomy. As in primary radical cystectomy, the space of Retzius is mobilized bilaterally. The peritoneum is entered, and adhesiolysis is performed. It is likely that the urachal remnant has previously been ligated and divided.

In the setting of completion cystectomy, dense bladder adhesions to the pelvic side wall and inlet may be encountered depending on the extent of bladder mobilization during the prior surgery. The bladder may be inadvertently entered and should be closed immediately to prevent any tumor spillage. Once the bladder has been freed of all intestinal and pelvic attachments, it can be closely assessed for areas of extravesical extension, particularly at the site of the previous partial cystectomy. Barring no gross extravesical spread, cystectomy can proceed as has been previously described.[71] A total lymphadenectomy is performed if not accomplished during the partial cystectomy. Diversion choice is not generally compromised by the previous bladder surgery.

Treatment Outcomes

Survival after completion cystectomy is largely determined by the stage of recurrent tumor and by patient comorbidities and performance status. Historically, the 5-year disease-specific survival rate after completion cystectomy was 50% to 78%.[72,73] Currently, there is a paucity of contemporary data summarizing outcomes after completion cystectomy, with only anecdotal reports described in the literature. Holzbeierlein et al.[68] studied 58 patients who underwent partial cystectomy. One patient required completion cystectomy for recurrence; his observed disease-free was 20.3 months. In another study by Kassouf et al.,[69] 37 patients underwent partial cystectomy; four of five individuals requiring completion cystectomy were disease-free at a median follow-up of 37 months.

Pelvic Recurrence

Pelvic recurrence after cystectomy can occur at any site in the true pelvis, including the surgical bed, the pelvic sidewall, or regional lymph nodes. Historically, the risk of local recurrence approached 40%. In contemporary studies, reported rates of local recurrence are much lower (7–18%).[4,74–76] Improved preoperative staging, patient selection, refined surgical technique including wide dissection and total pelvic lymphadenectomy, and expanded indications for neoadjuvant and adjuvant systemic therapies have likely led to this reduction. The vast majority of local recurrences will occur within the first 18 to 24 months following cystectomy, although later recurrences at 5 years have been observed.[76] Periodic rectal and pelvic examinations as well as pelvic imaging are necessary components of postcystectomy surveillance to detect local recurrence.

Risk Factors

The risk of local recurrence is influenced by tumor stage, regional lymph node involvement, and perhaps tumor histology. Greven et al.[74] investigated patterns of local failure in 83 patients undergoing cystectomy without adjuvant therapy. Pathologic stage was the only predictor of 5-year local recurrence-free survival. Increasing stage was associated with a higher risk of local recurrence; 6% of patients with pT2 tumors developed local recurrence compared to 51% of pT3b tumors. The median time to recurrence was 9 months, ranging from 3 to 62 months. In a second review of 145 cystectomy patients, Honma et al.[75] observed a 20%

local recurrence rate detected at a median of 8 months. While pathologic stage T3-T4 and nodal involvement correlated with clinical failure, the presence of squamous cell carcinoma was the only independent predictor of local recurrence in this cohort. Still, the importance of nodal invasion has been demonstrated in larger cohort studies. Hautmann et al.[3] evaluated 788 patients treated with radical cystectomy and pelvic lymph node dissection. Nodal metastasis, present in 143 patients (18%), was an independent predictor of recurrence-free survival ($p < .0001$). Local recurrence was observed in 20% of patients with nodal disease, compared to 4% for organ-confined tumors and 16% for non–organ-confined tumors without nodal spread.

Presentation

Patients with local recurrence often present with pelvic, perineal, or lower extremity pain, and rectal, urethral, or vaginal bleeding. Westney et al.[77] reported the M.D. Anderson Cancer Center experience with local recurrence after cystectomy. In a series of 33 patients, 76% were symptomatic at the time of recurrence; pelvic and rectal pain were the most common symptoms observed. Moreover, 42% of patients had a palpable tumor at the time of diagnosis. Asymptomatic patients were diagnosed based on digital rectal examination or by routine pelvic imaging, highlighting the importance of physical examination as well as radiographic imaging in postcystectomy surveillance.

Treatment

In general, there is a paucity of effective treatments for local recurrence. Therapy is largely composed of cisplatin-based systemic chemotherapy with or without radiation.[78] Surgical intervention is largely palliative, as demonstrated by Westney et al.[77] In this cohort of 33 patients with local recurrence, a multimodal therapeutic strategy was followed, with most patients receiving systemic chemotherapy alone or in combination with surgical excision or radiation. Eighteen (55%) patients received chemotherapy alone or in combination with radiation or surgery. Two patients underwent palliative diverting colostomy and chemotherapy with measurable disease response in one. Two patients underwent palliative colostomy only, which provided effective relief from bowel obstruction.

Infrequently, selected patients may be candidates for surgical excision of a well-defined local recurrence, although this is rarely the first step in treatment, since the risk of incomplete resection and associated positive margins is significant. Consequently, surgery may play its greatest role in palliation. In the Westney series, the formation of a colostomy was an important aspect of surgical management, providing a theoretical improvement in quality of life and a reduction in hospitalization time due to associated bowel obstruction. Ultimately, 79% of patients receiving therapy achieved resolution of their symptoms, despite poor overall survival.

Treatment Outcomes

Local and distant recurrences are often discovered simultaneously. Honma and colleagues[75] examined a population of 145 patients treated with radical cystectomy; 24 (17%) patients developed local recurrence. Of these 24, concomitant distant metastasis was observed in 19 (70.3%). Local recurrence, then, portends a very grave prognosis. This is further evidenced in another retrospective series that followed 228 patients treated with radical cystectomy with or without systemic chemotherapy for a median of 55 months. In this cohort, 41 suffered local recurrence. Five-year local control, freedom from distant metastasis, and overall survival rates were 80%, 68%, and 52%, respectively. The actuarial 5-year metastasis-free survival in those with adequate local control was 77% compared to 28% for those with local failure ($p < .0001$), highlighting the importance of optimizing local control.[79]

In general, the long-term prognosis for patients with local recurrence remains poor, with a median survival of 7 months.[77] Nonetheless, early detection of local recurrence after cystectomy may afford a modest treatment benefit if patients have a good performance status and can tolerate aggressive therapy. In the Westney series, 12 (36%) of 33 patients with pelvic recurrence had concomitant metastasis.[77] Patients with isolated local recurrence had a 5-month median survival if left untreated and an 8-month median survival if therapy was administered. Eighteen (55%) received attempted curative therapy composed of systemic chemotherapy with or without surgery or radiation; median survival was 18 months, with six of 18 patients having a complete response. Four patients tolerating combined multimodality therapy remained alive at 7, 14, 26, and 95 months, respectively.

Operative Techniques for Pelvic Recurrence

The operative approach to pelvic recurrence is quite variable depending on the tumor location. Perhaps the most important aspect is preoperative preparation. The patient should have recent staging without evidence of metastatic disease. The nutritional and performance status of the patient should be optimized when possible. The bowel should be prepared in case of bowel injury. Depending on the location and size of the tumor mass, it may be prudent to have surgical colleagues specializing in vascular surgery and colorectal surgery available for intraoperative consultation. Finally, the surgical assistant should be experienced.

The approach to the pelvis involves entrance into the peritoneum with careful lysis of adhesion. Adequate exposure is key to fully isolating the tumor mass, which is largely excised using sharp dissection. Care is taken to avoid vascular injury when dissecting the recurrent nodal obturator fossa mass, which can become adherent to the undersurface of the external iliac vein. The obturator nerve may be intimately involved with the tumor mass, and may not be salvageable. Again, preoperative patient counseling regarding the resection of neighboring structures is advised.

Ultimately the goal is complete resection with negative margins. Dense tissue surrounding the mass deep in the pelvis should be excised when possible. In view of the limited overall prognosis, wide resection resulting in substantial injury to the rectum or pelvic floor should be avoided, reserved only for very selected patients.

Conclusion

Bladder cancer is a broad disease requiring multiple treatments based on stage. These treatments may include endoscopic, intravesical, and extirpative procedures with or without systemic chemotherapy and radiation. The great majority of cases necessitating reoperation result from therapeutic complications. Fortunately, such complications from endoscopic resection of tumors and from the use of repeated intravesical agents are infrequent. Although complications related to radical cystectomy are common, occurring in roughly 30% of patients, few (<10%) require surgical intervention. Those complications related to gastrointestinal injury, obstruction, or related abscess that fail conservative management will require surgical intervention. This category makes up the bulk of reoperations for extirpative complication. For the most part, these are managed in a similar fashion to those occurring after primary intestinal surgery or after complications of chronic intestinal conditions as has been described in several chapters throughout this text.

The other aspect of bladder cancer management dictating reoperation is tumor recurrence. In this chapter we have highlighted the importance of salvaging patients with urothelial, bladder, and pelvic recurrence. In selected patients, this approach to treatment, with or without systemic therapy, can improve disease specific survival and quality of life. Consequently, we advocate the use of surgically based interventions in those with resectable lesions.

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9

Reoperative Surgery for Prostate Cancer

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The best treatment for prostate cancer is an individualized choice specific to each patient. The decision to undergo prostate cancer surgery is based on several factors including the patient's preoperative health status, ability to gain oncologic control, and the patient's previous surgical history. When considering a patient for radical prostatectomy (RP), previous prostate surgery must be considered. Reoperative surgery for prostate cancer can be associated with technical challenges that may impact the long-term functional and oncologic outcomes. Previous prostate procedures can vary from treatment of benign prostatic hyperplasia (BPH) to primary local therapy for prostate cancer. Thus, one must be aware of the added challenges and risks that such surgical history portends and relate this information to the patient prior to radical prostatectomy. In this chapter, we seek to outline how previous prostate surgery impacts the technical aspects and outcomes of both primary and salvage radical prostatectomy in patients with adenocarcinoma of the prostate.

Radical Prostatectomy After Surgery for Benign Prostatic Hyperplasia

In historical series, the incidence of previous prostate surgery for BPH in the population of men undergoing RP has ranged from 19% to 26%.[1–4] In more contemporary RP series, including both open and laparoscopic approaches, the incidence of previous prostate surgery has decreased to 5% to 9%.[5–13] This decrease in incidence is undoubtedly due to the increased use of medical therapy for BPH with a corresponding decrease in surgical treatment. Patients undergoing surgery for BPH typically have undergone either transurethral resection of the prostate (TURP) or open prostatectomy (OP), but other procedures for bladder outlet obstruction (BOO) such as bladder neck incision (BNI) or transurethral incision of the prostate (TUIP) may have been performed. More recently, a growing number of patients may have been treated with minimally invasive surgical treatments for BPH, including microwave thermotherapy and transurethral needle ablation of the prostate. While a history of previous benign prostate surgery is certainly not a contraindication to RP, it may present several technical challenges during the operation that should be anticipated.

Technical Challenges

Several authors reporting their experience in patients undergoing RP after prior prostate surgery have described an increased complexity of dissection.[1,14,15] It has been proposed that the increased level of operative difficulty after TURP is due to the extravasation of irrigation fluid outside the prostatic capsule, resulting in periprostatic inflammation.[2,16] In a recent series, Colombo and colleagues[5] reviewed their retropubic RP (RRP) in 109 men with previous surgery for bladder outlet obstruction. Eighty-eight men had previous TURP, and 21 men had previous open prostatectomy. In the author's opinion, dissection of the urethral stump and the neurovascular bundles (NVBs) were the most consistently difficult portions of the operation. Fibrosis and inflammation surrounding the prostate seemed to be the dominant cause of this difficulty. Modification of surgical technique from the typical retrograde dissection to either an antegrade or mixed antegrade/retrograde approach was necessary in 27% and 11% of patients, respectively, and more common when NVB preservation was being attempted. In a laparoscopic prostatectomy population, Menard and colleagues[10] noted a similar periprostatic tissue reaction after previous TURP that hampered their ability to perform NVB preservation. Difficulty in dissection of the membranous urethra was reported by Bandhauer and Senn,[1] who felt that this added to the complexity of the vesicourethral anastomosis.

The degree of difficulty during RP may also be related to surgical approach and the type of prior BPH surgery. In a recent series, Katz and colleagues[6] described their results in 35 patients undergoing laparoscopic radical prostatectomy (LRP) after previous TURP. Twenty-two were performed using transperitoneal laparoscopy, while in 13 an extraperitoneal laparoscopic technique was used. Overall, 40% of these operations were considered subjectively to be difficult dissections, with 64% of the transperitoneal LRP cases categorized as difficult dissections. Although no consistent

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anatomic site could be identified as most difficult, the extraperitoneal approach facilitated easier prostatic dissections and shorter operative times than the transperitoneal approach in this population. In 1994, Ramon and colleagues[16] reported their results of RRP in 153 men undergoing previous prostate surgery, with 63% having a previous TURP and 37% previous open prostatectomy for BPH. The authors found RRP in these patients to be technically more difficult. Previous open prostatectomy seemed to impair bladder mobilization and lateral dissection of the endopelvic fascia, but the apical prostatic dissection in these patients was not appreciably different than standard RRP. After TURP, the authors found dissection of the apex and membranous urethra to be more difficult than standard RRP, although posterior prostate dissection and completion of the vesicourethral anastomosis was not appreciably affected. Interestingly, Elder and colleagues[3] performed radical perineal prostatectomy (RPP) in 30 patients after TURP and found no subjective increase in difficulty when compared to RPP in surgery naïve patients. Likewise, Lindner and colleagues[2] performed RP in 38 patients after TURP, with 30% undergoing RPP and 70% undergoing RRP. These authors did not perceive a difference in technical difficulty favoring either one of these approaches.

Although subjective reports of more difficult dissection in this setting are common, objective results of intraoperative outcomes after previous BPH surgery are conflicting. In 16 patients undergoing open RRP after previous TURP, Bandhauer and Senn[1] noted on average a 30-minute increase in operating room (OR) time and a 300-mL increase in estimated blood loss (EBL) when compared to 64 patients undergoing primary RP. Likewise, in patients undergoing LRP, Katz and colleagues[6] found longer OR times and increased EBL in men with previous TURP. Table 9.1 shows the results of two studies comparing intraoperative outcomes of radical prostatectomy in those with a history of previous BPH surgery to those without a history of previous surgery. One study examining this comparison is an RRP population[5] and the other is in a group of patients treated with LRP.[12] Colombo et al.[5] compared experience in 109 men with a previous history TURP or open prostatectomy to that of 120 age-, prostate-specific antigen (PSA)-, and stage-matched controls without previous prostate surgery. As evidenced by longer OR times and higher EBL, the results suggest a much more difficult operation in those men undergoing previous TURP. In contrast, Eden et al.,[12] using a cohort of 600 patients undergoing LRP, found no difference in intraoperative outcomes when comparing 35 men with previous TURP and seven with previous TUIP to the remaining 558 patients of the LRP cohort. In a series of 500 consecutive LRP patients, Stolzenberg et al.[7] also reported no difference in OR times in 27 previous TURP patients. In RPP patients, Elder and colleagues[3] also failed to find a difference in either OR time or EBL in patients after TURP compared to patients without previous surgery, and in the series by Lindner and colleagues,[2] EBL was actually lower in patients having previous transurethral resection.

These studies highlight the inconsistent findings in the technical difficulty of RP after BPH surgery. Although much of the perceived difficulty after previous prostate surgery may be subjective, some studies do suggest objective differences in outcome. It may be that the perceived or real differences are more evident in patients undergoing RRP than those having perineal or laparoscopic approaches, suggesting that these latter two approaches are preferred in this setting. It's also likely that the "aggressiveness" of TURP and its subsequent periprostatic reactivity varies markedly. Radical prostatectomy by any approach after "minimal" TURP may not be noticeably different from the standard operation.

Oncologic Outcomes

Previous TURP in which resection has been generously extended to the prostatic capsule has been reported to compromise the surgeon's ability to remove the prostate en bloc at the time of RP. This difficulty is believed to be secondary to inflammation at the capsule, potentially influencing accurate pathologic staging.[2,5] However, the results of several series show the oncologic outcomes in patients with previous prostate surgery are comparable to their surgery-naive counterparts.[5–7,12] Preoperative PSA, Gleason sum, clinical tumor stage, and pathologic tumor stage are all associated with the probability of biochemical progression after RP.[17] Several studies have shown no difference in these factors between patients with or without previous prostate surgery with the exception of pathologic tumor stage.[5,12] In men with previous TURP, Eden and colleagues[12] reported an increased incidence of pathologic T3a

TABLE 9.1. Intraoperative Outcomes of Radical Prostatectomy After Previous Prostate Surgery.

	Prior TURP/OP	*No prior TURP/OP*	p *value*	*Prior BOS*	*No prior BOS*	p *value*
No. of patients	109	120	–	42	558	–
OR times (min)	135	125	<.001	186.9	185.8	.90
EBL (mL)	820	480	<.001	212	261.5	.13
Transfusion rate	38%	48%	.126	–	–	–
Catheter days	–	–	–	13.7	10.5	.003*
Hospital stay	–	–	–	2.9	3.2	.21

Source: Data from Colombo R, Naspro R, Salonia A, et al. Radical prostatectomy after previous prostate surgery: clinical and functional outcomes. J Urol. 2006;176:2459–2463; and Eden CG, Richards AJ, Ooi J, et al. Previous bladder outlet surgery does not affect medium-term outcomes after laparoscopic radical prostatectomy. BJU. 2006;99:399–402.

TURP, transurethral resection of the prostate; OP, open prostatectomy; BOS, bladder outlet surgery; OR, operating room; EBL, estimated blood loss; –, not reported.

*BOS group includes one patient with persistent anastomotic leak kept indwelling catheter for 120 days.

disease when compared to men with no previous prostate surgery. Colombo and colleagues[5] also reported a higher incidence of capsular violation in previous TURP patients, yet no difference was seen in the incidence of pT3 disease. However, in 26% of cases in which the patient had previous prostate surgery, the gland could not be removed en bloc and was sent as two or more specimens. This compares to en bloc-removal in 98% of men without previous surgery. The reported increases in pT3 disease and lower rates of en-bloc removal after TURP are likely due to the periprostatic inflammatory reaction that leads to a more difficult dissection. Whether these patients really have higher stage disease as a direct result of previous transurethral surgery or if a higher incidence of capsular incision makes capsular penetration more likely to be called by the pathologist is unknown.

Postoperative surgical margin status is a strong, independent predictor of disease progression after radical prostatectomy.[18,19] Overall, rates of positive surgical margins (PSMs) in men undergoing RP after previous prostate surgery do not differ from large series of men without previous surgery. The series by Colombo and colleagues[5] reported a 25.7% PSM rate in men undergoing RP after previous TURP, which compared favorably to a 22.5% rate in age-, PSA-, and stage-matched controls without a history of TURP. Katz and colleagues[6] reported a higher overall PSM rate of 34% in men undergoing LRP after previous TURP, yet when the results were stratified to include only those men with pT2 disease, the positive margin rate decreased to 22%, mirroring their own previously published pT2 PSM rate of 18.9% in men without prior prostate surgery.[20] However, Katz et al. found the PSM rate in those with pT3 disease was 75%. Menard and colleagues[10] also found similar pT2 PSM rates in those with and without previous prostate surgery. Yet, again, the PSM increased significantly when considering only those men with pT3 disease, 66% in men with previous prostate surgery versus 36% in men without. Eden and colleagues[12] also noted comparable positive margin status in men undergoing LRP with an overall PSM rate of 24% in men with a history of previous TURP and 18% in men without previous TURP. Although the rates of PSM published in the literature vary widely, PSM rates in men undergoing RP after previous prostate surgery with organ-confined pT2 disease are not appreciably different from the 7% to 22% PSM rates that have been published by both open and laparoscopic surgeons for similar stage disease.[13,18,21,22] Most concerning, however, is that previous prostate surgery appears to result in a higher incidence of positive surgical margins in men with pT3 disease. While the etiology for this is not clear, it suggests that previous prostate surgery may either facilitate extracapsular extension or cause periprostatic changes that make negative margins less achievable at the time of surgery due to obliterated tissue planes.

The location of PSM, though, does not appear to be significantly affected by previous TURP. Previous work in open prostatectomy and in LRP populations has shown that the majority of isolated positive margins are found in the apical and posterolateral locations.[13,19,23] Eden et al.[12] and Katz et al.[6] both found the majority of their positive margins in similar locations, suggesting that previous TURP does not alter PSM location. Although capsular reaction after TURP appears to make achievement of negative margins more difficult, particularly in patients with T3 cancers, the location of these positive margins is not different than in those without previous surgery.

Despite the potential for increased positive margins, the data regarding disease progression and survival in these patients at short-term follow-up is encouraging. In two series comparing RP outcomes in patients with and without previous prostate surgery, the authors found similar rates of PSA recurrence in those with previous prostate surgery at median follow-up of 12 to 30 months.[5,12] Katz and colleagues[6] did note a 22% PSA failure rate in LRP patients with a history of prior surgery with follow-up ranging between 2 and 21 months. However, 75% of these patients had pT3 disease, and postoperatively all had positive surgical margins. At a mean follow-up of 32 months, Ramon and colleagues[16] reported overall survival and disease-specific survival of 96% and 98%. While long-term survival data are lacking in this population of patients, short-term oncologic outcomes, namely biochemical progression, do not appear to be adversely affected by previous TURP or open prostatectomy.

Complications and Functional Outcomes

In general, the complication rates in this reoperative patient population have been low. Table 9.2 shows the perioperative and postoperative complications of several open and laparoscopic RP series after previous prostate surgery. In the series by Colombo and colleagues,[5] 27 patients had an anastomotic leak identified incidentally on a follow-up cystogram, but only two patients required any intervention. Rates of rectal injury have been low as well and compare favorably to that of large open RRP series. Previous authors have suggested a prior TURP before RP as a risk factor for the development of anastomotic stricture.[24] Tomschi and colleagues[25] found TURP to be a significant risk factor for postoperative anastomotic stricture in 239 men undergoing RP, but the rates of anastomotic stricture in RP patients after TURP shown in Table 9.2 are consistent with the 0.4% to 10% rates reported in large standard RP series by both laparoscopic and open surgeons.[4,8,11,22,26,27] Furthermore, several previous authors have examined the risk factors for anastomotic stricture and failed to demonstrate a significant correlation with previous TURP or bladder neck surgery.[4,8,26]

Contemporary RP series report urinary incontinence rates that range between 5% and 30% and vary based on the series and the definition of incontinence.[4,9,11] Assessing the true postprostatectomy incontinence rate in the literature is difficult due to the lack of standardization regarding the definition of incontinence, timing of incontinence measurement, method of quantifying incontinence, preoperative continence levels, and surgical technique.[4] Series specifically examining postprostatectomy urinary continence outcomes after previous prostate surgery are shown in Table 9.2. Bandhauer et al.[1] found no difference in incontinence rates whether the RP was a primary

TABLE 9.2. Perioperative and Postoperative Complications of Radical Prostatectomy after Previous TURP or Other Transurethral Prostate Surgery.

Series	*Mean age (yrs)*	*No. of patients*	*Postoperative bleeding (No.)*	*Rectal injury (%)*	*Anastomotic stricture (%)*	*Urinary continence (%)*	*Potency (%)**
Stolzenberg et al.[7]	63.9	27	0	4	–	–	–
Elder et al.[3]	62.0	30	–	0	13	80	–
Bass and Barrett[35]	61.0	36	0	3	5	50	–
Lindner et al.[2]	62.4	38	2	0	9	75	–
Katz et al.[6]	67.5	35	2	–	0	77	40 (42)
Eden et al.[12]	64.6	42	0	0	2	90	40 (33)
Menard et al.[10]	–	46	–	–	7	75	45 (57)
Colombo et al.[5]	62.9	43	–	0	9	86	28 (42)
Ramon et al.[16]	67.0	153	–	0	0	96	71 (30)

*No. in parenthesis represents percentage of men undergoing nerve-sparing radical prostatectomy.

–, not reported.

prostate operation or a secondary operation. Katz and colleagues[6] reported a 77% continence rate at 12 months similar to the 78% that has been previously published for their entire LRP series. Eden and colleagues,[12] when comparing men undergoing LRP with or without a history previous TURP, found poorer continence rates at 3 months in men with prior TURP (61% vs. 91%), but this difference was not seen at 12-month follow-up. Colombo and colleagues[5] found continence rates in men with a prior TURP to be 74% at 6 months and 86% at 12 months. In comparison, their continence rates in men without previous TURP were 92% at 6 months and 95% at 12 months. Other large RP series have shown increasing patient age, timing of follow-up, excision of the NVB, and the presence of a symptomatic anastomotic stricture all to be important risk factors for urinary incontinence after RP; however, prior TURP has not been shown to be an independent risk factor for urinary incontinence.[4,11] When comparing continence rates in men with or without previous TURP before RP, Steiner and colleagues[28] found that 92% of men in both groups had return of urinary control. Furthermore, both Lindner et al.[2] and Eden et al.[12] have noted that RP patients with previous TURP are older than their counterparts in consecutive series of patients and this may account for the lower continence rates in some series. Also, the ability to spare the NVB may play a role in the slightly decreased rates of urinary continence in these men as well.

In contrast to similar rates of urinary incontinence, erectile dysfunction (ED) may be more common after previous prostate surgery. Postoperative erectile status in men undergoing RP is dependent on several factors including age, preoperative erectile function, and adequate preservation of the NVB.[29] Comparison of erectile function outcomes after RP between series is difficult due to varying definitions and methods of data collection. In the large series of standard RP by Catalona et al.,[9] the mean age at prostatectomy was 63 years, and the authors were able to achieve partial NVB preservation in 93% and bilateral NVB sparing surgery in 86%. Overall potency rates in men undergoing nerve-sparing surgery in this study were 67%, and specifically in men age 60 to 69, postprostatectomy potency was achieved in 60%. Table 9.2 shows the potency data of several series in men undergoing RP after previous prostate surgery. The average patient in all these series is comparable to the 60- to 69-year-old demographic seen in the study by Catalona et al.,[9] and the potency preservation results after previous prostate surgery do not appear to be as good.

In the years since Walsh and Donker[30] first described the anatomic RP, Bandhauer and Senn[1] were the first to note difficulty in the dissection of the NVB in men who had previously undergone TURP, and all 16 patients in their series were impotent postoperatively. Other authors have also noted difficulty in dissecting the NVB. Menard and colleagues[10] recently published an abstract of 640 patients undergoing LRP with 46 patients having previous TURP. The authors reported the ability to preserve the NVB in only 56% of cases after TURP compared to 75% in those without previous TURP. Interestingly, the potency rates between the two groups did not differ significantly at 1 year, 45% versus 40%. Katz and colleagues[6] also described a greater subjective difficulty in performing NVB preservation in their series of LRP, and thus less than half of patients underwent a bilateral nerve-sparing operation. Of the nine men undergoing bilateral nerve-sparing surgery, only three of these patients were considered potent postoperatively. Additionally, five patients underwent unilateral nerve-sparing LRP, with only one being considered potent postoperatively. The majority of these 14 men were 65 years of age or older, which may contribute greatly to the potency outcomes reported.

Colombo et al.[5] used the International Index of Erectile Function–5 (IIEF-5), a validated quality-of-life instrument,[31–33] to compare preoperative and postoperative potency in men with and without a history of previous prostate surgery. Of the original 109 men with a history of TURP before RP, only 43 patients had complete baseline and follow-up potency data for analysis, while all 120 men in the comparative prostate surgery–naive group had complete data. The mean preoperative IIEF-5 scores in both groups of men reflected no ED, with scores of 23 in the previous TURP group and 24 in the no-surgery group. Follow-up potency data revealed that only 18 of these 43 men underwent NVB preserving surgery, and only five of these men had preservation of erectile function at 6 months. In contrast, 71 men out of 120 in the comparative group successfully underwent nerve-sparing surgery, with 47 men reporting successful preservation of erectile function at 6 months. While this study was not specifically designed to evaluate long-term potency outcomes, the potency results of the series in Table 9.2 support the contention that preservation of the NVB is more difficult after previous TURP and may contribute to lower potency rates.

Timing and Technical Modifications

The most appropriate time interval to wait between previous prostate surgery and RP has not been clearly established, but several authors have reported varying levels of difficulty at certain intervals. Nichols and colleagues[34] in 1977 described their results in 33 men undergoing RRP after TURP. The authors calculated morbidity scores for each patient based on the presence or absence of four morbidity endpoints. They then examined the morbidity scores using specific time intervals as cut points and found men utilizing an interval of at least 42 days between procedures demonstrated lower morbidity scores. This led the authors to recommend at least 6 weeks between procedures. In their series of RPP, Elder and colleagues[3] reported an overall 20% incontinence rate after previous surgery. Of those with incontinence, 50% underwent surgery between 4 weeks and 4 months after TURP. No patient in this series was incontinent when surgery was performed outside of this time interval. Eden and colleagues[12] failed to note a subjective or objective difference when performing LRP after previous prostate surgery, yet all patients in this series had at least a 3-month interval between initial surgery and RP. Katz and colleagues[6] also advise waiting at least 3 months between surgeries to allow for increased tissue healing and resolution of edema. Thus, if possible, a 3- to 4-month period should be allowed between initial TURP and RP.

Alterations in surgical technique may facilitate RP in the man with previous prostate surgery. The presence of fibrosis and inflammation at the bladder neck (BN) may result in a more difficult dissection at this location, potentially leading to either ureteral injury or a more complex vesicourethral anastomosis.[1] Early identification of the ureteral orifices may be helpful in preventing ureteral injury during dissection, particularly if the bladder neck has been distorted by previous resection. Ureteral stents should be used whenever ureteral location is in question. During open RP ureteral stents or pediatric feeding tubes can be placed easily once the anterior bladder neck has been incised.[5] Placement of double-J ureteral stents cystoscopically prior to LRP does not adversely affect bladder neck remodeling or the complexity of the vesicourethral anastomosis and provides a landmark for identification of the ureters.[6] Since the BN is usually wide open and fibrotic, BN reconstruction is usually required prior to performing the vesicourethral anastomosis. Reconstruction of the BN has been shown to be advantageous in this population. By tailoring the bladder neck in a posterior, racket-handle fashion, the distance between the ureteral orifices and the site of the anastomosis is increased, and the newly constructed BN is relocated to a more mobile area of the bladder.[6,12] Additionally, performing wide, lateral mobilization of the bladder allows for decreased tension on the vesicourethral anastomosis of even greater importance in a potentially fibrotic bladder neck.[1]

In summary, the technical aspects of RP can be altered by previous prostate surgery. However, complications remain low and functional outcomes are acceptable. Preservation of the NVB is more difficult after previous surgery and may result in lower potency rates, but continence should not be adversely affected. The surgeon should anticipate periprostatic and BN fibrosis that are likely to result in a more difficult dissection. However, with technical modifications, the operation can usually be performed safely.

Surgery After Failed Local Therapy

Salvage Radical Prostatectomy

When local radiotherapy fails as a primary treatment for prostate cancer, men with longer life expectancies and good performance status may be offered additional local therapy in the form of salvage radical prostatectomy, salvage radical cystoprostatectomy, salvage cryotherapy, or salvage brachytherapy.[36] Salvage RP is the only secondary prostate cancer treatment that has shown substantial, long-term cancer control and good treatment tolerability in men with local recurrence after failed RT.[37–42] However, salvage RP is infrequently used in men with increasing PSA after RT mainly due to trepidation regarding surgical difficulty and perioperative morbidity. Yet, studies have shown that up to 70% of men with a rising PSA after RT harbor locally recurrent disease.[43] The incidence of local recurrence in RT series ranges from 4.6% to 17% for cT1 disease and from 28% to 39% for cT3 disease.[44] In this section of the chapter, we outline the rationale, indications, technical challenges, and long-term results of salvage RP for locally recurrent prostate cancer after radiation therapy (RT). We also discuss the role of radical surgery in the setting of locally recurrent tumor after primary radical prostatectomy.

The Role of PSA in Salvage Radical Prostatectomy

The key to treating local recurrence is in identifying patients early before local progression and distant metastasis occurs. The American Society for Therapeutic Radiology and Oncology (ASTRO) definition of biochemical recurrence (BCR) after RT requires three successive rises in PSA level after a nadir PSA is achieved and suggests that these should be separated by 6 months.[45] Because one must wait 18 months to define BCR after RT, early identification of men who are at risk for local recurrence and who may benefit from salvage RP is difficult. As a result of this delay, the average time from RT to salvage RP in most series is 40 to 58 months.[38–40] Additionally, variations in PSA after RT may delay salvage therapy. A phenomenon known as PSA bounce occurs in up to 30% of patients within 3 years of RT in which patients experience a transient increase in PSA values with subsequent return to baseline PSA levels.[46–48]

While the median duration of PSA bounce has been reported to be as low as 12 months, other authors have reported bounce durations of 18 to 60 months.[47,48] While PSA bounce does not predict BCR, it does produce significant anxiety for patients. Early detection of local recurrence after RT may be best determined by using a specific post-nadir PSA cut point, or the nadir level itself, as these have both been strongly associated with BCR.[49]

A correlation between positive post-RT prostate biopsy and disease progression does exist, but biopsy results must be interpreted with caution. A significant number of patients undergoing prostate biopsy within 2 years after RT have a positive result, and the positive biopsy rate varies widely in the literature.[50] In a series of patients undergoing external beam radiation therapy (EBRT) and gold seed implantation, Scardino[51] reported a 58% local recurrence rate at 5 years and 82% at 10 years in men with positive prostate biopsies as compared to local recurrence rates of 18% and 32% at 5 years and 10 years, respectively, in men with negative biopsies. Yet, approximately 30% of patients with a positive biopsy at 12 months after RT will convert to a negative biopsy by 30 months.[50] Thus, while prostate biopsy alone is not recommended to define local recurrence within the first 2 years after RT, positive results on prostate biopsies performed 24 to 36 months after RT are highly predictive of radiation failure.[52] A rising PSA in association with a negative metastatic survey may likely represents locally recurrent disease. In the series by Zagars and colleagues,[43] 72% of men undergoing a prostate biopsy to investigate a rising PSA after RT were estimated to have local disease based on a negative metastatic survey and viable prostate cancer in the biopsy specimen. Thus, Eastham and Scardino[53] have defined local recurrence as a rising PSA in addition to a positive prostate biopsy and advocate that postradiation prostate biopsy be performed 18 to 24 months after RT.

Morbidity

The major drawback to salvage RP is the fear of operative morbidity and long-term complications. Yet, in experienced hands, salvage RP can provide good long-term outcomes with acceptable morbidity. Table 9.3 shows the perioperative and late postoperative complication rates of the largest salvage RP series. These contemporary studies show that rates of rectal injury are strikingly low and only slightly higher than the 0.05% to 9% seen in standard RP series reported by both open and laparoscopic surgeons.[9,13,22,54–59] Increasing experience with salvage RP may also decrease morbidity. Stephenson and colleagues[60] examined the complication rates in patients undergoing salvage surgery before and after 1993. A statistically significant decline over this interval was seen in major complication rate (33% vs. 13%), rectal injury rate (15% vs. 2%), and reoperation rate (15% vs. 3%). Median hospital stay also decreased from 10 to 3 days over this time period. The authors attributed the higher complication rates prior to 1993 to more extensive pelvic fibrosis resulting from the treatment modalities in effect at the time, the high frequency (73%) of pre-RT pelvic lymph node dissection (PLND), and the use of open retropubic interstitial radiotherapy (IRT) (65%). After 1993, PLND and retropubic IRT was performed in only 10% and 27% of patients, respectively. After 1993, their rates of operative and postoperative morbidity were similar to their own published experience with standard RP.[59] Ward and colleagues[41] performed a similar analysis of the Mayo Clinic experience using 1990 as their cut point and noted fewer blood transfusions and rectal injuries after 1990. The rates of anastomotic stricture remain high after salvage RP across all series. Stephenson and colleagues[60] reported a 30% stricture rate both before and after 1993, and Ward and colleagues[41] have seen an increase in strictures since 1990. The stricture rates of all four series are shown in Table 9.3. While the etiology of anastomotic stricture after salvage RP is unclear, microvessel injury from RT resulting in poor tissue healing is likely the cause. Fortunately, anastomotic stricture can be successfully treated in most patients with one or two endoscopic procedures.[42]

Predictors of Survival

Several important preoperative and postoperative factors are useful in predicting the outcome of men treated with salvage RP and are represented in Table 9.4. Preoperative PSA in men undergoing salvage RP has proven to be an important surrogate for oncologic outcome. While the preoperative PSA level has not been shown to specifically predict pathologic stage at salvage RP,[39,40] performing salvage surgery when the PSA is low is associated with better outcomes. Using a preoperative PSA cut point of 10 ng/mL, the 5-year BCR rates range from 53% to 91% in men with PSA greater than 10 ng/mL as compared to rates of 9% to 31% in men with a preoperative PSA of less than 10 ng/mL.[39,40] Figure 9.1 shows the Kaplan-Meier 5-year

TABLE 9.3. Perioperative and Postoperative Complications after Salvage RP.

Series	*Year*	*No. of patients*	*Perioperative mortality*	*Early complication rate (%)*	*Anastomotic stricture (%)*	*Rectal injury (%)*	*Urinary continence (%)*
USC[42]	1983–2003	51	0	–	41	2*	46
Mayo Clinic[40,41]	1990–2000	89	0	27	26	3	56
Wayne State[39]	1992–1997	30	0	17	17	3	50
Baylor/MSKCC[60]	1993–2003	60	0	13	32	2*	68

RP, radical prostatectomy; –, not reported.

*One patient in each series developed a urinary fistula.

Source: Data from Stephenson AJ, Eastham JA. Role of salvage radical prostatectomy for recurrent prostate cancer after radiation therapy. J Clin Oncol. 2005;23:8198–8203.

TABLE 9.4. Predictors of Oncologic Outcome after Salvage Radical Prostatectomy.

Factor	*Poor*	*Good*
Preradiation		
PSA[40]	>10 ng/mL	<4 ng/mL
Stage[39]	T3	T1-T2
Presalvage		
PSA[38,39,42]	>10 ng/mL	<10 ng/mL
Postsalvage		
Gleason[38–40,62]	>7	<7
Stage[38,39,41,42]	T3	T2
Surgical margins[38,39,42,61]	Positive	Negative
Lymph nodes[38,39,40,61]	Metastasis	No metastasis
SV[38,39,40,61]	Involvement	Free of tumor
Molecular		
DNA ploidy[40,41,62]	Aneuploid	Diploid

Source: Data from Chen BT, Wood DP. Salvage prostatectomy in patients who have failed radiation therapy or cryotherapy as primary treatment for prostate cancer. Urology. 2003;62:69–78.

progression-free probability (PFP) rates stratified by preoperative PSA value and illustrates the importance of performing salvage surgery when the PSA level is relatively low. Some authors have challenged the significance of a specific preoperative PSA cut point for salvage RP because it has not shown clear effect on disease-specific survival (DSS) and may exclude patients who would benefit from salvage surgery.[41] However, the preoperative PSA level has been shown to independently predict disease progression after surgery.[38,41,42] Therefore, salvage RP should be performed before the PSA rises above 10 ng/mL. Prostate-specific antigen levels prior to RT are also important predictors of pathologic stage at salvage RP. Amling and colleagues[40] reported a lower incidence of extraprostatic disease and positive lymph nodes in men with pre-RT PSA of 10 ng/mL or less, and men with a pre-RT PSA of less than 4 ng/mL were more likely to have organ-confined disease at salvage RP. These findings suggest that the PSA level prior to both radiation and salvage surgery is important when selecting patients for salvage prostatectomy.

Several postoperative pathologic factors are clearly useful in predicting oncologic outcomes (Table 9.4). In multivariate analysis of 138 patients, Ward et al.[41] found pathologic tumor stage to be the most important, independent predictor of DSS. Likewise, organ-confined disease results in a higher PFP[38] (Fig. 9.2). Uniformly, tumor involvement of the seminal vesicle (SV) and metastasis to the pelvic lymph nodes (LNs) are poor prognostic findings with high rates of disease progression[39] and a fivefold increase in the risk of cancer-specific death.[38] Unfortunately, roughly 40% of patients in salvage RP series are found to have SV involvement and LN metastasis.[9,38–40,61] Surgical margin status is also an important prognostic factor.[38,39,42] Garzotto and Wajsman[61] reported PSM rates of 31% in men undergoing salvage RP after iodine-125 brachytherapy. Disease-free survival at 5 years in this series was markedly improved in men with negative surgical margins as compared to men with PSMs (79% vs. 44%). Pathologic Gleason score (GS) has also been associated with worse disease-free survival (DFS)[38,40] and independently predicts DSS.[62] Furthermore,

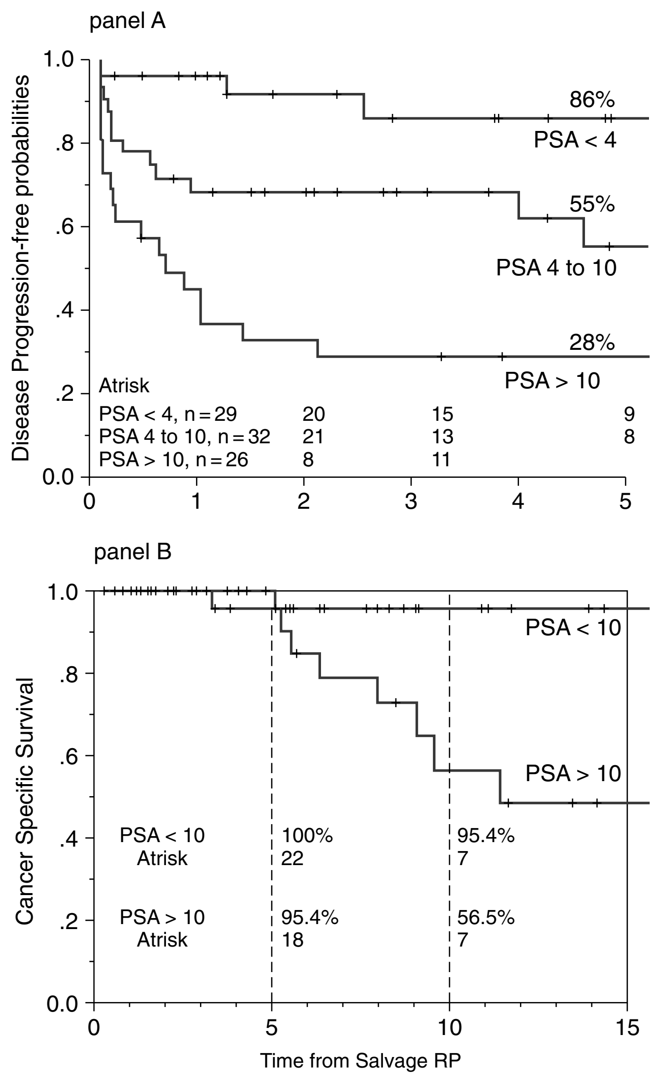

FIGURE 9.1. (**A**) The progression-free probability after salvage prostatectomy distributed by preoperative PSA level (ng/mL) is shown. (**B**) The cancer survival stratified by a preoperative PSA level of <10 or ≥10 (ng/mL). (From Bianco FJ, Scardino PT, Stephenson AJ, et al. Long-term oncologic results of salvage radical prostatectomy for locally recurrent prostate cancer after radiotherapy. Int J Radiat Oncol Biol Phys. 2005;62:448–453, with permission.)

high-grade tumors (GS 8-10) are more prevalent in salvage RP patients with rates of 34% to 44% in some series,[42,62] and cancers with Gleason scores of 9 to 10 may be present in up to 27% of salvage patients.[41]

Tumor DNA ploidy determined from RP specimens has also been shown to be an independent predictor of progression to distant metastatic disease and disease-specific death in salvage RP patients. Amling and colleagues[40] found a higher incidence of tetraploid and aneuploid cancers in men undergoing salvage RP as compared to the tumors seen in men undergoing standard RP, which are typically diploid cancers. On multivariate analysis, DNA ploidy was shown to be a strong predictor of DFS and DSS. Poorer outcomes were seen in men having aneuploid tumors

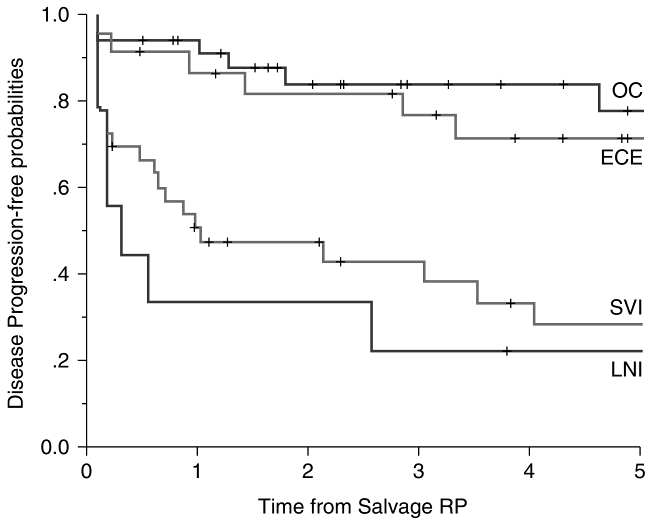

FIGURE 9.2. The progression-free probability after salvage prostatectomy stratified by pathologic stage. OC, organ confined; ECE, extracapsular extension; SVI, seminal vesicle invasion; LNI, lymph node invasion. (From Bianco FJ, Scardino PT, Stephenson AJ, et al. Long-term oncologic results of salvage radical prostatectomy for locally recurrent prostate cancer after radiotherapy. Int J Radiat Oncol Biol Phys. 2005;62:448–453, with permission.)

with reported 7-year DFS of 34% and 10-year DSS of 32% compared to DFS and DSS of 89% and 100%, respectively, in men with diploid tumors. By performing a prostate biopsy prior to salvage radical prostatectomy, analysis of DNA ploidy may help identify those men with aneuploid tumors who are less likely to benefit from salvage RP.

Oncologic Outcomes After Salvage Radical Prostatectomy

Radical prostatectomy after RT is the only salvage treatment modality for prostate cancer reporting 10-year survival data.[38–41] Table 9.5 summarizes the oncologic outcomes of the four largest salvage RP series. Median preoperative PSA ranged from 5.9 to 13.8 ng/mL with the more recent series showing lower preoperative PSA levels. Positive surgical margin rates range from 21% to 36% after salvage RP and are higher than those seen in standard RP series. Rates of organ-confined disease are also much lower than the 60% to 70% that is seen in standard RP.[13,18,22,63] The 5-year DFS rates in these series vary between 47% and 65% and the DSS rates range from 85% to 93%. These outcomes are certainly worse than those reported in standard RP series, reflecting the higher risk, locally advanced nature of many of these cancers.

Functional Outcomes

Table 9.3 shows the functional outcomes and complications after salvage RP reported in the major salvage RP series. When compared to standard RP, the rates of urinary incontinence are high after salvage RP. The rates of urinary continence range between 46% and 68%. With increasing experience, an improvement in the return of continence has been demonstrated. In the series by Stephenson and colleagues,[60] 57% of patients undergoing salvage RP before 1993 reported urinary continence (use of less than one pad per day) compared to 68% after 1993. Ward and colleagues[41] found similar results in their series with 43% of men undergoing salvage RP before 1990 regaining complete continence (one pad per day or less) compared to 56% after 1990. The increased use of interstitial brachytherapy in recent years may, however, contribute higher incontinence rates after salvage RP. In the series reported by Ward et al.,[41] 11 men underwent salvage RP for failed brachytherapy with complete continence rates in these men of only 36%. The authors theorized that periprostatic inflammation was greater in the brachytherapy patients and contributed to lower continence rates. The underlying etiology of the higher rates of urinary incontinence after salvage RP are unclear, but radiation-induced fibrosis and denervation of the sphincteric mechanism is thought to play a role in poorer continence rates.[39] After salvage RP, the factors predictive of the return of urinary continence include prostate size less than 25 cubic centimeters, ability to perform nerve-sparing surgery, and the presence of PSM.[60]

In men with severe urinary incontinence postoperatively (three or more pads per day), the placement of an artificial urethral sphincter (AUS) has been performed with good results. Stephenson and colleagues[60] placed an AUS in 23 patients reporting severe incontinence with all men reporting total continence after sphincter placement. Sanderson and colleagues[42] used the Expanded Prostate Index Composite (EPIC) questionnaire[64] to assess urinary function after salvage RP in 33 patients. Forty-five percent of these men required AUS placement for severe incontinence. Men with subsequent AUS placement were

TABLE 9.5. Oncologic Outcomes of Contemporary Salvage Radical Prostatectomy.

Series	*No. of patients*	*Median follow-up (months)*	*Median preop PSA (ng/mL)*	*Positive surgical margins*	*Organ-confined disease*	*DFS (years)*		*DSS (years)*	
						5	*10*	*5*	*10*
Gheiler et al.[39]	40	36	13.8	21	35	47	–	–	–
Sanderson et al.[42]	51	87	8.0	36	25	47	–*	85†	65†
Bianco et al.[38]	100	60	5.9	21	35	55	30	93	73
Ward et al.[41]	138	84	8.2	30	39	65	43	90	77

PSA, prostate-specific antigen; DFS, disease-free survival; DSS, disease-specific survival.

*No progression after 5 years.

†Overall survival only; disease-specific survival not reported.

categorized as incontinent, and thus the overall continence rate of the men completing the EPIC was 43%; however, 82% of men with an AUS and 69% of men without an AUS reported total continence or occasional dribbling. Overall urinary function and urinary bother scores in men undergoing salvage RP compared favorably to scores in men undergoing primary RT and standard RP.

Traditionally, erectile dysfunction has been a routine consequence after salvage RP due to the difficulty of preserving the NVB. However, Masterson and colleagues[65] demonstrated the feasibility of NVB preservation at salvage RP in select patients. Potency in this series was defined as erections satisfactory for intercourse with or without sildenafil. In total, 29 men underwent NVB preservation at salvage RP with bilateral NVB preservation in seven and unilateral NVB preservation in 22. Unilateral peripheral nerve graft was performed in 11 men undergoing unilateral NVB resection. Postoperatively, six men regained potency, five of the seven men undergoing bilateral NVB preservation and one man undergoing both unilateral NVB resection and unilateral peripheral nerve graft. Three of the six recovering potency did so over a period of 3 years. Sanderson and colleagues[42] also performed NVB preservation in nine patients undergoing salvage RP and placed an inflatable penile prosthesis (IPP) in 11 men. The authors obtained sexual function data in 62% of the patients using the EPIC questionnaire.[64] Results of the EPIC showed that men undergoing salvage RP without NVB preservation had significantly lower sexual function scores than their counterparts who had nerve-sparing surgery. However, those men who received an IPP had the highest sexual function scores, and their scores approached or exceeded that of previously published healthy, age-matched controls. Both of these studies highlight the fact that in the properly selected patients NVB preservation can be performed with acceptable results, and IPP placement remains an option in those men who do not recover potency after salvage RP.

Technical Challenges and Surgical Modification

Salvage RP is a technically challenging operation due to the dense fibrosis induced by RT; thus, preoperative patient selection, surgical technique, and surgeon experience are integral to the success of the operation. As detailed by Russo,[66] surgeons who perform this operation generally choose patients with the following characteristics: (1) age 70 or less; (2) few comorbidities, with a 10-year life expectancy; (3) local recurrence confirmed by needle biopsy; (4) digital rectal examination (DRE) consistent with organ-confined disease; and (5) serum PSA <10 ng/mL. Patients suffering from radiation-cystitis or radiation-proctitis should be fully evaluated with cystoscopy and endoscopy prior to surgery. The patient and physician should have a lengthy discussion regarding the increased morbidity associated with salvage prostatectomy including the rates of urinary incontinence, anastomotic stricture, erectile dysfunction, and rectal injury. Thorough mechanical and antibiotic bowel preparation should be carried out preoperatively. In several series, this precaution has allowed for primary repair of rectal injuries and obviated the need for colostomy in many cases.[38] Modifications in surgical technique may be necessary to successfully complete salvage RP. Prior surgery including PLND and open brachytherapy in addition to pelvic radiation can make access to the retropubic space very difficult, as normal planes are likely to be obliterated. Dissection of the retropubic space must be done with great care, using a combination of blunt and sharp technique. The iliac vessels are particularly susceptible to injury if previous PLND has been performed. In the instance when the retropubic space cannot be entered, the peritoneal cavity should be utilized as a route to the prostate and pelvis.

Surgical challenges in salvage RP have changed as the methods of administering radiotherapy have changed. Stephenson and colleagues[60] reported utilizing an abdominoperineal approach in 28% of patients undergoing salvage RP before 1993 compared to 0% after 1993. The abdominoperineal approach has historically been reserved for patients previously undergoing open interstitial radiotherapy. This approach facilitates easier dissection of the rectum from the prostate. The prostatic dissection is carried to the level of the seminal vesicles, with the remainder of the operation being carried out through a midline suprapubic incision. In contemporary series, though, a standard retropubic approach has proven adequate for the majority of procedures. In the series by Stephenson et al.[60] after 1993, a standard retropubic approach with retrograde prostatic dissection was performed successfully in 93% of cases, while a retropubic antegrade dissection was used in 7%. Pelvic lymph node dissection should be carried out prior to prostatic dissection. Frozen sections of the pelvic nodes should be sent for analysis and the procedure halted if nodal disease is found. Standard retropubic techniques should be carried out if possible, including ligation and division of the dorsal vein, division of the urethra, and control of the lateral pedicles. Antegrade dissection of the bladder neck may be required due to the fibrosis between the prostate and rectum. Nerve-sparing surgery has typically been omitted in these patients for fear of positive surgical margins and due to the difficulty of nerve preservation. However, recent series have reported the feasibility of NVB preservation. While the incidence of rectal injury has been low, the surgeon should be prepared if such an event occurs. If possible and if preoperative bowel preparation is adequate, the injury may be considered for primary repair using a two-layer closure. A mobilized segment of omentum should be interposed if possible over the injury prior to vesicourethral anastomosis to prevent fistula formation. Gross spillage of fecal contents associated with a rectal injury may require diverting colostomy for adequate healing particularly in patients with poor tissue characteristics secondary to radiation. The Foley catheter is typically left in place for up to 2 weeks.[66,67]

Bladder neck reconstruction with precise mucosa-to-mucosa approximation during vesicourethral anastomosis is key to the success of the operation, as anastomotic stricture rates in contemporary series have remained high.[41] Eversion of the bladder mucosa followed by a standard racket-handle reconstruction is advocated once the prostate has been excised. The disappointing incidence of anastomotic stricture has caused some authors to change their method of vesicourethral anastomosis. Stephenson and colleagues[60] have adopted a new method of vesicourethral anastomosis that entails closing the bladder neck in two layers and creating a new 26-French to 30-French bladder neck opening anterior on the bladder wall away from previous radiation. Long-term follow-up of this technique will provide better insight into any effect it may have on anastomotic stricture rate.

Lower continence rates after salvage RP have led some to explore novel urinary reconstruction techniques in these patients. Pisters and colleagues[68] reported their experience at the M.D. Anderson Cancer Center with salvage RP, complete bladder neck closure, and continent catheterizable stoma. Between 1995 and 1999, 13 patients undergoing salvage RP had bladder neck closure with formation of a continent catheterizable stoma performed. An appendicovesicostomy was used in nine patients and an ileovesicostomy in four. Five major postoperative complications were seen, including reoperation in four patients and one postoperative death secondary to sepsis from leakage of the bowel anastomosis. In follow-up, 10 patients remain dry both day and night with catheterization performed every 2 to 6 hours. Despite the technical challenges of the operation and the associated complication rate, the authors did note improved continence outcomes over contemporary series of standard vesicourethral anastomosis. Thus, informed and highly motivated patients may be considered candidates for this procedure.

Recently, salvage RP has been performed using a laparoscopic technique. The preliminary results were reported by Vallancien and colleagues[69] in 2003. Seven patients underwent laparoscopic salvage surgery after failed primary treatment with EBRT performed in five and interstitial brachytherapy performed in two. The authors described using a finger-assisted dissection in which a finger was placed in the rectum to facilitate the prostatorectal dissection. No intraoperative complications occurred, and the mean hospital stay was 6.2 days. At 11.2 months of follow-up, five patients are continent and two have stress incontinence. No nerve-sparing procedures were performed. To date, BCR has occurred in two patients, with the remaining five having undetectable PSA values. In addition, no anastomotic strictures occurred during follow-up. The results reported in this series represent outcomes in a very small number of patients and from a group with an extensive laparoscopic experience

Salvage Radical Surgery for Bulky Local Recurrence After Radical Prostatectomy

Radical prostatectomy is an effective method of cancer control, yet some 20% to 40% of men are at risk for recurrence of disease at 5 years.[70,71] Traditionally, biochemical failure and local recurrence after radical prostatectomy is treated with salvage RT[53,72] or with hormone deprivation therapy. Salvage RT is often reserved for men with evidence of biochemical failure many years after RP because those with high-risk features and early PSA rise are not likely to benefit from RT due to a higher likelihood of metastatic disease.[72] Bulky local recurrence after RP or both RP and salvage RT, however, represents a much different management dilemma. In 2005, Leibovici and colleagues[73] reviewed their series of five patients undergoing salvage radical surgery for bulky, locally recurrent prostate cancer after primary RP and salvage RT. The goal of radical surgery in this distinct population was the palliation of cancer symptoms and the control of local disease. All five men had previously undergone RP, with four of the five undergoing salvage radiation therapy for recurrent prostate cancer. Four of the five men had persistent, debilitating symptoms prior to surgery including hematuria, bladder outlet obstruction (requiring bilateral percutaneous nephrostomies), renal failure, rectal pain, and pelvic pain. Palliative treatment was carried out in four patients with total pelvic exenteration including fecal and urinary diversion. One patient was treated with resection of the vesicourethral anastomosis, bladder neck closure, and continent abdominal stoma. The authors freely admit that salvage surgery after previous RP is technically challenging and a major undertaking for both the patient and the surgeon. Tumor size in the five patients ranged from 3.8 to 10 cm in greatest diameter. While the intraoperative blood loss was not reported, the authors transfused an average of five units of blood per case. However, aside from the modest blood loss intraoperatively, no life-threatening complications or deaths occurred as a result of surgery. Postoperatively, local symptoms resolved in four of the five patients. One patient experienced persistent symptoms including the development of a new enterourethral fistula. No patient required long-term urinary drainage in the form of catheters, ureteral stents, or nephrostomy tubes after surgery. Biochemical failure (defined as two consecutive PSA increases) occurred in three patients, and two patients achieved undetectable PSA values. Two patients died of metastatic disease after surgery, one at 26 months and one at 3.5 months. Three patients were still alive after salvage surgery at 55 months, 5 months, and 7 months, respectively. The authors suggest that the population of men with locally recurrent prostate cancer likely to benefit from salvage surgery is low, yet the operation is technically feasible, is tolerated by patients, and may prolong survival in selected patients. This surgical approach to local recurrence after radical prostatectomy is used infrequently and should be considered secondary to more commonly used treatments for locally recurrent disease.

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10

Introduction to Reoperative Pelvic Surgery for Rectal Cancer

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Despite significant progress in the treatment of rectal cancer, local recurrence remains a difficult problem,[1] resulting in considerable morbidity and high cancer-related mortality. Prevention of local recurrence should therefore be the chief goal of the operating surgeon and multidisciplinary management team. However, some patients are potential candidates for curative re-resection and therapy. This chapter addresses the issues involved in surgical management of patients with locally recurrent rectal cancer.

Improved therapeutic strategies for patients with primary rectal cancer, including the surgical technique of total mesorectal excision (TME) as well as advances in neoadjuvant chemoradiotherapy, have improved outcomes and decreased the proportion of patients presenting with locally recurrent disease.[2] In studies published before the widespread use of TME, patients undergoing curative-intent rectal cancer surgery reportedly had a 4% to 30% risk of developing locoregional recurrence.[3,4] More recent studies, reflecting increasing use of TME as the acknowledged standard of surgical treatment, report 5-year local recurrence rates ranging from 5% to 15%.[5–10] However, 30% to 50% of these patients will die from locally recurrent tumor as the only manifestation of disease.[11,12]

While some local recurrences are true anastomotic recurrences, most adhere to or invade major pelvic structures. Such recurrences are difficult to address surgically, and treatment of these patients is therefore quite challenging.[13] In the absence of surgical intervention, however, 5-year survival following local recurrence is less than 5%, with a mean survival of only 7 months.[12] Therefore, surgery should be strongly considered whenever technically feasible. Surgical resection alone or external beam radiotherapy alone results in reported 5-year survival rates of 20% to 31% and 5% to 10%, respectively.[14–20] To better address the significant symptoms associated with recurrent rectal cancer with the intent to improve overall survival, a number of highly specialized institutions have used multimodality therapy, including preoperative chemoradiation, extensive surgery, and intraoperative radiation therapy (IORT). IORT, as part of multimodality therapy, has been undertaken in an attempt to improve survival as well as local control, with some benefits seen in carefully selected patients.[21–24] Studies of the true efficacy of IORT are ongoing. The 5-year survival rates for patients with recurrent rectal cancer who undergo multimodality therapy can range from 25% to 40% in highly specialized centers.[9,13,25–27]

Risk Factors and Prevention

The best management of recurrence is, of course, prevention. Tumor biology plays an important role in the likelihood of recurrence. However, despite ongoing efforts to determine the prognostic impact of specific histologic features, no tumor-specific characteristics have as yet been clearly associated with local recurrence. This much is clear: the more advanced the stage of the primary rectal cancer, the greater the potential for recurrence. When surgical resection is properly carried out, stage I rectal cancer has a very low potential for local recurrence. This potential increases in the setting of stage II and III rectal cancers, even with the use of adjuvant chemoradiation. Other influential factors include intratumoral lymphatic or vascular invasion, perineural invasion, tumor aneuploidy, high tumor grade, necrosis, obstruction, or perforation at time of presentation.[28–33]

Surgically, one of the major determinants of recurrent disease following primary resection is a positive circumferential or distal resection margin[34–36]; incomplete resection is a compromise treatment. Clinical and pathologic studies have shown that a positive surgical margin is associated with a much higher incidence of local recurrence than a negative surgical margin. Therefore, a major objective of sphincter-preserving resection in rectal cancer patients is procurement of negative gross and histologic surgical margins, best achieved with TME. Because distal intramural

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tumor extension below the mucosa is noted in as many as 40% of patients, with extension of more than 1 cm in 4% to 6%, a distal resection margin of 2 cm has traditionally been advocated for nonirradiated patients in order to optimize oncologic outcome.[37–39] However, a recently reported prospective study at Memorial Sloan-Kettering Cancer Center (MSKCC) by Guillem et al.[40] applying comprehensive pathologic analysis to rectal cancer specimens, showed that in patients with rectal adenocarcinoma following preoperative combined modality therapy (CMT) and TME-based resection, distal margins of 1 cm may suffice for complete removal of locally advanced tumor. Guillem and colleagues concluded that, although residual cancer after preoperative CMT is more likely in the setting of distally located tumors, occult tumor beneath the mucosal edge is rare and, when present, limited to less than 1 cm (Fig. 10.1). These results extend the indications for sphincter preservation, as distal resection margins of only 1 cm may be acceptable following preoperative CMT.[40]

Adherence to the technique of TME rather than blunt dissection increases the likelihood of achieving negative margins and completely resecting mesorectal deposits, and is thus associated with a lower incidence of local recurrence. A study by Heald and Ryall[41] demonstrated that technically correct TME was associated with less than 3% local recurrence at a mean follow-up of 4.2 years. The authors later published another series showing an actuarial local recurrence rate of 5% at 5 years after curative anterior

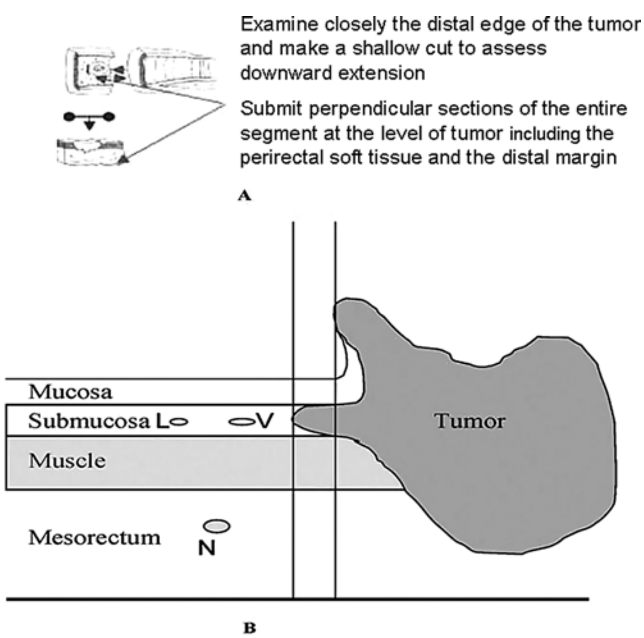

FIGURE 10.1. (**A**) Examination of rectal specimen for distal mural spread beneath mucosal edge of the tumor. (**B**) Schematic diagram representing potential sites of viable tumor extension beneath distal-most mucosal edge of the tumor. Sites include the submucosa, muscle, mesorectum, lymphatic vessel, blood vessel, and nerve. L, lymphatic vessel; V, blood vessel; N, nerve. (From Guillem JG, et al. A prospective pathologic analysis using whole-mount sections of rectal cancer following preoperative combined modality therapy: implications for sphincter preservation. Ann Surg. 2007;245(1):88–93, with permission of Lippincott Williams & Wilkins.)

TABLE 10.1. Local Recurrence After Total Mesorectal Excision (TME) in Patients with Primary Rectal Cancer.

Study	n	*Follow-up (months)*	*Dukes stage:* n (%)	*Local recurrence (%)*
Bulow et al.[106] (2003)	311	36	A: 73 (23) B: 143 (46) C: 93 (30)	11
Nesbakken et al.[107] (2003)	134	38	A: 38 (28) B: 56 (42) C: 40 (30)	9
Wibe et al.[36] (2002)	686	29	A: 165 (24) B: 261 (38) C: 260 (38)	7
Heald et al.[108] (1998)	519	99	A: 102 (20) B: 167 (32) C: 142 (27) D: 108 (21)	3
Enker et al.[109] (1995)	246	72	B: 99 (40) C: 147 (60)	7

resection.[7,41] Similar results have been reported by other groups, confirming that local recurrence rates range from 3% to 11% when the principles of TME are rigorously followed (Table 10.1).[6–9,36]

Treated with proper surgical resection, stage I rectal cancer poses a very low risk of local recurrence. The potential risk increases significantly, however, in the setting of stage II and III rectal cancers, even with adjuvant chemoradiation. Over the last two decades, neoadjuvant therapy has been shown to reduce rates of local recurrence. Several studies have attempted to assess the role of adjuvant therapy in reducing local recurrence and improving survival. Preoperative and postoperative radiotherapy have consistently been shown to facilitate reduction in local recurrence. A 2001 meta-analysis of 22 randomized radiotherapy trials suggests that preoperative radiotherapy reduces the risk of local recurrence and death from rectal cancer.[42,43] Three recently published meta-analyses have documented the definitive superiority of neoadjuvant treatment over adjuvant treatment with regard to reduction in local failure rates and cancer-specific survival.[42,44,45] The Dutch Rectal Cancer Trial, a randomized, multicenter study of 1861 patients, addressed the role of preoperative radiation and its impact on local recurrence in patients undergoing optimal surgery (TME). They reported that 2-year local recurrence rates were significantly improved (from 8.2% to 2.4%) when radiation was given preoperatively, before TME.[6] A reduction in local recurrence rates at 5 years was observed: from 11.4% recurrence after TME alone to 5.6% after preoperative radiotherapy and TME. However, this did not translate into an improvement in 5-year survival. Additionally, radiotherapy is associated with higher morbidity. The advisability of adding chemotherapy to preoperative radiation (neoadjuvant combined chemoradiotherapy) has undergone intense scrutiny vis-à-vis its impact on local recurrence and survival. Additional 5-fluorouracil (5-FU)–based chemotherapy theoretically acts as a radiosensitizing agent, albeit at the high cost of increased hematologic and gastrointestinal toxicity. In the recently published European Organization for Research and Treatment of Cancer (EORTC) trial 22921, patients with clinical stage T3 or T4 resectable rectal cancers were randomly assigned to receive one of the following four treatments: preoperative radiotherapy, preoperative chemoradiotherapy, preoperative radiotherapy and postoperative chemotherapy, or preoperative chemoradiotherapy and postoperative chemotherapy. The 5-year cumulative incidence rates for local recurrences were 8.7%, 9.6%, and 7.6%, respectively, in the groups that received chemotherapy preoperatively, postoperatively, or both; the cumulative 5-year incidence rate was 17.1% in the group that did not receive chemotherapy ($p = .002$). The authors concluded that chemotherapy, regardless of whether it is administered before or after surgery, confers a significant benefit with respect to local control.[46]

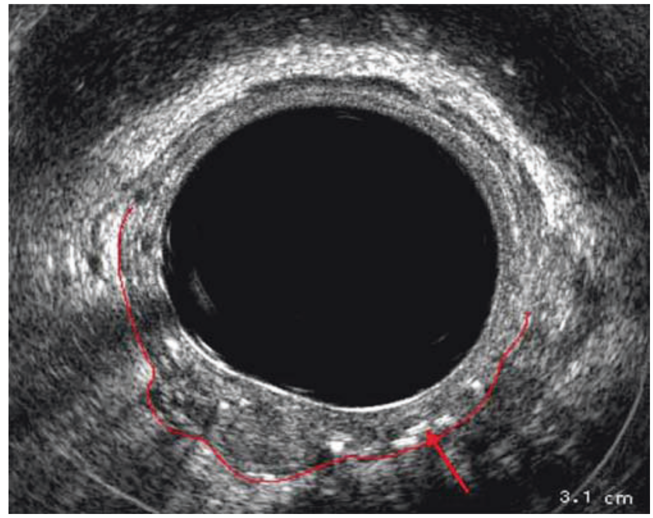

FIGURE 10.2. Endorectal ultrasound (ERUS) image showing recurrent rectal cancer (line) at the anastomosis. *Arrow*, staple line; *line*, delineation of locally recurrent tumor.

Prognostic Factors

The length of time between resection of the primary rectal cancer and diagnosis of local recurrence is prognostic for outcome. An interval of less than 1 year is a poor prognostic indicator; this may reflect both the adequacy of the original surgical resection and the biology of the cancer. An isolated, true anastomotic recurrence is a good prognostic factor (Fig. 10.2). Many are likely related to implantation of tumor cells in the fresh anastomosis; these are generally identified at an early stage during endoscopic follow-up, which makes them more amenable to resection with negative margins. Central (as opposed to peripheral) recurrences are more amenable to resection with negative margins, and are therefore associated with a better surgical outcome. Hahnloser et al.[9] analyzed a total of 394 patients who underwent surgical exploration for recurrent rectal cancer with curative intent. They identified several factors predictive of curative resection vs. palliative resection and prognostic for overall survival. In a logistic regression analysis, initial surgery with end-colostomy and symptomatic pain (both univariate) and increasing number of sites of recurrent tumor fixation in the pelvis (multivariate) were associated with palliative surgery (Table 10.2). Furthermore, they showed that overall survival was significantly decreased in the setting of symptomatic pain or more than one tumor fixation (Fig. 10.3).

In an MSKCC study of 119 patients treated with surgery and IORT for recurrent colorectal cancer from 1994 to 2000, Moore et al.[47] found that tumors confined to the axial location, or the axial and anterior locations, are more likely to be completely resectable than tumors involving the pelvic sidewall or lateral structures. They found that negative margins were achieved in 90% of patients with axial recurrences only, and in 71% of those with axial and anterior recurrences only (Table 10.3). In cases where there was no lateral involvement by tumor, negative margins were achieved 64% of the time, and in cases where there was no iliac vessel involvement, negative margins were achieved 55% of the time. However, when the location of

TABLE 10.2. Factors Associated with Palliative Versus Curative Surgery.

	Univariate (frequency)			*Multivariate (logistic)*		
Variable	OR	95% CI	*p* value	OR	95% CI	*p* value
Gender						
Male vs. female	0.8	0.5–1.3	.32	–	–	–
Age						
<60 years vs. ≥60	1.0	0.7–1.6	.88	–	–	–
Primary operation						
Sphincter-preserving vs. stoma	1.7	1.1–2.0	.02	0.5	0.2–0.9	.06
Recurrent cancer						
No vs. 1 fixation	5.8	3.1–10.9	.001	8.3	3.9–17.4	.001
No vs. 2 fixations	12.9	6.5–25.9	.001	16.2	7.0–37.6	.001
No vs. 3 or more fixations	48.8	19.9–118.9	.001	57.2	17.2–189.5	.001
Presence of symptoms						
Asymptomatic vs. symptomatic, no pain	0.9	0.5–1.9	.97	–	–	–
Asymptomatic vs. symptomatic + pain	3.2	1.8–5.7	.001	1.4	0.67–3.0	.35

OR, odds ratio; 95% CI: 95% confidence interval.

Source: From Hahnloser D, et al. Curative potential of multimodality therapy for locally recurrent rectal cancer. Ann Surg. 2003;237(4):502–508. Used with permission of Lippincott Williams & Wilkins.

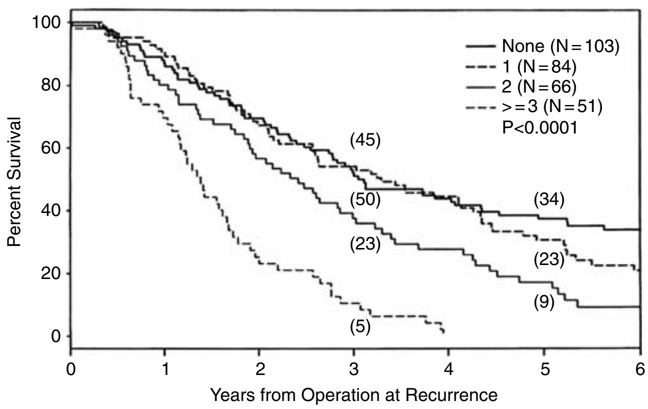

FIGURE 10.3. Kaplan-Meier survival curve comparing the number of fixations of the locally recurrent rectal cancer to the pelvis. The numbers in brackets on each curve indicate the number of patients alive at 3 and 5 years, respectively. (From Hahnloser D, et al. Curative potential of multimodality therapy for locally recurrent rectal cancer. Ann Surg. 2003;(4):502–508, with permission of Lippincott Williams & Wilkins.)

the recurrence was other than axial and anterior, negative margins were achieved in only 43%; when there was lateral involvement by tumor, negative margins were achieved in only 35%; and when the iliac vessel was involved by tumor, negative margins were achieved in only 17%.

TABLE 10.3. Anatomic Involvement of the Recurrent Cancer and Percent R0 Resection.

Anatomic involvement[a]	*No. of Patients*	*% R0*	*Odds ratio (95% confidence interval)*	*p value*
Axial only				
Yes	21	90	12.7 (2.8, 116)	<.001
No	98	43	1	
Axial/anterior only				
Yes	36	72	3.6 (1.4, 9.3)	.003
No	83	42	1	
Posterior				
Yes	44	50	1	.52
No	75	52	1,1 (0.48,2.4)	
Lateral				
Yes	56	36	1	.002
No	63	65	3.4 (1.5, 7.6)	
Iliac Vessel				
Yes	12	17	1	.01
No	107	55	6.1 (1.2, 59.5)	
Ureteral				
Yes	17	29	1	.07
No	102	55	2.9 (0.87, 11.3)	
Vaginal[b]				
Yes	10	53	1.1 (0.32, 3.9)	1
No	36	50	1	

[a]Tumor could involve more than one location.

[b]Female patients only ($n = 55$).

Source: Adapted from Moore HG, et al. Colorectal cancer pelvic recurrences: determinants of resectability. Dis Colon Rectum. 2004;47(10):1599–606, with permission of Springer Science + Business Media.

Management of Recurrent Rectal Cancer

The management of recurrent rectal cancer can be divided into three phases (Tables 10.4–10.6). Phase 1 involves diagnosis, evaluation, and preoperative workup of the patient, with staging to define extent of disease. Phase 2 involves preoperative chemoradiation for those who are suitable candidates. Phase 3 involves surgical and ancillary approaches to local pelvic recurrence.

Phase 1

General Evaluation, Risk Assessment, and Initial Staging

Once the diagnosis of local recurrence is established, the patient should undergo a general evaluation and risk assessment. Complete resection may be technically feasible in some cases. However, if an individual's overall physical or psychological condition makes him or her a poor risk for extensive re-resection, noncurative alternatives such as surgical palliation and chemoradiation may be indicated.

TABLE 10.4. Phase 1 in Management of Recurrent Rectal Cancer.

General evaluation and risk assessment
- Healthy (ASA I-III)
  Initial staging
- Exclude contraindications
- Confirm local disease (histology)
- Determine resectability (clinical, imaging)
- • Clinical
  FO: not fixed
  FR: fixed resectable
  FNR: fixed nonresectable
- • Imaging
  Spiral CT
  MRI
  PET/CT

TABLE 10.5. Phase 2 in Management of Recurrent Rectal Cancer.

Preoperative therapy	
• If no prior RT	5040 cGy + chemotherapy
• If limited prior RT	Modified regimen
• If full dose prior RT	No additional RT; possible chemotherapy
Restage to R/O interval distant metastases	

TABLE 10.6. Phase 3 in Management of Recurrent Rectal Cancer.

Surgical resection
- Ureteral stents
- Laparotomy
- Mobilization, resection, stoma vs. anastomosis
- Extended resection (multidisciplinary team)
  - Exenteration (anterior, posterior, or total)
  - Sacrectomy
- Frozen section margins
- Intraoperative radiation therapy (IORT)
- Reconstruction
  - Omentum
  - Rectus abdominis flap
  - Gracilis, others

Patients in poor health who are unlikely to tolerate multimodality therapy followed by curative-intent surgery, or who have an American Society of Anesthesiologists (ASA) classification of IV or V are not acceptable surgical candidates. Emotional and psychological factors such as motivation, realistic expectations, and preparedness are as important as physical health status in facing this challenging course of combined treatment. If the patient is relatively healthy (ASA I–III, without evidence of distant disease) he or she may be considered for a potentially curative approach. Patients should be informed and willing to accept the short- and long-term risks and potential functional limitations associated with the multimodality approach, as well as the possibility that subsequent procedures or interventions may be required in the event of postoperative complications or re-recurrence.

Staging is undertaken to identify any contraindications to resection. The goal is to evaluate the extent of local disease and rule out extrapelvic spread. Histologic verification of recurrence should be obtained by either endoscopic or computed tomography (CT)-guided biopsy. Colonoscopy should be performed whenever technically possible in order to rule out the presence of synchronous lesions. Workup should include a complete clinical examination. Particular attention should be directed to the rectal or rectovaginal exam, as these are crucial in determining whether a recurrence is mobile, tethered, or fixed to rigid pelvic structures. Symptoms suggesting metastatic disease, such as extrapelvic bone pain, changes in respiratory symptoms, and neurologic pain or headaches, must be carefully evaluated.

Imaging studies should be done to assess resectability and rule out distant metastatic disease. Most patients initially undergo CT imaging of the chest, abdomen, and pelvis, which has demonstrated accuracy in evaluating recurrent rectal cancer and the presence of extrapelvic disease (Fig. 10.4). Magnetic resonance imaging (MRI) of the pelvis can provide additional valuable information; the extent of pelvic sidewall involvement, sacral involvement, and the proximity and potential involvement of the major pelvic and sacral nerve roots are all best seen on MRI. Recurrent extra mucosal rectal lesions identified by endorectal ultrasound are amenable to ultrasound-guided needle biopsy (Fig. 10.5).

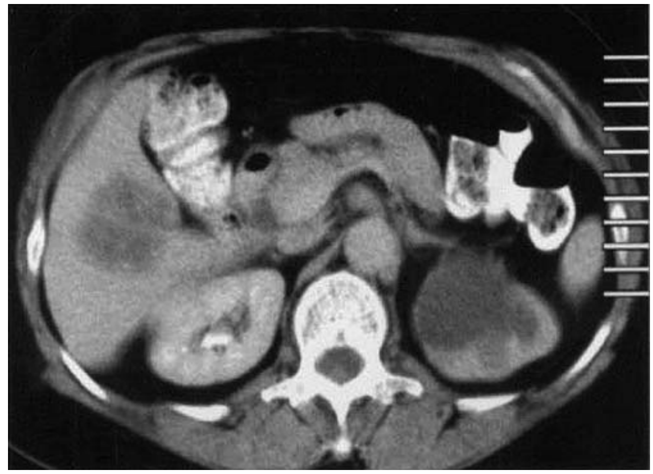

FIGURE 10.4. CT scan showing metastatic liver disease from recurrent rectal cancer.

Accurate identification of extrapelvic disease is essential. CT, MRI, and nuclear medicine scans (positron emission tomography [PET]; PET/CT) are all useful imaging modalities for showing disseminated or extrapelvic disease. All can be used to detect hepatic metastases; the sensitivity of CT and MRI in identifying colorectal liver metastases are reportedly 82% and 84%, respectively.[48]

Intraluminal recurrence may be detected on follow-up sigmoidoscopy or colonoscopy. However, the majority of local rectal recurrences are extraluminal, as reported by Barkin et al.[49] in their analysis of 452 patients followed by endoscopic examination after colorectal cancer surgery. Barkin et al. identified 49 local recurrences, only 15 (31%) of which were intraluminal. Thus, other diagnostic modalities in addition to endoscopy are essential in identifying local recurrence during patient follow-up. Local recurrence can be revealed by CT, endorectal ultrasound, MRI, nuclear medicine scans, and PET/CT scans. CT is still the most commonly used imaging tool for

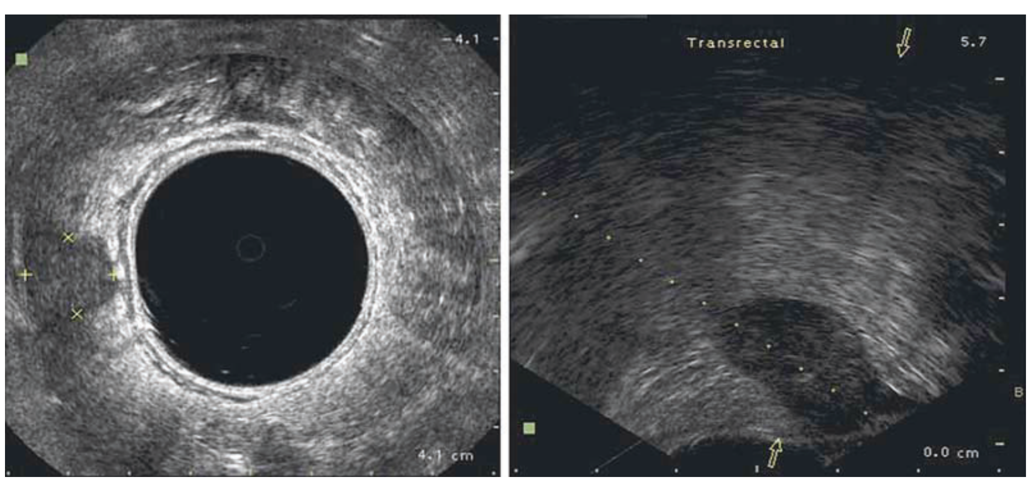

FIGURE 10.5. *Left:* Endorectal ultrasound (ERUS) image showing extrarectal lesion. *Right*: ERUS-guided biopsy of the lesion.

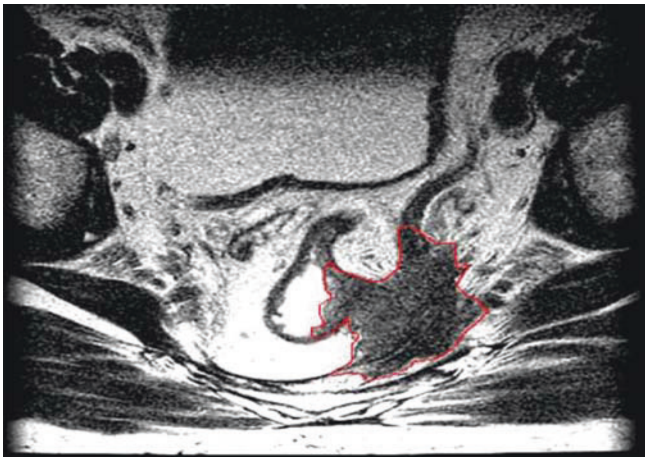

FIGURE 10.6. MRI of recurrent rectal cancer (*line*) showing lateral extension with tumor invasion of left pelvic side.

identification of pelvic recurrence. Early studies of CT reported high sensitivity[50,51]; however, these findings were not reproduced in later studies because of difficulty distinguishing between scar tissue and neoplasm.[52,53] Farouk et al.[54] reported the accuracy of CT in detecting abdominal and pelvic disease to be 80% and 89%, respectively; CT accuracy in predicting tumor-related operability was 85%. MRI appears to have similar or higher accuracy in detecting and delineating recurrent rectal cancer (Figs. 10.6 and 10.7). Sensitivity can be high, reportedly ranging from 77% to 100%, but specificity may be low, ranging from 29% to 86% and leading to many false-positive diagnoses. The task of differentiating recurrent cancer from benign fibrosis remains the most significant challenge.[55] Pema et al.[56] compared CT with MRI in diagnosing recurrent rectosigmoid cancer, concluding that MRI had 91% sensitivity and 100% specificity, with an accuracy of 95%. PET/CT scan has become an especially powerful radiologic tool in differentiating recurrent rectal cancer from benign pelvic disease, with a sensitivity of 98% and specificity of 96%. As with MRI, accumulation of postradiotherapy inflammation can lead to an increase in fluorodeoxyglucose (FDG) and false-positive findings.[57] As always, the correlation of imaging and clinical findings is paramount. Endorectal ultrasound (ERUS) has been used to detect local recurrence with adequate sensitivity and specificity following treatment for rectal cancer (Fig. 10.2). It is safe, with a high diagnostic yield. ERUS often facilitates early detection of local recurrence when endoscopy and digital rectal examination fail, thereby enhancing the opportunity for curative resection. Although ERUS shows extraluminal tissue and permits transrectal biopsy, it provides limited information on the extent and resectability of a recurrence. Additionally, its applicability is limited in male patients who have undergone abdominoperineal resection but not in female patients where it can be done transvaginally and add valuable information.[58–60]

Determining Resectability

Resectability is determined by assessing anatomic location and ascertaining which other anatomic structures are fixed to the lesion. Several studies suggest that improved outcome following resection of local recurrence depends on achieving a complete R0 resection with microscopically negative margins. A number of other factors impact the probability of complete resection. Advanced stage of the primary tumor, elevated carcinoembryonic antigen, previous abdominoperineal resection (APR), older patient age at initial diagnosis, male gender, sciatic nerve involvement, and preoperative evidence of hydronephrosis are all associated with a lower likelihood of achieving complete resection.[61–64]

Several systems are employed by various institutions for assessing resectability. The Mayo Clinic uses a scheme based on evaluating anatomic location and other structures fixed to the tumor. In this scheme the tumor is classified as F0 when it is free of fixation, FR when fixed but resectable, and FNR when fixed and not amenable to resection. FR is further subdivided by the anatomic extent of tumor fixation (anterior, lateral, and posterior).[65]

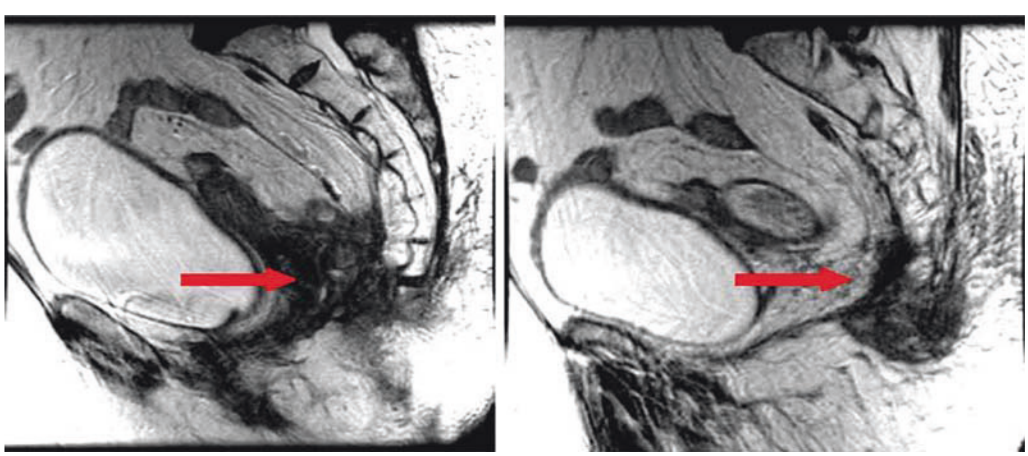

FIGURE 10.7. MRI showing central and sacral recurrence.

At MSKCC, we classify anatomic tumor involvement based on a system initially described by Guillem and Ruo[66] in 1998. Tumor location is classified as follows: (1) axial: not involving anterior, posterior, or lateral pelvic walls, including anastomotic recurrence following LAR; (2) anterior: involving the urinary bladder, vagina, uterus, seminal vesicles, or prostate; (3) posterior: involving bony pelvic sidewall structures, predominantly the sacrum and coccyx; and (4) lateral: involving the iliac vessels, pelvic ureters, lateral lymph nodes, pelvic autonomic nerves, and sidewall musculature. Determinants of resectability in colorectal cancer recurrence were assessed at our institution in a study by Moore et al.,[47] who studied 119 patients brought to the IORT suite for planned complete resection of locally recurrent rectal ($n = 101$) and colon ($n = 18$) cancer. R0 resection was achieved in 61 patients. The authors found that, when recurrence was confined to the axial location only, or to the axial and anterior locations, R0 resection was achieved significantly more often than when other locations were involved by tumor ($p <.001$, $p = .003$, respectively). When a lateral component was present, R0 resection was achieved significantly less often than when there was no lateral component ($p = .002$). It was concluded that pelvic recurrences confined to the axial location, or to the axial and anterior locations, are more amenable to complete resection (R0) than those involving the pelvic sidewall.[47] Although this classification is very useful, it does not totally predict resectability preoperatively simply because new findings may be identified intraoperatively.

In our experience, contraindications to surgical re-resection include (1) extrapelvic disease (with the exception of extrapelvic disease in young, fit patients who have potentially resectable distant metastatic disease); (2) sciatic pain, and imaging evidence of sacral root nerve involvement (Fig. 10.8); (3) bilateral hydronephrosis (although this does not constitute an absolute contraindication, especially in patients who are candidates for total pelvic exenteration) (Fig. 10.9); (4) circumferential pelvic sidewall involvement; and (5) S1 or S2 bony or neural involvement. Additionally, patients who are poor surgical risks (ASA IV–V) are not candidates for the extensive surgery required to resect pelvic recurrence (Table 10.7).

Phase 2

Preoperative Multimodality Treatment

Surgery with curative intent constitutes the basis of treatment for locally recurrent rectal cancer. The aim is to obtain microscopically negative margins in the resected specimen. Unfortunately, as the normal surgical planes are often disrupted by previous surgery, this is not always possible. Moreover, surgery alone results in a high rate of local and distant failure.[13] To improve the outcome, surgery is combined with multimodality therapy, including radiotherapy and chemotherapy, whenever possible. Chemoradiotherapy is frequently given preoperatively to patients with recurrence. Systemic chemotherapy is used to treat possible disseminated disease as well as advanced local recurrence when additional radiotherapy cannot be given. In the last few years, some specialty centers have added IORT in an attempt to further improve outcomes.

Preoperative radiation therapy does not offer a significant chance for cure per se. However, when combined with preoperative sensitizing chemotherapy, the chance of obtaining negative margins increases, as does the chance of cure. Bedrosian et al.[67] reported that patients receiving preoperative chemoradiation treatment (CRT) were more likely to have microscopically negative resection margins. Moreover, their data suggest that preoperative CRT may increase the likelihood of an R0 resection, thus improving survival and the chance for long-term cure. Hence, patients with pelvic recurrence who have had no prior radiation treatment are candidates for preoperative chemoradiation, with a goal of downsizing the recurrence and therefore increasing the potential for resection with negative margins. For patients who have previously undergone limited radiation therapy, a modified regime may be conducted. Patients who have already received a full dose of radiation are generally not candidates for additional radiation. Aggressive chemotherapy is an option in select patients. When a patient undergoes preoperative multimodality therapy, re-staging imaging studies should be performed 4 weeks after completion to rule out interval development of distant metastases and to confirm the possibility for curative approach, before being subjected to radical resection.

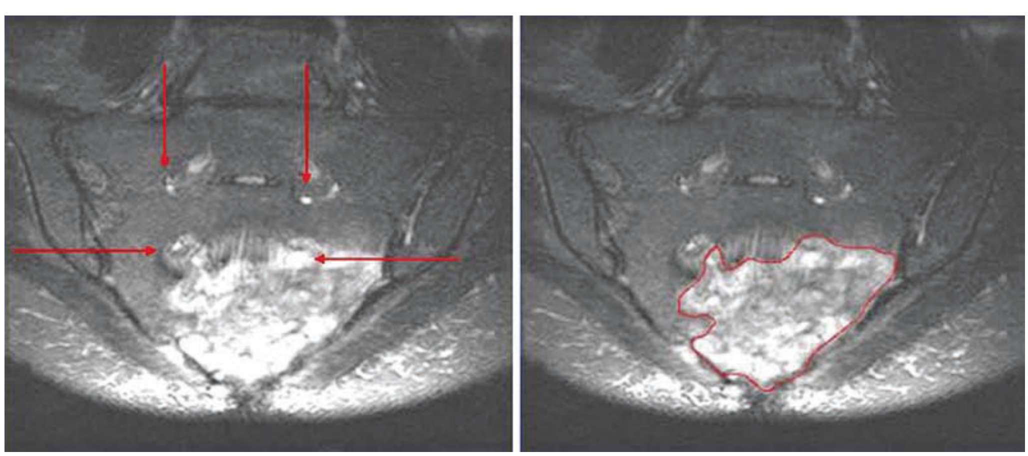

FIGURE 10.8. CT scans in a patient with recurrent rectal cancer showing sacral nerve involvement (*left, arrows*) and recurrent tumor (*right, line*).

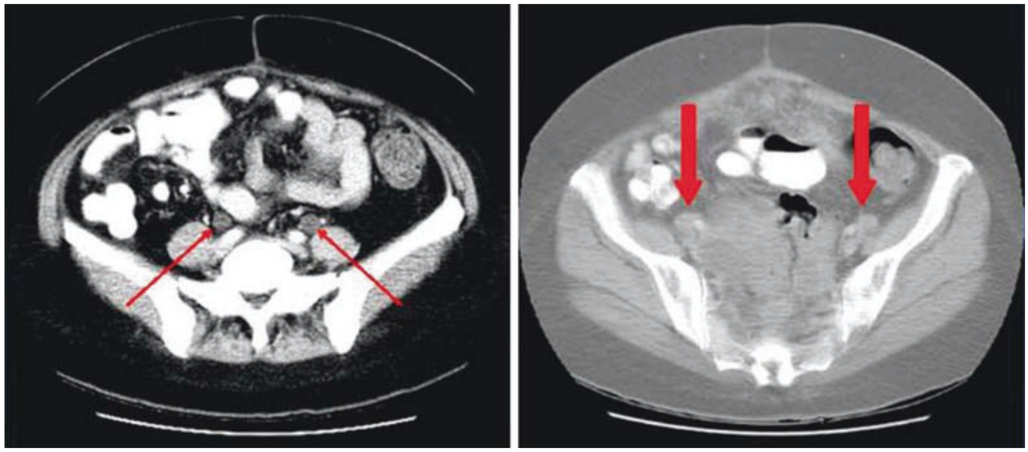

FIGURE 10.9. CT scans in a patient with recurrent rectal cancer showing bilateral hydronephrosis (*arrows*).

TABLE 10.7. Contraindications to Surgical Resection for Locally Recurrent Rectal Cancer.

Extrapelvic disease
Sciatic pain
Bilateral hydronephrosis
Circumferential pelvic sidewall
S1 or S2 (bony or neural)
Poor surgical risk (ASA IV-V)

At MSKCC we prefer to schedule patients for surgery within 6 weeks of completing preoperative chemotherapy or radiotherapy.

Despite the use of multimodality therapy and its concomitant benefits, 5-year survival of patients with locally recurrent rectal cancer is poor, ranging from 22% to 31%. Rates of local control range from 50% to 71% (Table 10.8).

Phase 3

Surgical Resection and Intraoperative Radiotherapy

Surgical Resection

It is essential that the true potential for resection of locally recurrent disease be carefully evaluated before curative-intent surgery is offered to the patient. Involvement of a multidisciplinary team including a colorectal surgeon, orthopedic surgeon, urologist, plastic surgeon, and radiation oncologist is important in optimal management. The magnitude of the operative procedure, as well as prognostic factors, reconstructive and functional issues, and the true likelihood of potential cure, must be discussed realistically with patient and family. Although symptomatic relief is associated with resection of recurrence, the development of other symptoms makes a completely asymptomatic clinical course uncommon.[68] Some surgeons believe that APR, rather than a sphincter-saving procedure, should be performed in all cases of resectable recurrent rectal cancer. This is not universally accepted, however. Our policy at MSKCC is to offer restorative re-resection to those patients who have an adequate distal surgical margin. Preoperative review of previous procedures for rectal cancer must be completed, with special attention to the vascular supply and to the level of inferior mesenteric artery ligation. Additionally, the possibility of a permanent or temporary stoma must be discussed with the patient. Total pelvic exenteration (TPE) is performed in select patients with locally recurrent disease. While this extensive procedure can be performed safely and may result in significantly prolonged survival, less satisfactory outcomes are associated with development of local recurrence following abdominoperineal resection.[69]

TABLE 10.8. Outcomes After Multimodality Therapy for Recurrent Rectal Cancer.

Reference	*Number of cases*	*Resection (%)*	*5-year survival (%)*	*Re-local recurrence (%)*
Bussieres et al.[27]	73	57	31	29
Valentini et al.[110]	47	45	22	31
Salo et al.[70]	131	79	31	
Wiig et al.[111]	107	41	30	50
Mannaerts et al.[73]	33	64	60 (36 months)	27
Shoup et al.[13]	111	100	39	33
Hahnloser et al.[9]	304	100	25	

Resection for recurrent rectal cancer should be undertaken with curative intent, although in reality most of these procedures end up being palliative rather than curative. Careful surgical planning is essential. The patient is usually admitted to the hospital on the day of surgery; mechanical and oral antibiotic bowel prophylaxis is done at home. The IORT suite is reserved for the case, when available. General endotracheal anesthesia is used. The patient is placed in the lithotomy position, the arms are preferably extended, and the lower extremities are supported by Allen stirrups, with the tip of the coccyx over the edge of the bed. Meticulous care is taken with respect to positioning, as these procedures may be lengthy. Articulations and pressure areas are padded and protected, as needed, in order to prevent nerve injury or compartment syndrome. The use of preoperative cystoscopy and placement of bilateral ureteral stents will help identify the ureters and protect them from inadvertent iatrogenic injury. At MSKCC we use a midline abdominal incision, as preservation of the blood supply to the rectus abdominis is warranted in case of pelvic floor reconstruction with a rectus abdominis flap. Upon entering the abdomen, complete lysis of adhesions is performed if necessary. The entire abdominal cavity must be visualized and palpated in order to rule out the presence of any previously undetected extrapelvic recurrence. As noted before, and depending on the anticipated extent of the planned pelvic resection, extrapelvic disease would generally be considered a contraindication to radical resection, except in the case of a young, fit patient with potentially resectable distant disease limited to the liver or lungs. In these cases, a simultaneous (or even a staged) procedure can be undertaken. Frozen sections of any area suspicious for extrapelvic disease should be sent to the laboratory. In about 20% to 37% of cases, exploration determines that the disease is not resectable.[67,70] In this setting the goal should be to provide optimal palliation.

If the decision is to proceed with resection, a self-retaining retractor is employed and the small bowel mobilized out of the pelvis to gain adequate pelvic access and exposure. Dissection should start high and away from the area of recurrence, as radiation changes and fibrosis from previous pelvic therapy can distort the anatomy. An intraoperative decision is then made regarding the plane of resection. Depending on the depth of recurrence and depth of invasion into adjacent structures, we follow three potential planes of dissection in an attempt to accomplish a curative procedure (Fig. 10.10): plane 1, between visceral and parietal fascia; plane 2, outside parietal fascia; and plane 3, outside internal iliac vessels. Plane 1 is the plane between the visceral fascia and the parietal fascia that is used when a proper TME is performed. This plane is only accessible when a proper TME was not performed at the original resection of the primary rectal cancer, and if the recurrence occurred within the mesorectum that was left behind. Nowadays the chance of encountering this circumstance is exceedingly rare since proper TME technique is used by the majority of surgeons. Plane 2 involves dissecting outside the parietal fascia if it can be determined that this is a tumor-free plane, in instances where the recurrent tumor is close but not adherent to or penetrating the parietal fascia. Finally, plane 3 is the necessary plane to dissect when the tumor extends beyond the parietal fascia into the pelvic sidewall. This necessitates ligating the internal iliac artery and vein, and dissecting in plane 3 outside the internal iliac vessels. The pelvic nerves can be affected when plane 3 is dissected, and may need to be sacrificed in some circumstances. The plane 3 dissection field is technically challenging and demands expertise and proficiency in order to minimize blood loss and nerve injury. However, in many instances where the pelvic sidewall is involved, plane 3 is the necessary plane to achieve an R0 resection.

It is essential that a multidisciplinary team be in place for reconstructive purposes and in the event that in-continuity resection of major adjacent organs becomes necessary. Once the recurrence has been resected, frozen sections should be obtained from the surgical margins. Selective use of IORT, if available, can be considered at this point. Viable tissue to help close the perineal and pelvic wound will enhance the healing process. Reconstruction is often accomplished with the use of an omental pedicle flap, or a myocutaneous flap such as a rectus abdominis or transposed graciloplasty.

MSKCC Experience

A 10-year retrospective analysis of patients with locally recurrent rectal cancer, performed by Salo et al.,[70] reviewed 131 individuals who were operated on with curative intent from 1986 to 1995. The goals of the study were to determine predictors of resectability and to assess postsalvage survival. Resection proved possible in 79% of the 131 patients. Overall 5-year survival was 31%. Median hospital stay was 14 days. Operative mortality was an acceptable 0.8%, with morbidity of 24%. Stages of the primary tumors were as

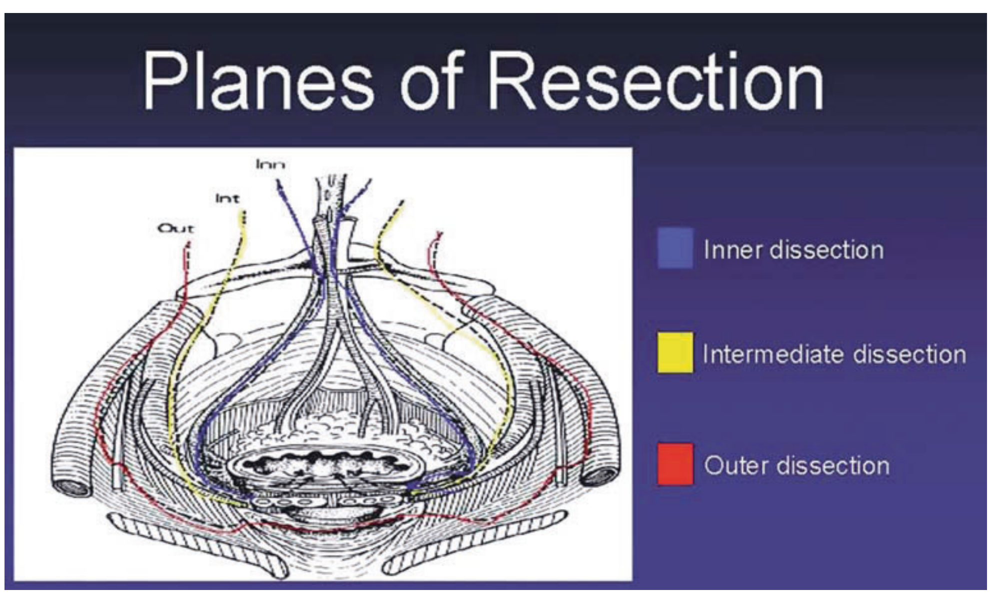

FIGURE 10.10. Planes of dissection when attempting curative surgery for locally recurrent rectal cancer. (Modified from Takahashi T, et al. Lateral node dissection and total mesorectal excision for rectal cancer. Dis Colon Rectum. 2000;43(10):S59–S68, with permission.)

follows: stage I, 29; stage II, 43; stage III, 48; stage IV, three; and unknown stage in eight patients. Concomitant salvage procedures included sacrectomy in 16 patients, partial vaginectomy in 15 patients, hysterectomy in nine patients, and pelvic sidewall dissection in 21 patients. Forty-six patients underwent abdominoperineal resection; 20 underwent low anterior resection; and 18 underwent total pelvic exenteration. Hartmann's resection was performed in 11 patients, perineal sacrectomy in three, perineal excision in three, and abdominal resection in two. IORT was administered to 52 patients.

Of the 71 patients who underwent curative R0 resection, median survival was 42 months, with a 3-year survival of 57% and a 5-year survival of 35%. For patients with an R1 resection (positive microscopic margin), median survival was 32 months, with a 3-year survival of 38% and a 5-year survival of 23%. Patients with incomplete R2 resection (gross residual disease) had a median survival of 27 months, with a 3-year survival of 36% and a 5-year survival of 9%. Of the 28 patients who were not resected, median survival was 16 months, with a 3-year survival of 4% and a 5-year survival of 0%. The stages of the original primary cancers did not significantly impact overall survival outcome. The primary surgical procedure was statistically significant, however, showing a difference between patients who had had sphincter-saving resection vs. those who had undergone abdominoperineal resection, with a median survival of 34 months for the sphincter-saving group vs. 21 months for the APR group. Use of adjuvant therapy did not differ significantly. Several prognostic factors were identified for patients undergoing resection (Table 10.9). Preoperative carcinoembryonic antigen (CEA) level was a prognostic indicator, as patients with normal CEA at the time of recurrence had a median survival of 38.6 months vs. 22.7 months for those with elevated CEA levels. Patients with symptoms at presentation, especially pain, had worse survival (18 months) than those who were asymptomatic or without pain on presentation (34 months). Patients who underwent resection had a median survival of 36 months compared with those who were not resectable (16 months). The disease-free interval was found to be longer following abdominoperineal resection, suggesting that recurrence after APR was not detected at an early stage; CEA levels were also elevated in patients who had previously undergone APR, again suggesting that delayed diagnosis was a factor. Additionally, patients with pain at time of presentation were more common in the APR group than in the sphincter-saving group. The possibility of undergoing resection for recurrence was greater for those who had had sphincter-saving resection initially than for those who had had APR. The most favorable outcomes after salvage resection were observed in those patients whose recurrence was limited to the bowel wall. The good outcomes for this group dictate that optimal resection is achieved in the setting of limited recurrence not extending beyond the bowel wall (Fig. 10.11).

The subset of patients who have locally advanced recurrent disease with sacral involvement may benefit from sacropelvic resection. With posterior recurrence of a rectal cancer, extended resection including partial sacrectomy may be necessary in order to achieve a negative margin (Fig. 10.7). Such cases are best undertaken by a multidisciplinary team, using a combined anterior/posterior approach. This is a demanding but potentially beneficial procedure involving en-bloc resection of a portion of the sacrum and surrounding involved structures. Lesions invading the sacrum that are located centrally, midline, and below the S2-3 junction, are most amenable to this procedure. Lesions involving the sacrum above this level are generally not amenable to resection, except in isolated instances. If only the anterior table of the sacral bone is involved, partial resection of the sacrum can be considered.

Melton et al.[71] reviewed the MSKCC experience of sacropelvic resection in the setting of recurrent rectal

TABLE 10.9. Prognostic Factors for Patients Who Underwent Resection.

Variable	n	*Median survival time (months)*	p *value* Univariate	*Multivariate*	*Relative risk (95% confidence interval)*
All patients who underwent resection	103	36.3			
CEA level before salvage operation					
Elevated (≥5 ng/mL)	40	30.0	.0037	.037	1.70 (1.03–2.80)
Normal (<5 ng/mL)	55	47.9			
Symptoms at presentation with recurrence					
Pain	23	23.5	.076		
No pain	80	37.1			
Gross residual disease					
Gross residual disease	19	26.6	.023		
No gross residual disease	84	38.6			
Microscopic margins					
Positive margins	32	30.8	.061		
Negative margins	71	41.9			
Extent of disease					
Outside bowel wall	91	32.5	.0021	.037	4.58 (1.10–19.0)
Limited to bowel wall	12	–*			

*Median survival time for this group has not been reached.

Source: Adapted from Salo JC, et al. Surgical salvage of recurrent rectal carcinoma after curative resection: a 10-year experience. Ann Surg Oncol. 1999;6(2):171–177, with permission of Springer Science + Business Media.

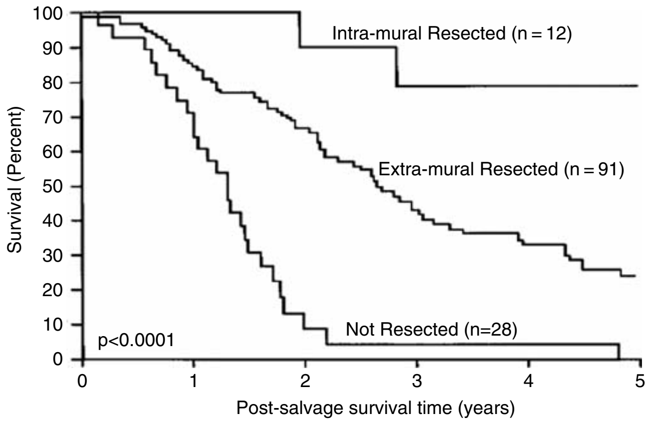

FIGURE 10.11. Kaplan-Meier survival curves for patients who underwent exploration with curative intent for pelvic recurrence of rectal cancer, comparing intramural versus extramural resection of the specimen versus those who were not resected ($p <.0001$, log rank test, no resection group vs. other groups. (From Salo JC, et al. Surgical salvage of recurrent rectal carcinoma after curative resection: a 10-year experience. Ann Surg Oncol. 1999;6(2):171–177, with permission of Springer Science + Business Media.)

cancer, evaluating 29 patients who had sacral resection with curative intent for recurrence involving the sacrum. Sacral resections were performed at S2-S3 in 55% of these patients, and at S4-S5 in 45%. Most patients who had initially undergone an APR had total exenteration (9/13), while most of those who had initially undergone sphincter-preserving resection had an APR (12/16). An anterior (41%) or combined anterior/posterior approach (59%) was used. IORT was given to 12 patients (41%). Pedicle flaps were often used. As noted in other reports,[14,72,73] complications occurred in 59% of these patients, with perineal wound breakdown (31%) and pelvic abscess (17%) being most prevalent. Only one patient in the study died. Complete resection with negative margins (R0) was achieved in 62% of the patients, with microscopically positive margins (R1) in 34% and grossly positive margins (R2) in 3%. On univariate analysis, factors associated with better survival were as follows: R0 resection ($p = .005$), absence of cortical bone invasion ($p <.001$), less transfusion ($p = .03$), and lack of anterior organ involvement ($p = .02$). Disease-specific survival was 63% at 2 years and 20% at 5 years. It appears that, despite the low rate of cure, this radical approach provides local disease control for some patients, with acceptable morbidity.

Patient selection is the most important factor in potentially curative surgery such as sacral resection for locally recurrent rectal cancer. Preoperative staging and a multidisciplinary approach are imperative in light of strong evidence that the best possibility for cure depends on achieving an R0 resection. Preoperative assessment of extent of local disease and the potential for achieving clear resection margins, while ruling out distant disease, is accomplished with CT/MRI and PET-CT scans. Despite the considerable accuracy of these imaging tools, however, it is still difficult to determine with certainty whether a negative margin will be achieved until the specimen is actually resected. Further studies are warranted in order to better determine which patients are most likely to obtain an R0 resection.

Recurrence after APR is a very difficult management problem. This is particularly true in male patients, for whom such recurrence almost always necessitates total pelvic exenteration. In female patients with intact uterus and vagina, the bladder is usually protected; thus, resection incorporating the ovaries, uterus, and posterior vagina is often adequate, permitting preservation of the bladder. Although pelvic exenteration is a very radical procedure, it does improve the chances of achieving a negative margin. Satisfactory 5-year cure rates have been reported.

Intraoperative Radiotherapy

In patients with unresectable recurrent disease, the tumor is virtually always more locally extensive than is indicated by physical and radiographic examinations. This is due to the propensity of these tumors to adhere to or directly invade adjacent organs and vital structures.

A major limitation of pelvic external beam radiation therapy (EBRT) is that, in many cases, the dose required to achieve an adequate level of local tumor control exceeds the tolerance of the surrounding normal tissues. In an attempt to overcome this limitation, a number of approaches have been used. The most promising is IORT.

The primary advantage of IORT is that radiation can be delivered at the time of surgery to the specific site with the highest risk of local failure (the tumor bed) while decreasing the dose to the surrounding normal tissues. IORT can be delivered by one of two techniques: linear acceleration-based electron beam or high-dose-rate (HDR) brachytherapy. A potential technical advantage of brachytherapy is that there are virtually no clinical situations in which, due to anatomic or technical constraints, IORT cannot be delivered.

At MSKCC we use a combined-modality treatment strategy that includes EBRT (if feasible) with or without chemotherapy, surgical resection, and HDR-IORT. We use this approach with every patient with extraanastomotic recurrent pelvic rectal cancer. However, the final decision to use HDR-IORT is done intraoperatively in consultation with the radiation oncologist. The only situation that we do not consider HDR-IORT is when gross disease is not amenable for resection. HDR-IORT is delivered using the Harrison-Mick (HAM) applicator. The HAM applicator (Fig. 10.12) consists of a flexible pad of material made of silicone rubber, measuring 8 mm in thickness and traversed by an array of catheters spaced 1 cm apart. Because of its flexibility, the HAM applicator easily conforms to the shape of the tumor bed wherever it is applied. (This technique has been described previously by Harrison et al.[74]) Briefly, surgery is performed in a dedicated operating room with appropriate shielding for the [192]HDR- IORT source. Once tumor resection is completed, the surgeon and the radiation oncologist define the boundaries of the tumor bed (Fig. 10.13). A HAM applicator of appropriate size is then placed over the target area. Packing is usually used to displace adjacent bowel and to hold the applicator in place. Lead shields are often used to protect adjacent normal structures, such as the ureters, that are not part of the

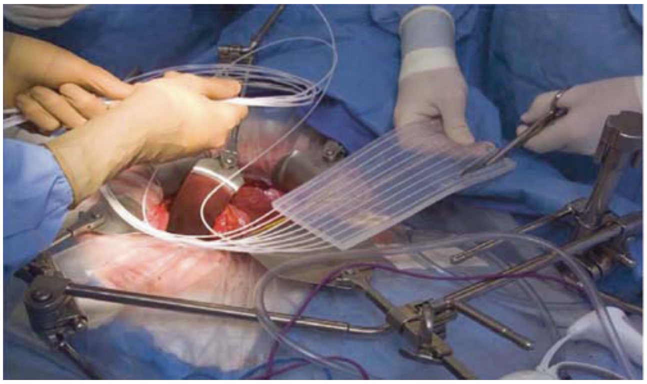

FIGURE 10.12. HAM applicator is shaped according to surgical bed where it will be positioned.

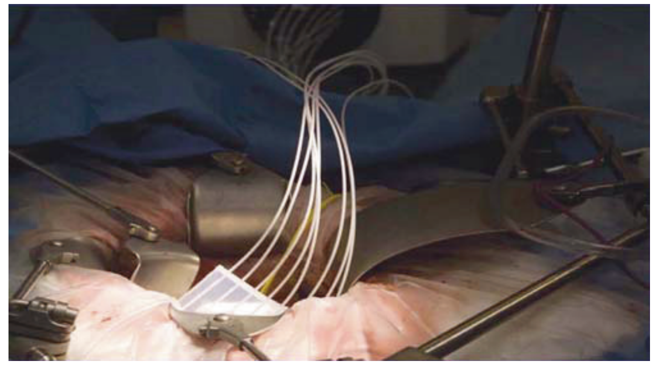

FIGURE 10.14. The applicator, which has been placed over the surgical bed, is connected to the high-dose-rate machine using connecting tubes.

target area. The applicator is connected to the HDR machine with tubes stabilized by special clamps (Figs. 10.14 and 10.15). The staff then leaves the room, and the patient receives treatment via the HDR remote after-loader while being continuously monitored (with cameras and electronic equipment) by the anesthesia team in an adjacent room (Fig. 10.16). In a study led by Minsky,[21] in which the authors analyzed 74 patients with recurrent rectal cancer who were treated by surgery and HDR-IORT over a period of 6 years, they concluded that a negative microscopic margin ($p = .04$) and the use of IORT + EBRT ($p = .04$) were significant predictors of improved survival. Shoup et al.[13] studied 111 patients who underwent surgery for recurrent rectal cancer along with IORT with curative intent. With a median follow-up of 23 months, 60 patients (60%) recurred: 20 (33%) locally, 27 (45%) distantly, and 13 (22%) at both sites. Of all variables analyzed, only complete resection with negative margins and the absence of vascular invasion in the recurrent specimen predicted improved disease-free and disease-specific survival ($p < .01$ for both). Median disease-free survival and median disease-specific survival were 31 and 66 months, respectively, for complete resection compared with 7.9 and 23 months for resection with microscopic or grossly positive margins ($p < .01$ for both). Median disease-free survival and median disease-specific survival were 6 and 16 months, respectively, in the presence of vascular invasion in the recurrent specimen compared with 23 and 57 months in the absence of vascular invasion ($p < .01$ and $p < .05$, respectively). Complete resection and the absence of vascular invasion were the only predictors of improved local control as well ($p < .05$ and $p < .01$, respectively).

However, probably because of the lack of prospective randomized studies, it is difficult to report on the degree of benefit obtained by IORT. Reports in the literature vary, with both positive and negative findings.[22,25] The Mayo Clinic published the largest series on multimodality treatment for recurrent rectal cancer, with IORT used as a boost to areas at risk for residual tumor under the guidance of the surgeon and radiotherapist.[23] A total of 304 patients underwent resection for recurrence. IORT was applied selectively in 52% of patients at the time of palliative surgery and in 33% of patients at the time of curative surgery; relatively good 5-year survival was achieved for each group (21% and 27%, respectively). However, the authors stated that no conclusion regarding the independent effect of IORT on survival could be drawn because of the possibility of selection bias. Nevertheless, they stated that good overall results were demonstrated with IORT, specifically in the area of local control, and concluded that combined therapy should continue to be applied selectively.

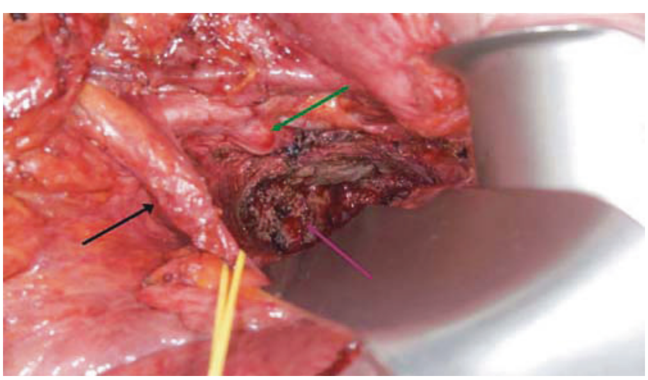

FIGURE 10.13. Patient with recurrent anterior and left posterior rectal cancer after resection of tumor and before intraoperative radiation therapy (IORT). *Black arrow,* right ureter; *green arrow,* left internal iliac artery, ligated; *purple arrow,* pelvic sidewall outside internal iliac vessels where resection was extended and where IORT will be directed.

FIGURE 10.15. The applicator is connected to the high-dose-rate machine using connecting tubes stabilized by special clamps.

FIGURE 10.16. Intraoperative radiation therapy (IORT) treatment is monitored in an adjacent area to the OR by radiation oncology team, while the patient is being monitored by the anesthesia team and surgical team with electronic cameras and monitors.

Radiotherapy in the form of EBRT with or without IORT carries an increasing risk of complications as overall dose increases. Late effects include peripheral neuropathy, ureteral stenosis, and osteonecrosis. Ureteral stenosis occurs in up to 7% of cases.[75] The ureter is not the dose-limiting structure for radiotherapy, however, because stents can be placed to relieve any obstruction and preserve renal function. Rather, the peripheral nerves are the dose-limiting structure for IORT, as the rate of peripheral nerve damage ranges from 16% to 52%.[22,24,76–78]

Palliative Therapy for Advanced Recurrent Rectal Cancer

When cure is not a realistic option, palliation of symptoms and improvement of quality of life in the final stages of disease is of great importance. Local pelvic disease secondary to recurrence presents a variety of symptoms that are difficult to control. These include but are not limited to rectal bleeding, rectal obstruction, urinary obstruction, fistulas, and severe pain associated with invasion of the pelvic nerves or lateral pelvic sidewall. Palliative medical and surgical options continue to expand, and selection of the appropriate treatment in each individual case requires careful assessment of the extent of local disease, presence of distal disease, current symptoms, possible future symptoms, and the patient's overall functional status.

Palliative therapies may be noninvasive, minimally invasive, or invasive. Radiotherapy (pelvic irradiation) still plays a major role in controlling local symptoms, particularly bleeding and pain, achieving palliation of severe pelvic pain in as many as 90% of patients. Unfortunately, some of these individuals experience recurrence of pain before death.

Minimally invasive surgery includes placement of ureteral stents for relief of urinary obstruction secondary to local invasion, placement of colonic wall stents, and laser therapy to relieve impending or ongoing obstruction. Stent placement is a useful palliative treatment for inoperable recurrence, in the setting of distant disease, or as a bridging tool during treatment aimed at definitive resection. Treatment options depend on the patient's condition, the site of obstruction, extent of disease, and life expectancy. As stent placement is an emerging technology, studies comparing it with colostomy are rare. Although palliative resection or decompressive colostomy remains the standard of care, alternative noninvasive treatments are being considered and applied. Placement of a self-expandable metallic stent (SEMS) in patients with recurrent rectal cancer is a minimally invasive procedure that obviates the need for colostomy, relieving the patient's physical and psychological burden and contributing to improvement in quality of life. SEMS placement is reportedly a safe and highly effective alternative, providing definitive palliation to patients with impending obstruction who cannot undergo curative resection because of extensive pelvic infiltration, disseminated metastatic disease, or unacceptably high surgical risk. Encouraging results have been reported for permanent stenting, with initial success rates of approximately 90%[79–81]; technical and clinical success have been reported in 80% to 100% of those treated. Minor complications include transient anorectal pain, tenesmus, and rectal bleeding. Stent migration and colonic perforation are also well-recognized hazards.[81]

Tomiki et al.[82] evaluated the clinical aspects of SEMS placement, comparing its palliative effect with colostomy in the setting of inoperable malignant colorectal obstruction. They found that the average postoperative hospital stay was 22.3 days for patients who underwent stent placement, compared with 47.4 days for those who underwent colostomy ($p = .016$). Average duration of time to readmission was 129.2 days for the stent placement group and 188.4 days for the colostomy group. The estimated duration of primary stent patency was 106 days. Mean survival period was 134 days in patients with stents. The authors reported that postoperative hospital stay was shorter for patients with stents, but the duration of time to readmission as well as survival were longer in patients with colostomy. They concluded that stent placement nevertheless increases palliative treatment options and is an effective therapy contributing to improved quality of life.

Spinelli and Mancini[83] reported on a group of 37 patients undergoing stent implantation for advanced rectosigmoid cancer. Successful decompression was achieved in 78% of the patients. Reobstruction by tumor progression occurred in 15%, but this was treated effectively either by placement of a second stent or by laser photoablation. There were no major complications related to stent placement, although early treatment failure was observed in a high proportion of patients (21%). The main reasons for failure were stent migration (9%) and anorectal pain (6%), requiring stent removal. Contraindications for stenting include incontinence, low rectal cancer (<5 cm from the anal verge), and planned application of hyperthermia.

Hünerbein et al.[80] reported on the use of self-expanding metal stents for palliation in 34 patients with malignant rectal obstruction and incurable disease. The rate of successful placement was 97%, without major complications.

Stent migration, pain, and incontinence caused early failure in 21% of these patients. A mean patency of 5.3 months was observed in 26 patients (79%), but re-stenting was required in two patients. Despite initial success with stenting, a colostomy was created in two other patients: in one patient after 3.4 months because of incontinence, and in the other patient after 9.2 months because of a rectovesical fistula. Overall, 18% underwent palliative surgery because of early complications or long-term failure of stent treatment. The authors concluded that SEMS are useful alternatives to colostomy in carefully selected patients with limited life expectancy, but that a considerable percentage of those patients will subsequently require surgical palliation because of stent treatment failure.

In most of the series reporting on use of SEMS, patients achieved a median survival of 3 to 6 months, comparable to the median survival associated with a diverting colostomy.[80,84] It is also well known that patients view having a colostomy as negatively impacting quality of life.[84] However, a prospective randomized trial should fully address the benefits and risks associated with this new invasive modality for palliative care. Tumor-related symptoms such as pain or bleeding may not be improved by stenting. Other treatment modalities, however, especially radiotherapy and chemotherapy, may be used along with stenting to palliate the most debilitating symptoms of tumor progression. The most serious problems associated with stenting (migration and reobstruction) should decrease substantially in the future with the availability of larger-diameter stents designed specifically for the rectum.

The choice between SEMS placement and colostomy for palliative management of inoperable, malignant colorectal obstruction should be considered carefully on a case-by-case basis. Stent placement seems to be a better management option in patients with ascites and high anesthetic risk, or in patients who refuse colostomy. However, if a rectal tumor is <5 cm from the anus, stent placement may cause incontinence and significant pain secondary to proximity to anus. Hence, colostomy may therefore be a better option in this circumstance. In the setting of a rapidly growing tumor, particularly one with multiple stenoses, surgical treatment is superior to stent placement because of the high probability of stent or bowel occlusion at other locations. The choice should therefore be made in light of the disease and health status of each individual patient.

With the greater availability of new, minimally invasive modalities such as laparoscopic colostomy, lower rates of morbidity and mortality have been reported. Milsom et al.,[85] reviewing their experience of palliative laparoscopic colorectal cancer surgery in 30 patients with incurable disease, reported that laparoscopic stoma creation was performed in 11 patients (five colostomies, six ileostomies). Three patients were converted to an open procedure intraoperatively. Median operative time was 60 minutes and median blood loss was 50 mL. There were no intraoperative complications. Postoperative death occurred in two severely debilitated patients following stoma creation (18%). Median time to passage of both flatus and stool was 2 days postoperatively; median time to discharge from hospital was 7 days. All patients were able to eat and recovered normal bowel function. During a median follow-up period of 10 months, five patients in the stoma group died (median time to death: 8 months). No port-site recurrences were observed. This study suggests that laparoscopic diversion with either ileostomy or colostomy is an important palliative option for many patients, associated with fast recovery and short hospital stay. However, because of the poor performance status of most of these patients, even in the hands of surgeons experienced in minimally invasive operative techniques mortality can be as high as 18%.

Endoscopic lasers are another alternative to colostomy or SEMS. Their purpose is to remove tissue endoluminally by coagulative necrosis or immediate tissue vaporization. The most commonly used mode is the neodymium:yttrium-aluminum-garnet (Nd:YAG) laser. The number of treatments ranges from one to 12, with symptom-free intervals of 2 to 18 months between treatments.[86–88] Palliation of symptoms and improvement in quality of life are achieved in as many as 90% of patients; however, the palliation effect appears to decrease over time. Kiran et al.[88] has reported successful symptom control over a mean period of 15.7 months in patients with unresectable rectal cancer.

There are no known data on the use of palliative resection in patients with recurrent rectal cancer except for the studies done by Milsom et al.[85] and Miner et al.[68] The MSKCC experience of palliative surgery for recurrent rectal cancer, reported by Miner et al.,[68] yielded interesting results. The authors studied 105 consecutive patients, all of whom required repeat surgery for locally recurrent rectal cancer. Patients were observed for a minimum of 2 years or until death. Surgery was performed with palliative intent in 23%. Prior to re-resection, 79% of those treated with palliative intent had significant symptoms: bleeding in 21%, obstruction in 42%, and pain in 21%. After repeat surgery improvements were noted in 40% of those affected by bleeding, 70% of those affected by obstruction, and 20% of those affected by pain. During follow-up, however, additional or recurrent symptoms were noted in 87% of patients. This study concludes that, although surgery for recurrence is associated with symptomatic relief, the recurrence or development of alternate symptoms makes a completely asymptomatic clinical course uncommon. Bleeding and obstruction often improved after surgery, but effective pain control was difficult to achieve, and the durability of symptom relief was limited. Pain was the most poorly controlled symptom overall and remained the most prevalent symptom at completion of follow-up. Gross disease, present in all patients treated palliatively, was independently associated with a briefer symptom-free period.

Overall, symptomatic control is best achieved when complete palliative resection of local disease is possible. When resection is not feasible symptom relief, although not as durable, can be achieved with careful application of the palliative procedures discussed above. Duration of symptomatic relief appears to be shorter for those patients with residual disease following palliative therapy. However, the findings from this study show that some degree of symptom relief can be achieved even without complete resection of local disease. Hence, the absence of or impossibility of achieving negative margins should not be absolute contraindications to palliative intervention, as a symptom-free period, however brief, can be achieved.

Summary: Reoperative Treatment of Locally Recurrent Rectal Adenocarcinoma

The decision to choose between invasive, minimally invasive and noninvasive methods for palliative relief of symptoms in the setting of locally recurrent rectal cancer demands the highest clinical and surgical judgment. A multidisciplinary approach is essential in this complex decision-making process. When considering the appropriate and effective use of palliative procedures for patients with recurrence, the surgeon is confronted with a range of multidisciplinary options and technical challenges. Extensive discussion with the patient and his or her family is of paramount importance in obtaining informed consent and achieving effective therapy.

Despite advances in treatment of primary rectal cancer, locally recurrent disease remains a major problem. A multidisciplinary approach is required when addressing therapeutic options. Optimal preoperative staging aids in the selection of operative candidates. An R0 resection is the best chance for cure. Preoperative CMT—and IORT, when indicated—offer a chance of improved local control and survival when R0 resection is achieved. Depending on the anatomic location of the recurrence, preoperative assessments by plastic, urologic, and orthopedic surgeons are often required. Despite the length of these procedures, resection can be performed with acceptable morbidity and minimal mortality in the majority of patients. Although outcomes have improved over the past few decades, the prognosis for patients with locally recurrent rectal cancer is still poor. Cure rates of 20% to 50% have been reported in this population.[67,71]

Recurrent Squamous Cell Carcinoma of the Anus

Many reports of malignant neoplasms in the anal area use different terminologies to define the location of the malignancy. The World Health Organization (WHO) and the American Joint Committee on Cancer (AJCC) have developed a universally accepted descriptive terminology for the histologic typing of intestinal neoplasms of the anal region.[89,90] Their terminology states, "The anal canal is defined as the terminal part of the large intestine, beginning at the upper surface of the anorectal ring and passing through the pelvic floor at the anus. The lower part extends from the dentate line and downwards to the anal verge." The perianal skin (the anal margin) is defined by the appearance of skin appendages (such as hairs). There exists no generally accepted definition of its outer limit.

Cancer of the anus arises in the perianal skin and or anal canal. This is a relatively uncommon tumor, constituting 1.5% of all gastrointestinal malignancies. However, its incidence in the United States has increased over the past decade. Squamous cell carcinoma (SCC) is the most common histologic subtype, and the one we will discuss in the remainder of this chapter.

Treatment of anal SCC has changed dramatically since the 1974 publication by Nigro[91] describing an effective chemoradiation treatment (CRT) protocol. Since then, chemoradiotherapy (the Nigro protocol) has largely replaced radical surgery as the dominant treatment for primary anal cancer. Nigro-based CRT results in cure rates ranging from 75% to 95%, comparing favorably with the cure rates achieved by abdominoperineal resection (45–60%).[92]

Despite the excellent results associated with CRT, a significant number of patients with anal SCC (as many as 15%) fail initial therapy, and an additional 10% to 15% develop local recurrence. In a recently published study of 129 patients treated for anal SCC, Ferenschild et al.[93] reported a failure rate of 19% (24 of 129 patients).

In the event of suspected or proven recurrent disease, full restaging with a CT scan or MRI should be initiated. If CT and MRI are inconclusive, PET-CT may be helpful in differentiating recurrent disease from treatment-related abnormalities by detecting sites of increased glucose utilization. However, biopsy—either interventional CT-guided biopsy or biopsy performed via direct visualization—should be done before ablative surgery is considered.

Currently, the best salvage treatment for recurrent or persistent anal SCC is still abdominoperineal resection, resulting in a 5-year survival rate of 30% to 50%. However, a clear distinction should be made between recurrent and persistent disease. Patients with persistent disease have a poorer outcome, with 5-year survival ranging from 13% to 64%, in contrast to patients with recurrent disease with 5-year survival ranging from 36% to 82%.[94–102] In the largest published series to date, Akbari et al.[97] reported a 5-year survival of 51% in patients with recurrent disease undergoing salvage APR vs. only 31% in patients with persistent disease. Other favorable prognostic factors include lesions smaller than 5 cm and younger patient age (<55 years).[95,94,99,103]

Salvage APR, however, is associated with significant morbidity. Delayed perineal wound healing, probably secondary to radiotherapy, is present in about two thirds of patients. In an analysis of patients with persistent or recurrent SCC of the anus, Papaconstantinou et al.[103] reported perineal wound complications—half of them major complications—in 80% of patients. Other reports in the literature describe significant perineal wound complications in 33% to 66% of patients.[93,101,102] The complication rates are far worse than those for patients undergoing APR for rectal cancer (11%), possibly reflecting the more focused radiation fields and higher radiation doses used to treat anal SCC.

Other common complications are persistent wound infection, or sinus tract formation with chronic drainage and inflammation. These may necessitate formal reconstruction, for which there are many options. We have found that vacuum-assisted closure (VAC) is a good technique for acute and chronic wounds; hyperbaric oxygen therapy may also be considered. Most importantly, prevention of major perineal wounds by use of muscle or myocutaneous flap reconstruction at the time of salvage APR should be undertaken whenever technically feasible. Tei et al.[104] have shown that transpelvic rectus abdominis musculocutaneous flap following salvage APR for recurrent anal cancer is associated with a much lower complication rate (0%) than primary closure (63%).

Symptomatic disease in the groin should be treated on a selective basis. In most cases a radical (i.e., inguinofemoral) groin dissection is done, with 5-year survival of 55%.[105] Subsequent radiotherapy can be considered if the region has not previously received maximum doses of radiation. Akbari et al.[97] reported that nodal disease at time of salvage was an independent predictor of worse outcome.

Distant metastatic disease is generally managed with palliative rather than curative intent. Active chemotherapy agents include cisplatin and fluorouracil. Resection of metastases in the liver or lung can be considered if these are solitary or few in number, and if the primary disease has been controlled with a reasonable disease-free interval from the time of initial treatment.

In conclusion, salvage APR following failed chemoradiotherapy for recurrent SCC of the anus is curative in up to 30% to 50% of patients. However, survival for patients with persistent disease can be as low as 13%. Perineal wound complications are common, constituting a major morbidity that can be improved with VAC or prevented with myocutaneous flap reconstruction at the time of salvage surgery.

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11

Recurrent Pelvic Organ Prolapse

Tristi Wood Muir

Pelvic organ prolapse is common in women around the world. Fifty percent of women who experience childbirth have disorders of the pelvic floor.[1] Currently, conservative options exist to manage disorders of the pelvic floor, and the majority of women with minimal symptoms or with major medical problems choose this route. However, surgical management is a viable option for many. Approximately one in nine of these women will undergo at least one procedure for pelvic organ prolapse or urinary incontinence in their lifetime.[2] Prolapse can have a profound effect not only on form but probably more importantly on function. Jelovsek and Barber[3] found that women who seek treatment for the management of advanced prolapse have a decreased sense of body image and quality of life.

Most women who undergo a surgical procedure for the management of their prolapse anticipate that they will never have to deal with the problem again. In the United States, it is estimated that more than 225,000 women annually undergo surgery for pelvic organ prolapse,[4] with the direct costs of the surgery in excess of $1 billion.[5] However, it is estimated that nearly 30% of procedures are for recurrent prolapse.[2] The lifetime of a surgical repair for prolapse is largely unknown. Many women with recurrent prolapse choose to treat the prolapse conservatively. In a cross-sectional questionnaire study of women who had prior surgery for pelvic organ prolapse, 42% had current symptoms of prolapse.[6]

Recurrent pelvic organ prolapse most commonly involves the same anatomic site.[1,7] In a cohort of women in the Pacific Northwest, the time interval between the first pelvic organ prolapse or urinary incontinence procedure and the second averaged 12.5 years.[7]

We know very little about why some women have a recurrence of their prolapse. The recurrence may be a surgical failure that is obvious at the first preoperative visit or recurs rapidly. The recurrence may be at a new site due to a deviation of the angle of the vagina from the surgery performed to correct the prolapse or incontinence. The surgery may be at a new site because it was not recognized and corrected at the time of the original repair. The recurrence may be secondary to a connective tissue defect in the patient (she may be a hernia former!). Alternatively, the recurrence may occur following the "lifetime" of the repair, which is similar to the life span of joint replacements.

Women who undergo prolapse surgery at a younger age have been found to be at risk for recurrence.[1,8] The durability of a repair may expire sooner for women with a higher stage of prolapse. Whiteside et al.[8] found that women who were operated on with a higher stage prolapse were more likely to have a recurrence within 1 year of the operation than were women with a lesser degree of prolapse. Diez-Itza et al.[1] found a correlation between anatomic recurrence at 5 years and preoperative stage of prolapse.

The development of prolapse may be secondary to some identifiable risk factors. If the risk factors for the development of prolapse are recognized, some of them may be modifiable for the prevention of the development of prolapse or the development of recurrence.

Risk Factors Associated with Prolapse

The development of pelvic organ prolapse can be examined in a number of ways. Bump and Norton[9] described a model to organize the risk factors for prolapse into factors that that predispose to, incite, and promote prolapse or lead to decompensation of the pelvic floor (Table 11.1). Once you surgically manage prolapse, recurrence may occur again and again.

Women may be born with a predisposition to prolapse. In a 2005 review of the literature, Kim et al.[10] found that some morphologic and functional differences exist between races, but the clinical impact on the development of pelvic organ prolapse that these differences produce remains to be proven. The role of genetics in the development of prolapse is more profound in women with connective tissue disorders, such as Ehlers-Danlos and Marfan's syndrome. Women with connective tissue disorders often have hyperextensible skin. Following a vaginal delivery, the vagina will not "spring" back to normal, and pelvic organ prolapse is common.[11] Histologic changes in the expression of collagen and the proteins that remodel collagen have been demonstrated in women with prolapse and incontinence.[12–16] It is not known whether these changes

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TABLE 11.1. Risk Factors Associated with Prolapse.

Predisposing factors	*Inciting factors*	*Promoting factors*	*Decompensating factors*
Race	Vaginal delivery	Physical exertion	Aging
Anatomy		Bronchopulmonary disease	Menopause
Morphology		Constipation	Concomitant disease
Histology		Obesity	
Familial genetics		Pelvic surgery	

Source: Modified from Bump R, Norton PA. Epidemiology and natural history of pelvic floor dysfunction. Obstet Gynecol Clin North Am. 1998;25:723–46, with permission of Elsevier.

are in response to the prolapse or if there is a genetic shift in the remodeling process toward degradation in women who subsequently develop prolapse. Recently, a familial predisposition toward the development of pelvic organ prolapse was demonstrated. A high concordance of prolapse was demonstrated between 101 pairs of nulliparous and parous postmenopausal sisters.[17] While genetics predisposed some of these sisters to prolapse, inciting factors were also at play in this study. In the vast majority (88–100%) of cases of discordancy between the sisters, the parous sister had the more advanced prolapse.[17]

Vaginal delivery of a term infant is thought to be the most significant inciting event to promote the development of pelvic organ prolapse.[6,18] Cesarean section has been found to be protective to the pelvic floor.[19] The fetal head passes through the vaginal canal and may damage the connective tissue supports, the levator ani muscles, or the innervation to the levator ani. Vaginal delivery, particularly in the occiput-posterior position, is associated with an increased risk for posterior vaginal wall and perineal body trauma. Magnetic resonance images in the postpartum period show changes in intensity within the levator ani muscle.[20] These changes likely reflect the recovery process following neurologic or muscular damage related to childbirth. The damage incurred at the time of childbirth may not result in symptomatic prolapse until years later. The levator ani muscle is also at risk for the effects of aging, leading to muscle atrophy and devascularization. To date, no test has been developed to identify women who would benefit from an elective cesarean section over a vaginal delivery in order to protect them from the development of subsequent prolapse. While pregnancy and vaginal delivery appears to be the most significant factor, it is not the whole story. Prolapse occurs in 2.4% to 18% of nulliparous women.[6,17] However, nulliparous women who undergo prolapse surgery may have less risk of recurrence of their prolapse.[1] Once the operation is performed, the repaired prolapse is nestled in an "intact" pelvic floor that has not suffered the consequences of a vaginal birth.

During the lifetime of a woman, there are repetitive activities that she may perform that promote the development of prolapse or the recurrence of prolapse. Woodman et al.[21] found that women who are laborers or factory workers and are in the lower socioeconomic income bracket are more likely to have prolapse. Chronic illnesses such as chronic pulmonary disease may increase the repetitive abdominal pressure placed on the pelvis. Chronic constipation has been linked to the development of prolapse.[9] It is suggested that with chronic straining, there is a stretch placed on the pudendal nerve and the nerve to the levator ani muscle. Fecal incontinence has been found to be more prevalent in women with rectoceles that extend beyond the hymen (31%) than those in which the prolapse is inside the hymenal ring (19%).[22] Obesity is associated with an increased risk of prolapse and recurrent anatomic and symptomatic prolapse.[1]

Pelvic surgery may promote the development of pelvic organ prolapse. Hysterectomy often has been identified as a risk factor for promoting the development of pelvic organ prolapse. In a large case-control study in Switzerland, Dällenbach et al.[23] found that the primary risk factor associated with a hysterectomy and subsequent development of pelvic organ prolapse was the degree of prolapse upon presentation for the hysterectomy. The risk of subsequent prolapse repair following a hysterectomy in a woman with preoperative grade 2 prolapse (to the hymen) was 8.0 times that of a woman without prolapse who underwent a hysterectomy, regardless of the route.

Surgery to correct pelvic organ prolapse or urinary incontinence may also promote the development of recurrent or subsequent prolapse. The posterior deviation of the vaginal axis in the sacrospinous vaginal vault suspension has been thought to be the culprit in the increased risk of subsequent anterior vaginal wall prolapse.[24–29] By the same token, anterior wall deviation following a Burch colposuspension is thought to expose the apex and posterior vaginal wall to increased abdominal pressure. A prospective, long-term follow-up study on the development of pelvic organ prolapse following a colposuspension found that 29/77 women (38%) had developed symptomatic prolapse and 22/29 (76%) of these women had already undergone surgical management for the prolapse (three others were awaiting surgery and four were treating their prolapse conservatively).[30] The "tension-free" midurethral slings have not been associated with an increased incidence of pelvic organ prolapse.[31]

Degeneration accompanies aging. Muscles atrophy and nerves lose function through the aging process or comorbid disease. Hormonal changes occur with menopause that affect the connective tissue of the vagina, supporting tissues, and pelvic organs.[32] Investigators are beginning to understand the relationship between the role of the sex steroids and the development and treatment of pelvic organ prolapse. As these changes occur on a cellular level, the woman's prolapse inches closer to a symptomatic stage of prolapse. Several studies have shown that with advancing age, the incidence and prevalence of pelvic organ prolapse increase.[33]

Anatomy and Pathology

The support for the bladder, uterus, and rectum is maintained by the interaction of connective tissue attachments and an intact, innervated pelvic floor musculature. The urethra, vagina, and rectum leave the abdominal cavity through a closed levator hiatus. The etiology of pelvic organ prolapse is thought to be multifactorial, including abnormalities of connective tissue, pelvic floor muscles, or the innervation to the pelvic floor.

Norton[34] used the analogy of a boat in a dry dock to describe the interplay of the functioning pelvic floor and connective tissue supports. The pelvic floor muscles (primarily the levator ani muscles) play the supporting role of the water. When the water level is adequate, little stress is placed on the ropes (connective tissue supports) keeping the boat (pelvic organs) in place. However, when the water level is dropped, the ropes are not able to hold the boat for long. When the levator ani muscles no longer are able to maintain a closed levator hiatus, the pelvic organs are now dangling over an open levator hiatus with only the connective tissue supports to hold them.

Direct damage to the levator ani muscle or to its innervation may open the hiatus, such as occurs during childbirth, and place the burden of support on the connective tissue of the pelvic organs. Prior damage to the connective tissue support of the vaginal walls that may have occurred in a previous delivery may only be visible in light of loss of levator ani function (during a subsequent delivery or at the time of menopause). The puborectalis, the medial portion of the levator ani, provides a sling of support for the vaginal and rectal tube. This sling leads to an angulation of the midposterior wall of approximately 45 degrees from vertical. The proximal portion of the vagina lies upon (and is supported by) the pubococcygeus and iliococcygeus portion of the levator ani muscles. The chronically contracted puborectalis helps to close the potential space of the vagina and close the levator hiatus. With an intact, innervated pelvic floor, there is little stress and strain placed on the connective tissue support system. With the vaginal canal closed, the anterior and posterior vaginal walls are in direct apposition (Fig. 11.1). During a cough or sneeze, the pressure generated within the abdomen is equilibrated on both the anterior and posterior vaginal walls. With defecation, the increased pressure placed on the posterior vaginal wall is equilibrated by the opposing anterior vaginal wall. There is no stress placed on the endopelvic fascial attachments. If there is muscular or neurologic damage to the puborectalis, the levator hiatus widens and the vaginal canal is now opened. The increased rectal pressure and distention associated with defecation now places strain on the endopelvic fascial attachments and the fibromuscularis of the posterior vaginal wall (Fig. 11.2).

DeLancey and Hurd[35] and DeLancey et al.[36] have clinically determined that the levator hiatus is larger in women with prolapse than in those without prolapse. Magnetic resonance imaging (MRI) has confirmed that the size of the levator hiatus and levator symphysis gap increases with increasing stage of prolapse.[37] Women who undergo forceps delivery are at risk for a major levator ani injury as determine by MRI. In a case-control study, DeLancey et al. found that 58% of women who reported having a forceps delivery had a major levator ani injury in comparison to 28% of women not reporting a forceps delivery. Lennox Hoyte and colleagues[38] have evaluated the change in morphology of the levator ani muscles with two- and three-dimensional MRI. They have demonstrated that women with prolapse have significantly more levator ani degradation, laxity, and loss of the integrity of the sling portion of the levator ani (puborectalis) compared to asymptomatic controls. The etiology of this change may be due to direct muscle damage associated with childbirth or chronic straining, or as a result of damage to the innervation of the pelvic floor. In a woman with an intact pelvic floor, the puborectalis is in a chronic state of contraction.

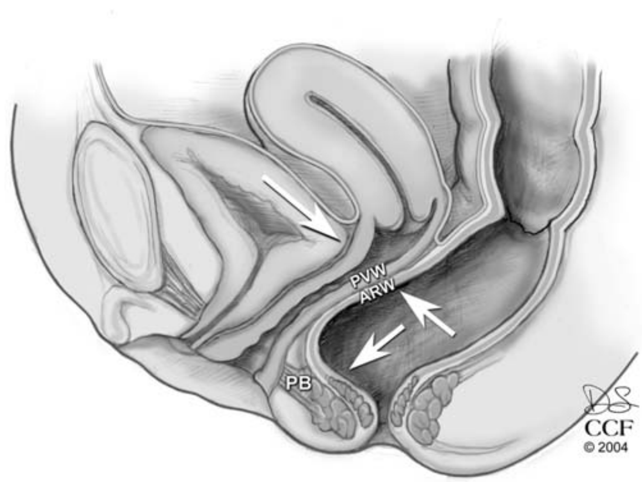

FIGURE 11.1. Sagittal view of the well supported pelvis. The anterior and posterior vaginal walls are in direct apposition. (With permission of the Cleveland Clinic Foundation.)

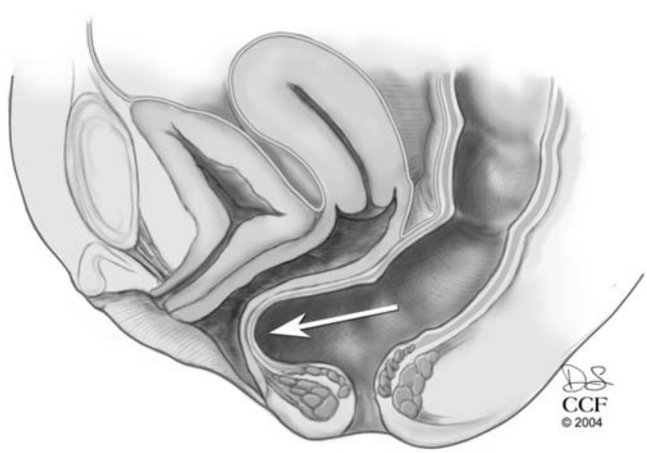

FIGURE 11.2. Rectocele. Widened levator hiatus and increased pressure posteriorly, an increase in pressure is placed on the connective tissue support of the posterior vaginal wall. (With permission of the Cleveland Clinic Foundation.)

The histology of connective tissue in women with prolapse has been described to differ from that of women without prolapse. There is an increase in the distensible collagen type (type III) in the vaginal wall and cardinal and uterosacral ligaments.[13,14,16] Smooth muscle fascicles in the cardinal and uterosacral ligaments of women with prolapse and incontinence have been arranged in a disordered fashion and are thinner than those without prolapse or incontinence.[12] The current data lead us to believe that the remodeling of the connective tissue in the pelvis of women with prolapse is accelerated as compared to women without prolapse.[15] If the balance of remodeling is weighed toward degradation rather than regeneration of the connective tissue, prolapse may develop.

The surgical management of prolapse is focused around connective tissue support of the vagina. John DeLancey[39] divided the connective tissue support of the vagina into three levels. All three levels of support should be evaluated and addressed if indicated during surgical management of the recurrent pelvic organ prolapse.

At level I, the apical portion of the vagina is suspended and supported primarily by the cardinal-uterosacral ligaments. This mesentery of support originates on the posterior cervix and upper vagina and inserts on the sacrum and pelvic sidewalls. In a woman with normal support and an intact pelvic floor, the apex of the vagina is dorsally directed to lie upon levator ani muscles in a horizontal fashion. With increases in abdominal pressure, the anterior and posterior vaginal walls are in apposition, the vaginal tube is closed and supported by the pelvic floor muscles.

Level II includes the support for the middle half of the vagina. The anterior vaginal wall is a trapezoid of fibromuscularis and provides support to the bladder and urethra. The lateral support is provided by the arcus tendineus fascia pelvis, a condensation of connective tissue over the levator ani muscles. The arcus tendineus fascia pelvis extends from the posterior, inferior aspect of the pubic bone to the ischial spine. The proximal (apical) half of the posterior vagina is also supported by an endopelvic attachment to the arcus tendineus fasciae pelvis. However, the distal half branches more dorsally attaching to the arcus tendineus fasciae rectovaginalis[40] (Fig. 11.3).

The role of the perineal body is to resist caudally directed force by the rectum and to provide a physical barrier between the vagina and rectum. The anterior portion of the perineal body blends into the perineal membrane. The perineal membrane spans the anterior half of the pelvic outlet and is composed of dense fibromuscularis. The perineal body is thicker (approximately 3 cm in length) and more defined in women. It includes interlacing muscle fibers of the bulbospongiosus, transverse perinei, and external anal sphincter.[41] The perineal body is anteriorly attached to the vaginal epithelium and muscularis of the posterior vaginal wall. Laterally, the perineal body is attached to the ischiopubic rami through the transverse perinei muscles and the perineal membrane, which includes the bulbospongiosus. The perineal body extends cranially in the posterior wall of the vagina to approximately 2 to 3 cm proximal to the hymenal ring. This dense, fused level of support represents DeLancey's level III support. Posteriorly, the perineal body

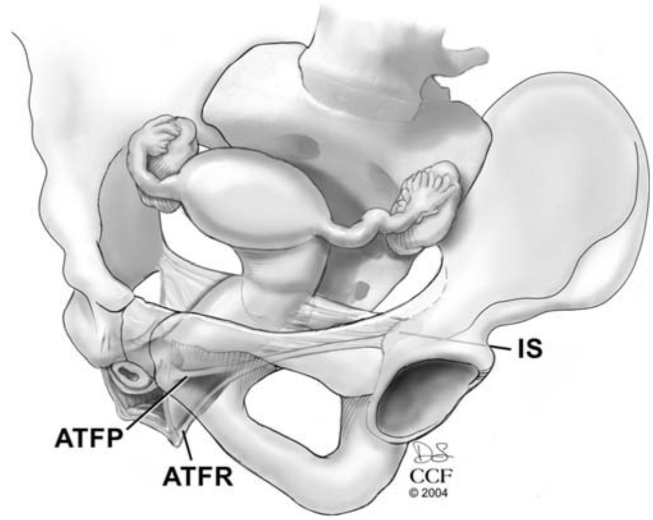

FIGURE 11.3. Connective tissue supports of the vagina. (With permission of the Cleveland Clinic Foundation.)

includes the anterior portion of the external anal sphincter and its attachment to the longitudinal fibrous sheath of the internal anal sphincter. The perineal body is suspended by and attached to the puborectalis muscle. Interruption in the support of the perineal body allows the posterior vaginal wall, perineal body, and the distal portion of the anterior rectal wall to descend with increased rectal pressure.

An understanding of the basic anatomy inspired the development of prolapse models. Nichols and Randall[42] proposed that a prolapse is an end result of either distention (overstretching of the fibromuscularis of the anterior vaginal wall) or displacement (breaks in the connective tissue).[42] A. Cullen Richardson et al.[43] popularized the "site-specific" approach to identifying specific breaks in the connective tissue and repairing those defects.

Surgical Management of Apical Prolapse

Apical loss of support of the anterior vaginal wall may occur with a separation of the anterior or posterior vaginal fibromuscularis from the cardinal-uterosacral ligaments. The loss of attachment may result in a hernia of the small bowel (enterocele) or sigmoid (sigmoidocele) into the vagina. Surgical management may be accomplished by reconstructing the support to the vaginal tube to the apex, or providing a compensatory support. Anatomic reconstruction reattaches the uterosacral ligaments to the apex of the vaginal tube. Compensatory surgery is one that provides support of the apex but is not associated with reestablishing the anatomic support provided by the uterosacral ligaments. Compensatory surgery includes the suspensions to the sacrospinous ligament or iliococcygeus fascia, or procedures that provide mesh support through an abdominal, laparoscopic, or vaginal approach. Physicians who treat recurrent prolapse have to carefully review the prior operative records to see what has been done in the past in order to plan the successive surgical approach. Obliterative procedures are an option for recurrent advanced apical prolapse in women who do not desire future vaginal intercourse.

Apical Prolapse Using Uterosacral Ligaments

McCall Culdeplasty

Milton McCall[44] described an operation for the treatment and prevention (when used at the time of hysterectomy) of enteroceles. The uterosacral ligaments are plicated in the midline and the posterior cul-de-sac is obliterated. This procedure, which maintains vaginal length and was described as a "quick and easy" vaginal procedure, gained popularity among gynecologic surgeons and is still widely performed today.[45,46] The efficacy of the procedure for apical support has been reported to be from 95% to 100%.[44,47] Webb and colleagues[48] reported that 82% of patients undergoing a modified-McCall culdeplasty, the Mayo culdeplasty, were "very satisfied" or "somewhat satisfied" following the procedure.

The McCall culdeplasty is also used as a prophylactic procedure at the time of vaginal hysterectomy to reduce the incidence of postoperative apical prolapse. Cruikshank and Kovac[49] randomized women who were undergoing a vaginal hysterectomy to one of three surgical methods of cul-de-sac obliteration and support: McCall culdeplasty; vaginal Moschcowitz; and purse-string closure of the peritoneum, which did not include the uterosacral ligaments. Significantly fewer women in the McCall culdeplasty group as compared to women undergoing the two other methods had pelvic organ prolapse of the apical portion of the posterior vaginal wall (McCall, 6%; Moschcowitz, 30%; closure of peritoneum only, 39%).[49]

The McCall culdeplasty combines the idea of using the uterosacral ligaments for apical support and the theory of obliteration of the peritoneum of the cul-de-sac. A series of sutures are placed from one uterosacral ligament, reefing the peritoneum to the contralateral uterosacral ligament. McCall[44] originally described placing a series of at least three permanent sutures to accomplish this component. He then placed another series of absorbable sutures through the midline of the posterior vaginal wall near the apex, which also traveled the course from uterosacral ligament to uterosacral ligament including the peritoneum of the posterior cul-de-sac. Modifications of the procedure have simplified it to the placement of a series of delayed-absorbable sutures through the posterior vaginal epithelium and completing the plication of the uterosacral ligaments and obliteration of the posterior cul-de-sac[48] (Fig. 11.4).

The complications described with this procedure include ureteral obstruction.[47,48] The ureters are anterior and lateral to the uterosacral ligaments. As the ureter travels over the pelvic brim toward the bladder, it is closest to the uterosacral ligament (approximately 0.9 cm) near the junction of the uterosacral ligament and the cervix.[50] During a plication of the uterosacral ligaments, the peritoneum near the ureter or the ureter itself may be incorporated into the suture leading to obstruction.[51] Cystoscopy to ensure ureteral patency should be considered when performing this procedure for correction of prolapse or as a prophylactic procedure to prevent prolapse. Webb and colleagues[48] retrospectively examined the results of 660 women who underwent a Mayo culdeplasty and reported that injury to the bladder or rectum occurred in 2.3% of patients during the vaginal dissection. Vault hematoma and blood transfusion occurred in 1.3% and 2.2% of the women undergoing this procedure, respectively.[48]

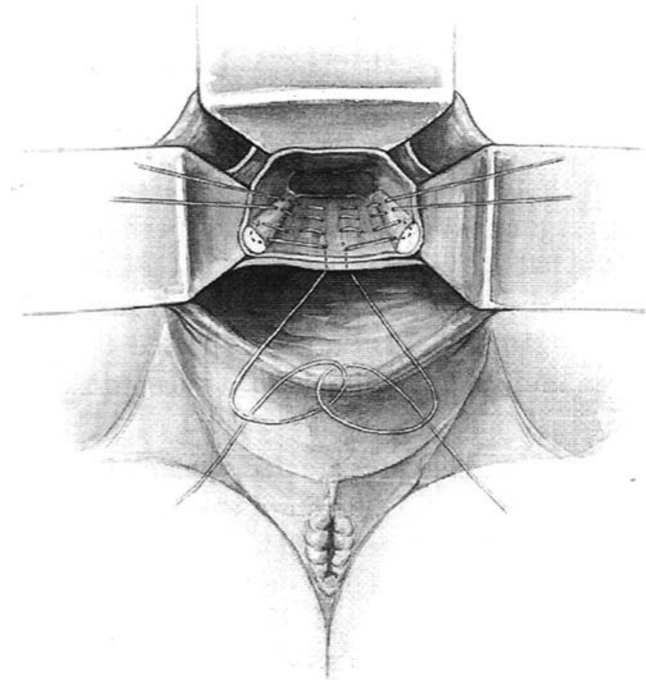

FIGURE 11.4. McCall's culdeplasty. The lowest suture incorporates the posterior vaginal wall, providing additional support. (From Walters MD, Karram MM. Urogynecology and Reconstructive Pelvic Surgery, 2nd ed. St. Louis: Mosby; 1999:224, with permission of Elsevier.)

Uterosacral Vaginal Vault Suspension

The distal uterosacral ligaments have been used to resuspend the uterus or vaginal apex for more than 100 years (Manchester procedure and McCall culdeplasty). Recently, the intermediate to proximal uterosacral ligaments have been described to resuspend the vaginal apex with and without plication or obliteration of the cul-de-sac. This support directs the upper vagina and cervix toward the hollow of the sacrum, allowing it to be supported over the pelvic floor muscles. The anatomic success rate of this procedure has been reported to be from 67% to 96% (Table 11.2)[52–58] Satisfaction or symptom relief was expressed by 82% to 100% of the women who underwent this repair.[52,55–58]

The key steps of the procedure are the placement of bilateral sutures on the intermediate to sacral portions of the uterosacral ligaments and reapproximation and suspension of the apical fibromuscularis ("fascia") of the anterior and posterior vaginal walls. A series of one[58] to three sutures are placed in each uterosacral ligament. The apical portion of the fibromuscularis of the anterior and posterior vaginal walls is identified. The superior arms of the

TABLE 11.2. Efficacy of the Uterosacral Vaginal Vault Suspension.

Author	*Patients (no.) at follow-up/initial presentation*	*Follow-up (mean # months)*	*Anatomic cure (%)*	*Satisfaction*	*Reoperation (%)*
Jenkins (1997)[52]	50	33	96%	100% (no standardized questionnaires	0%
Shull et al. (2000)[53]	289/302	14	87%	Not reported	2/289 (0.7%)
Barber et al. (2000)[54]	39/46	15.5 (median)	67%*	90%	3/39 (7.6%)
*Karram et al. (2001)[55]	168	21.6	94%	89%	
Amundsen et al. (2003)[56]	33	28	82%	82% (symptom resolution)	Not stated
*Silva et al. (2006)[57]	72/110	61.2	84.7%	94%	2/72 (2.8%)
Wheeler et al. (2007)[58]	32/35	24.3	Not clearly stated; mean postop point C was –7.8±1.60 cm	88.9%	0%

*Anatomic cure defined as < POP-Q stage II prolapse; none of these patients were symptomatic.

uterosacral sutures are placed sequentially through the anterior wall fibromuscularis. The inferior arms of the uterosacral sutures are placed through the posterior wall fibromuscularis (Fig. 11.5). When these sutures are tied, the fibromuscularis of the apical vagina is closed (closing the vaginal tube at the apex) and resuspended to the proximal portion of the uterosacral ligaments. Some surgeons perform this procedure following plication of the uterosacral ligaments and obliteration of the cul-de-sac, in keeping with the spirit of the McCall's culdeplasty.[55,57] The anterior and posterior vaginal walls are then suspended to the plicated uterosacral ligaments. The procedure has also been described through an extraperitoneal approach.[59] This approach is very useful when it is difficult to enter the enterocele into the abdominal cavity. The uterosacral ligaments can be identified extraperitoneally by placing tension with a Kocher or Allis clamp (directed toward the ceiling) on the lateral apex of the vaginal epithelium. The uterosacral ligaments are found posterior and medial to the ischial spines.

The complications associated with the uterosacral vaginal vault suspension include injury to adjacent organs and alterations in function. Injury to the bladder has occurred in up to 4% and small bowel in up to 0.5% of women undergoing this procedure.[52,55] Small bowel obstruction has been described to occur with proximal suspension of the vagina to the uterosacral ligaments.[60] Three cases were described following 623 vault suspensions in which intraperitoneal sutures led to a minimum incidence rate of 0.3%.[60] Barber and colleagues[54] observed the development of de novo genuine stress incontinence in 13% of women undergoing prolapse surgery inclusive of the uterosacral vaginal vault suspension. Blood transfusion was required in 1% to 5% of women undergoing this procedure.[53,54,56,59]

As with the McCall culdeplasty, injury to the ureters or ureteral obstruction has been described. Ureteral obstruction or injury has occurred in placing the uterosacral sutures in up to 11% of procedures.[52–55,59] In most cases of ureteral obstruction, the uterosacral ligament sutures are

FIGURE 11.5. Uterosacral vaginal vault suspension procedure. The proximal uterosacral ligaments are secured to the fibromuscularis (often termed "pubocervical and rectovaginal fascia") of the anterior and posterior vaginal walls. (Courtesy of Caudia Bachofen, MD.)

removed and free flow from the ureteral orifice is noted on repeat cystoscopy. However, the necessity of ureteral reimplantation or stenting has been described.[53–55] Dwyer and Fatton[59] suggest that the extraperitoneal approach to the uterosacral ligament suspension decreases the risk of ureteral injury by eliminating the potential for peritoneal kinking of the ureter. They describe a 1.6% (2/123) ureteral obstruction rate, all occurring in the first 50 cases, prior to elevating the bladder and ureters out of the field with a Briesky-Navratil retractor.[59]

Neural pain has been described with a variety of reconstructive prolapse surgeries such as sacrospinous ligament suspension and iliococcygeus vault suspension procedures. The uterosacral ligament suspension procedure has been associated with this complication as well. The intermediate to sacral portion of the uterosacral ligaments fans over sacral nerve roots S1-S4.[61] Techniques to avoid injuring these nerves include using a small needle with a tight curve, or grasping the uterosacral ligament with a long Allis clamp. This allows the ligament to be pulled away from the underlying neurovascular entities of the pelvic sidewall. Neuritic pain in the ipsilateral lumbosacral nerve distribution has been described following a seemingly uncomplicated uterosacral vaginal vault suspension.[61,62] Treatment includes prompt recognition and removal of the involved sutures. Physical therapy may also be of benefit.

Shull et al.[53] found no significant increased risk of anatomic failure when the uterosacral ligament vaginal vault suspension was performed as a primary prolapse procedure or performed in women with recurrent pelvic organ prolapse. The use of the intermediate to proximal (sacral) portion of the uterosacral ligaments provides bilateral support of the vagina directed toward the hollow of the sacrum (Fig. 11.6). The anatomic and functional results have shown excellent outcomes for up to 5 years of follow-up.[57] The proximity of the ureters to the uterosacral ligaments necessitates the performance of cystoscopy to ensure ureteral patency.

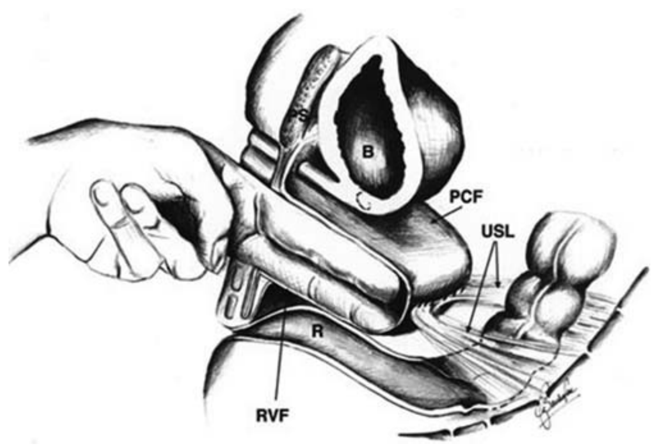

FIGURE 11.6. At the conclusion of the procedure, the vagina has bilateral apical support directed toward the hollow of the sacrum. USL, uterosacral ligaments; PCF, pubocervical fascia (fibromuscularis); RVF, rectovaginal fascia (fibromuscularis); R, rectum; B, bladder; PS, pubic symphysis. (Courtesy of Caudia Bachofen, MD.)

Sacrospinous Ligament Fixation

The sacrospinous ligament spans the distance between the sacrum and ischial spine. This strong ligament has been used for apical support procedures for decades. Randall and Nichols[63] introduced the sacrospinous ligament fixation to the United States in 1971. Success rates at the apex of the vagina vary from 79% to 100%, and at all sites in the vagina from 66% to 100% (Table 11.3).[24–29,64–75] To date, bilateral sacrospinous ligament fixation has not been shown to be more efficacious than unilateral suspension.

The rectovaginal space is entered and dissection is performed through the rectal pillar to the sacrospinous ligament and overlying coccygeus muscle (Fig. 11.7). This dissection is performed on the patient's side that corresponds to the surgeon's dominant hand (typically on the patient's right side). Two sutures are placed approximately two finger-breadths

TABLE 11.3 Efficacy of the Sacrospinous Ligament Fixation Procedure.

Primary author (year)	*No. of Patients at follow-up/initial presentation*	*Mean follow-up (months)*	*Anatomic cure rate at apex (%)*	*Anatomic cure rate at all sites (%)*
Morley (1988)[64]	71/100	>12	96	76
Cruikshank (1990)[65]	48	24	98	83
Shull (1992)[24]	81	1.5–60 (range)	98	66
Holley (1995)[25]	36	15–79 (range)	92	76
Sauer (1995)[66]	24	13.8	79	75
Peters (1995)[67]	30	48 (median)	80	77
Paraiso (1996)[68]	243	73.6	93	69
Salvat (1996)[69]	20	84	100	90
Schlesinger (1997)[70]	17	9.8	88	88
Sze (1997)[71]	75/96	24	95	71
Ozcan (1999)[72]	54	28	96	Not clearly stated
Lantzsch (2001)[26]	123/200	57.6	97	87
Nieminen (2001)[73]	19/25	33	95	79
Guner (2001)[74]	26	31	100	88
Maher (2001)[27]	36	19	97	67
Lovatsis (2002)[75]	200/293	12-60 (range)	97	88
Nieminen (2003)[28]	122/138	24 (median)	95	79
Maher (2004)[29]	43/48	22	81	69

medial to the ischial spine. Delayed-absorbable or permanent suture is recommended for this procedure. A number of devices have been described to facilitate placing these sutures, such as the Deschamps ligature carrier, Shutt needle punch, Miya hook, and Endostitch device.[63,70,76,77] The sacrospinous sutures are anchored to the apex of the vagina with pulley sutures. In a woman with prolapse that has extensively stretched the vaginal fibromuscularis and epithelium, the location of the "new" apex may be determined by measuring the distance from the hymen to the ischial spine.[78] Trimming of the redundancy and passing of the sutures through the "new" apex may then be performed. Typically, a posterior repair of the fibromuscularis is performed prior to tying the sutures in the sacrospinous ligament.

Lo et al.[79] performed a sacrospinous ligament fixation with polypropylene mesh anchored to the sacrospinous ligament and the fibromuscularis of the anterior and posterior vaginal wall in 15 women with recurrent prolapse. No woman required further surgery after a mean follow-up of 2.9 years, and only two women developed recurrent prolapse (stage I anterior wall prolapse). An increase in sexual inactivity and dyspareunia was noted in this small study.

Complications of a sacrospinous ligament fixation include those that are common in vaginal surgery

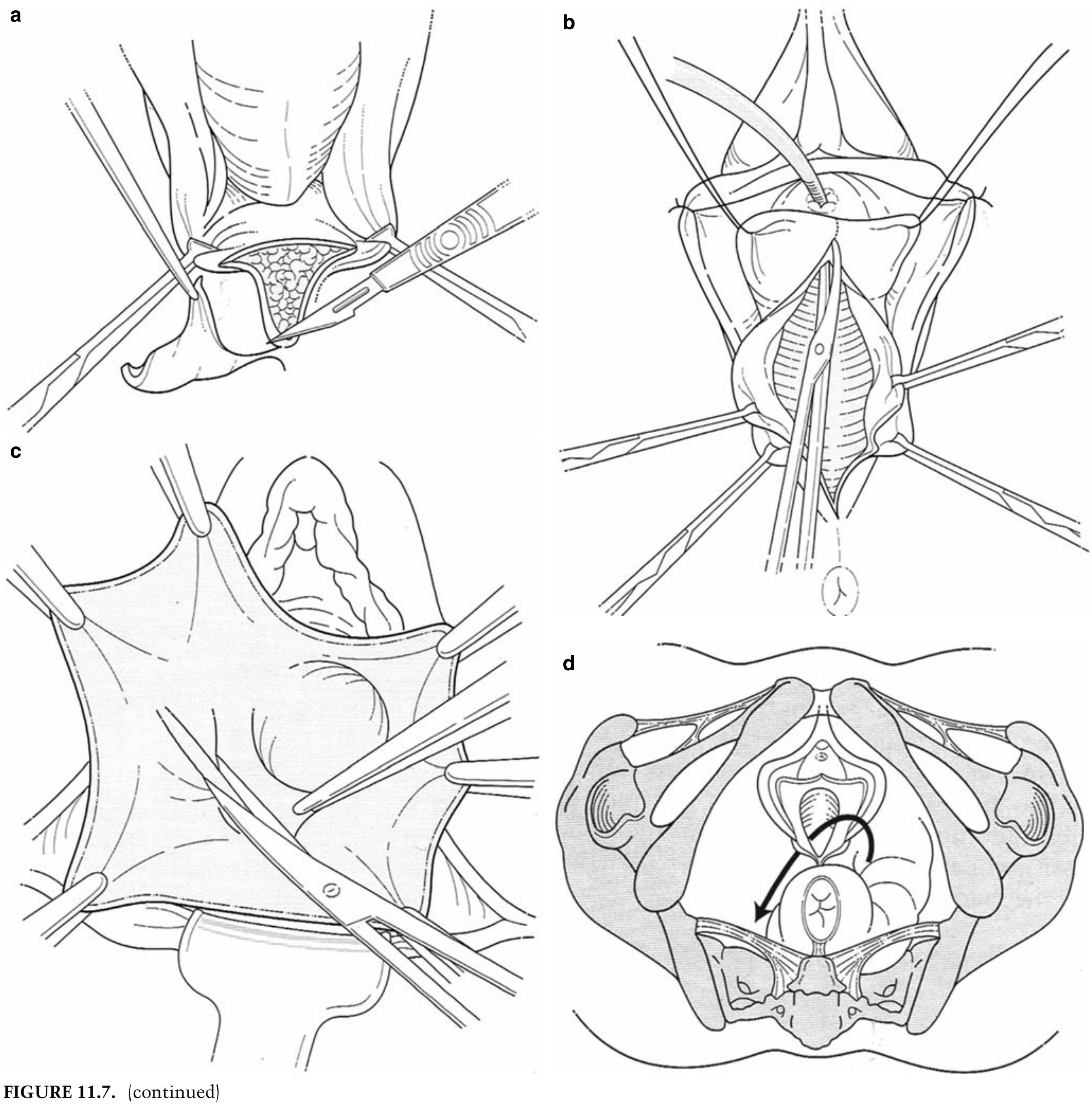

FIGURE 11.7. (continued)

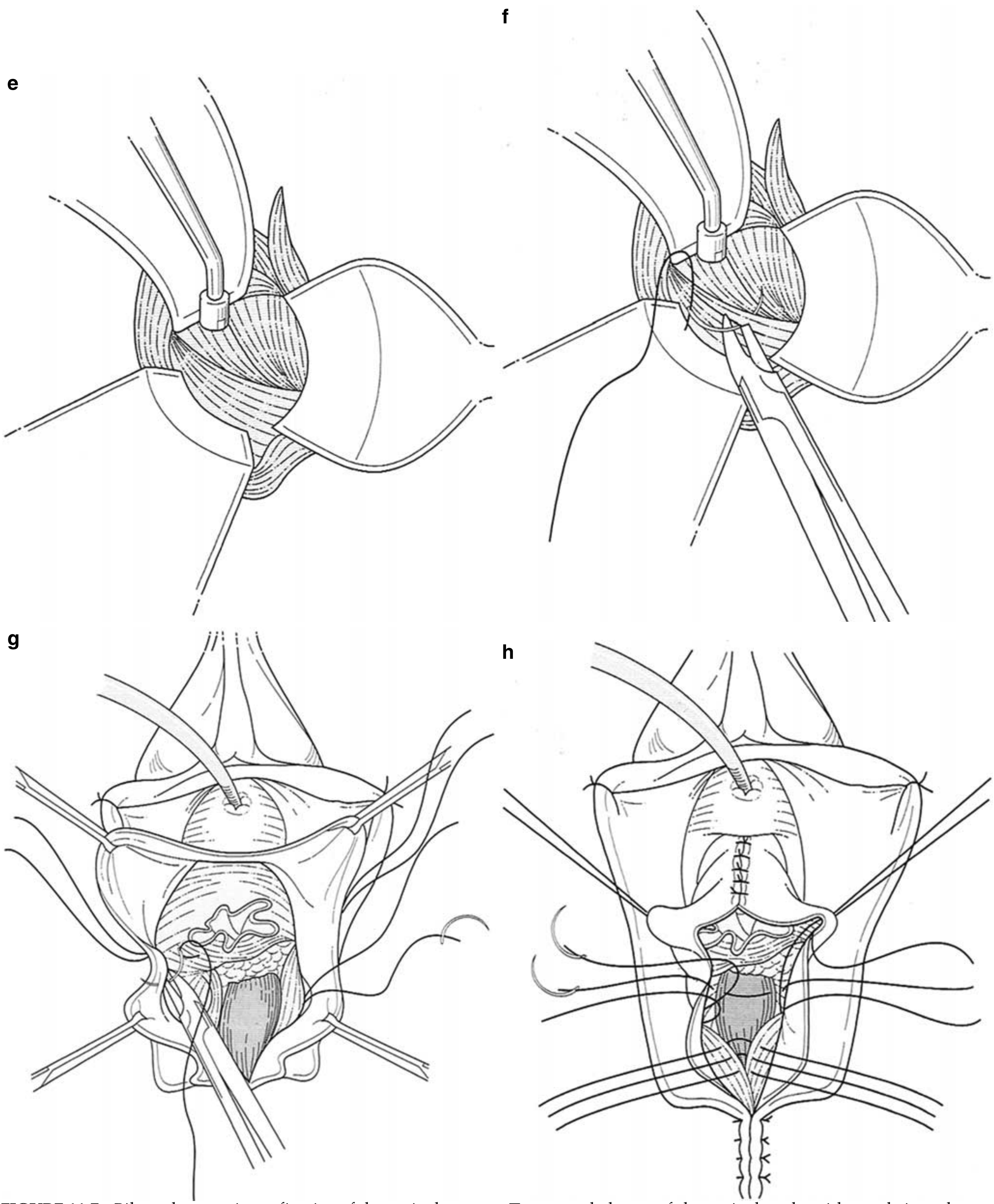

FIGURE 11.7. Bilateral sacrospinous fixation of the vaginal vaunt prolapse after hysterectomy. (**A** and **B**) The pararectal space is widely exposed. (**C** and **D**) Dissection plan toward the sacrospinalis ligament and three valves are positioned to expose the sacrospinalis ligament, which is then secured under direct visual control. (**E**) The same nonabsorbable suture is used to secure the sacrospinalis ligament and is then passed through the initially identified vaginal vault apex at the location of the uterosacral insertion. (**F** and **G**) Transversal closure of the vaginal vault, with care being taken to avoid a high compression of the rectum, possibly causing defecation difficulties. (**H**) Then closure of the posterior midline incision after colpectomy, although limited in sexually active patients. (From Stanton S, Zimmern P. Female Pelvic Reconstructive Surgery. New York: Springer; 2002, with permission of Springer Science + Business Media.)

(infection and injury to adjacent organs) and those that are specific to the anatomy of the sacrospinous ligament. Rectal laceration has been described.[72] Gluteal pain is a common complication of the sacrospinous ligament fixation.[26,28,65,74,75] The pudendal and sciatic nerves pass behind the sacrospinous ligament, and if injured, motor, sensory, and severe pain have been reported.[80] In addition, nervous tissue has been found within the body of the sacrospinous ligament itself, suggesting that nerve injury may be an unavoidable part of this procedure.[81]

Life-threatening vascular injury has been described with the sacrospinous ligament fixation.[82,83] Placement of the sutures in the sacrospinous ligament medial to the ischial spine is performed to avoid injury to the internal pudendal neurovascular structures. The internal pudendal vessels pass behind the ischial spine and are relatively protected by it. By placing the fixation sutures medial to the spine, the sutures pass in close proximity to the inferior gluteal vessels.[82] Barksdale et al.[82] examined 10 embalmed cadavers to elucidate the vascular anatomy in proximity to the sacrospinous ligament. They described the inferior gluteal vessels passing posterior to the sacrospinous ligament, approximately midway between the ischial spine and the sacrum. If bleeding does occur, exposure is limited. Vaginal packing and stabilization of the patient are advised as the first steps in the management of hemorrhage in this setting.

The incidence of postoperative anterior wall prolapse varies greatly in the published literature and has been reported to be up to 27%.[24–29] One of the difficulties in comparing outcomes is that many studies vary in their definition of "cure." Holley et al.[25] report that 92% (33/36) of women had grade 1 postoperative anterior wall prolapse following a sacrospinous fixation. However, stage or grade 2 is more commonly defined as recurrence,[84] and applying this definition, 24% of the women had postoperative anterior wall prolapse, which is very similar to the outcomes reported by other surgeons (Table 11.2). The proposed mechanism behind this increase in recurrent or de novo anterior wall prolapse is that the axis of the vagina is retroverted following a sacrospinous ligament procedure, opening up the anterior vaginal wall to increases in abdominal stress. The anterior vaginal wall may be even more exposed if the procedure is combined with an operation that over-elevates the bladder neck (such as a needle colposuspension for stress urinary incontinence).

The sacrospinous ligament fixation procedure is one of our most studied apical suspension procedures. This procedure achieves excellent apical support. Postoperative recurrent or de novo anterior wall prolapse is a concern with all prolapse procedures, and there is a suggestion that the sacrospinous ligament fixation may increase this risk.

Iliococcygeus Vaginal Vault Suspension

The iliococcygeus muscle, a component of the levator ani, is located lateral to the proximal and apical portion of the vagina. Bilateral fixation of the vaginal vault to the endopelvic fascia overlying the iliococcygeus muscle was described by Inmon[85] in 1963. Bob Shull and colleagues[86] reported their experience with a series of patients using the iliococcygeus fascia just distal to the ischial spine, to support the vaginal cuff. Peters and Christenson[87] describe using the fascia overlying the coccygeus muscle, cephalad to the iliococcygeus muscle, with a projected 2-year success rate of 96%. The efficacy of the iliococcygeus vaginal vault suspension is 53% to 96%.[27,86,88] (Table 11.4)

TABLE 11.4 Efficacy of the Iliococcygeus Vaginal Vault Suspension Procedure.

Primary author (year)	*No. of patients at follow-up/initial presentation*	*Mean follow-up (months)*	*Anatomic cure (%)*	*Reoperation (%)*
Shull (1993)[86]	42	1.5–60 (range)	81	4.8
Meeks (1994)[88]	110	≥36	96	NS
Maher (2001)[27]	36/50	21	53	2.8

The iliococcygeus suspension is performed through a dissection of the posterior vaginal wall. The subepithelial dissection is carried out laterally until the ischial spine is identified. One or two delayed-absorbable sutures are placed bilaterally in the condensation of connective tissue overlying the iliococcygeus distal to the ischial spine (near the arcus tendineus fascia pelvis). A suture passer that is able to pass sutures in a small space can be helpful in this area. These sutures are then anchored to the lateral fibromuscularis ("fascia") and epithelium (if absorbable suture is used) of the ipsilateral apex.

The complications commonly associated with vaginal reconstruction including blood transfusion and injury to surrounding viscera have been reported. Blood transfusion when iliococcygeus has been incorporated into the procedure has been performed in up to 2% of women.[88] Cystotomy and enterotomy have also uncommonly occurred.[88] Additionally, Maher and colleagues[27] described buttock pain in 19% of patients who underwent an iliococcygeus vaginal vault procedure. They proposed that the etiology of gluteal pain was muscle ischemia rather than direct nerve damage. Peters and Christenson[87] report a 1% incidence of sciatic nerve injury associated with extending the suspension to the coccygeus fascia in their vault suspension procedure.

The iliococcygeus vaginal vault procedure is a simple procedure that provides adequate support of the vaginal vault. The vaginal length achieved with this procedure is intuitively not as great as that achieved with the sacrospinous or uterosacral vaginal vault suspension procedures. The level of attachment is at the proximal point of DeLancey's level II rather than level I suspensory support. However, this procedure generally avoids the risk of hemorrhage that may occur with the sacrospinous ligament procedure or the risk of ureteral injury of the uterosacral vaginal vault suspension.

This procedure may also be incorporated into a site-specific posterior wall repair, reattaching the apical portion of the posterior wall fibromuscularis to its proximal, lateral fascial attachment overlying the iliococcygeus muscle. As noted, gluteal pain has been reported in up to 19% of women who have this procedure.[27] Early gluteal or sciatic pain frequently resolves following early suture removal. If the iliococcygeus sutures are absorbable and both ends are brought through the epithelium of the apex and cut long, they may be accessible in the office for removal if necessary.

Abdominal Sacrocolpopexy

The vagina may be suspended to the anterior longitudinal ligament of the sacrum with graft placed along both the anterior and posterior vaginal walls. This abdominal approach suspends the vagina in the correct axis and preserves or enhances vaginal length. A recent comprehensive review of the literature by Ingrid Nygaard et al.[89] writing for the Pelvic Floor Disorders Network found that the success rate of this procedure for prolapse varies widely from 58% to 100%. The median reoperative rate for the studies was 4.4%. Satisfaction with the procedure is also of vital importance. A large retrospective analysis of 169 women undergoing an abdominovaginal sacral colpoperineopexy found that when they where asked at postoperative evaluations up to 24 months, "Would you go through the same surgery again?," 77.3% said yes, 4.9% responded no, and 17.8% did not answer the question.[90]

The procedure may also be performed through an abdominal or laparoscopic approach. A dilator is placed in the vagina to facilitate dissection of the vesicovaginal and rectovaginal spaces. Two separate pieces of mesh or a Y-shaped mesh may be introduced into the abdominal cavity and sutured with several rows to the posterior and anterior vaginal walls. It is imperative to include the fibromuscularis of the vaginal walls in these sutures. If a significant posterior vaginal wall defect and perineal descent is apparent, the posterior mesh may be sutured to the perineal body as well as the posterior vaginal wall sacrocolpoperineopexy.[90,91] Suturing into the apex is generally avoided to decrease the risk of mesh erosion. The peritoneum overlying the sacrum is opened (with the sigmoid retracted to the left and the right ureter identified). The anterior longitudinal ligament is exposed. The mesh is attached to the anterior longitudinal ligament of the sacrum with suture or a tacking device near the sacral promontory at approximately S1-2. Attachment of the mesh to S3-4 should be avoided to decrease the risk of bleeding in the presacral space. These sutures are then placed through the two grafts that are connected to the anterior and posterior vaginal wall (Fig. 11.8). The bridge of support between the vagina and the sacrum should lie without tension in the hollow of the sacrum. The grafts are then reperitonealized. Concomitant procedures may be performed as needed. A prophylactic Burch retropubic urethropexy has been found to significantly decrease the risk of postoperative de novo stress urinary incontinence when compared to women who did not have a retropubic anti-incontinence procedure performed (23.8% vs. 44.1%).[92]

In women with recurrent prolapse and a history of a prior abdominal sacrocolpexy, the point of failure is generally at the vagina. A vaginal approach may be performed to isolate the defect and reattach the vagina to the mesh support. If an abdominal approach is undertaken, the graft material may be scarred at the sacrum but detached from the vagina. If the graft material from the prior sacrocolpopexy is present at the sacrum, it should be used for the sacral attachment of the repeat procedure if not infected.[93] Attempts at removal and replacement of mesh from the sacrum may induce presacral bleeding.

The risk of recurrence with this procedure primarily involves the anterior and posterior vaginal walls.[89,94,95] The apex generally remains well supported. The risk of recurrence may be affected by the choice of graft material. Culligan et al.[95] randomized 100 women to receive cadaveric fascia lata or polypropylene for the graft material during an abdominal sacrocolpopexy. The objective anatomic failure rate among the women receiving the cadaveric fascia lata was 32% at 1 year vs. 9% for the women receiving the

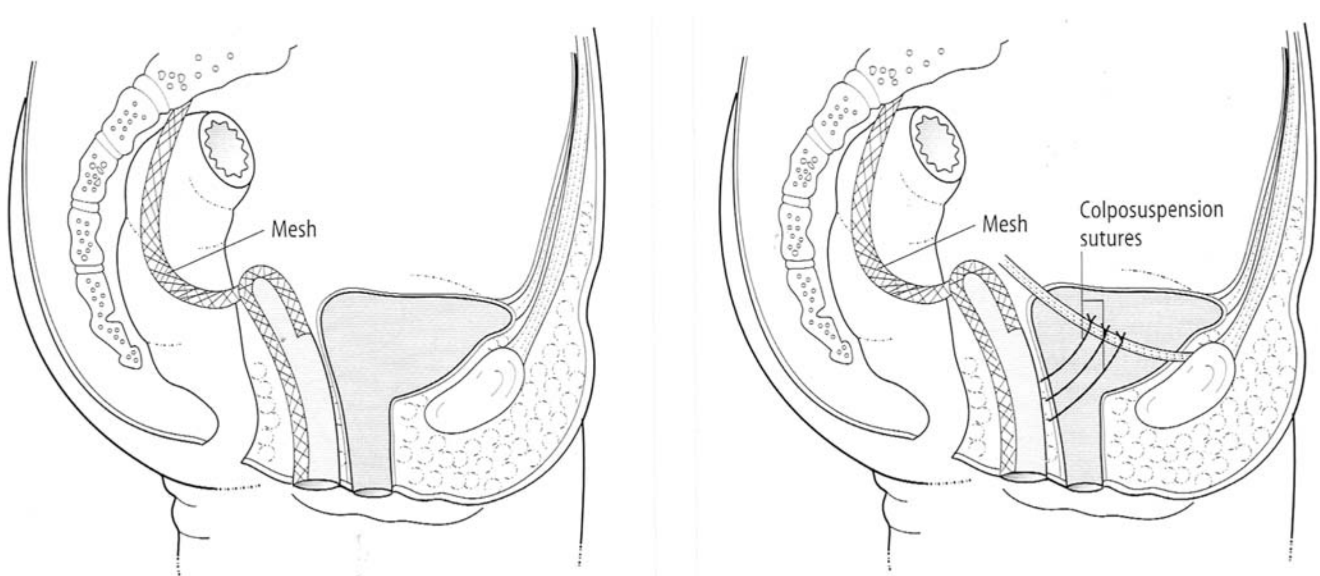

FIGURE 11.8. Abdominal sacrocolpopexy. (From Stanton S, Zimmern P. Female Pelvic Reconstructive Surgery. New York: Springer, 2002; with permission of Springer Science + Business Media.)

polypropylene. Eighty-three percent of the anatomic failures were in the anterior compartment, while the apex remained well supported.[95]

Complications associated with the sacrocolpopexy most commonly include infections of the urinary tract (10.9%) or wound infections (4.6%).[89] In a prospective multicenter study of the gastrointestinal complications following an abdominal sacrocolpopexy, the rate of small bowel obstruction was 1.9% to 2.5% and the rate of ileus was 2.2% to 2.5%.[96] The rate of bowel obstruction requiring reoperation was approximately 1.2% within 1 year of the operation.[96] Injury to surrounding organs may also occur. The intraoperative complication that is most worrisome is presacral hemorrhage. Bleeding from the presacral space can be life-threatening because the bleeding vessels may disappear into the sacrum. Exposure of the anterior longitudinal ligament and attachment of the graft toward the sacral promontory rather than S3-4 may decrease this risk. Hemorrhage or transfusion occurred in 4.4%.[89]

Erosion may occur with any graft material that is implanted. The properties of the graft and the length of follow-up are important in understanding the likelihood of capturing the true rate of erosion. The erosion rate is estimated to be 3.4%.[89] The erosion rate will vary depending on the graft material used. Cadaveric and autologous fascia will have a very low erosion rate, while multifilament mesh will be associated with a higher erosion rate. Additionally, erosion may be increased if the graft or suture used to anchor the graft in the sacrocolpopexy or sacrocolpoperineopexy is introduced through the vagina. In a retrospective analysis of 273 abdominal sacrocolpopexies and sacrocolpoperineopexies, Visco and colleagues[97] observed an erosion rate of 3.2% in the abdominal sacrocolpexy group and 4.5% in the abdominal sacrocolpoperineopexy group. In contrast the erosion rates were 16% and 40%, respectively, in women in which the sutures were introduced vaginally.Erosions may occur years after the procedure was performed; therefore, the erosion rate will be higher the longer we follow women undergoing an abdominal sacrocolpopexy.

Debate has existed about whether a concomitant hysterectomy at the time of an abdominal sacrocolpopexy increases the risk of mesh erosion.[98–102] In a large retrospective cohort study of 313 women undergoing an abdominal sacrocolpopexy with ($n = 101$) and without ($n = 212$) a concomitant hysterectomy, Wu and colleagues[102] found that concomitant hysterectomy was not associated with mesh erosion (6.9% vs. 4.7%, $p = .42$). Brizzolara and Pillai-Allen[101] found that in women with ($n = 60$) and without ($n = 64$) a concomitant hysterectomy, the erosion rate was very low (0.8%) when using polypropylene (80%) and allograft (20%) mesh.

De novo stress incontinence or defecatory dysfunction may occur following this procedure.[92,103] The subject of the development of de novo stress incontinence was addressed by the Pelvic Floor Network with a multicenter, prospective randomized trial. It is now recommended that a Burch retropubic urethropexy be performed at the time of an abdominal sacrocolpopexy to reduce the risk of postoperative de novo stress incontinence.[92]

Abdominal sacrocolpopexy has been compared to the sacrospinous ligament vaginal vault suspension in three published trials. In two of these prospective, randomized trials, the abdominal sacrocolpopexy was the more efficacious procedure.[104,105] To date, the only other published prospective, randomized trial comparing a vaginal and abdominal reconstructive procedure also compared the abdominal sacrocolpopexy and sacrospinous vaginal vault suspension in 95 women.[29] The overall satisfaction was similar between the two groups: 85% vs. 81% for abdominal vs. vaginal, respectively.[29] However, there was a lower rate of recurrent apical prolapse in women who underwent an abdominal sacrocolpopexy 4.3% (2/46) vs. women who underwent a sacrospinous fixation 18.6% (8/43).[29] The anatomic efficacy gained with the abdominal sacrocolpopexy over the vaginal procedure comes with a price: longer operating room times, higher hospital costs, higher short-term morbidity of using the abdominal approach, as well as the long-term risk of mesh erosion, compared to the vaginal approach.[106,107]

Tension-Free Vaginal Mesh Kit Procedures

Compensatory procedures, such as the abdominal sacrocolpopexy, have enjoyed the stasis of the gold standard.[106] When gynecologic surgeons are faced with surgically managing recurrent prolapse, often the gold standard is recommended. The new tension-free vaginal mesh procedures attempt to capitalize on the durability and efficacy of the abdominal sacrocolpopexy while maintaining the advantages of a vaginal approach. Currently, the short-term results reveal short-term anatomic cure rates of 91% to 95%[108–111] (Table 11.5).

The anterior repair of prolapse in each of the kits follows the same basic steps. A midline incision is performed in the anterior vaginal wall, and every attempt is made to leave the fibromuscularis (pubocervical fascia) on the vaginal side. Hydrodissection may facilitate this step. Leaving the full-thickness fibromuscularis layer on the vaginal epithelium is proposed to reduce the risk of postoperative vaginal mesh erosion. This dissection is carried out bilaterally along the pelvic sidewall to the ischial spine. Now the arcus tendineus fascia pelvis is palpable from the back of the pubic bone to the ischial spine. Four skin incisions are made in the genitocrural folds, one in each anteromedial edge of the obturator foramen at the level of the clitoris, and the others, 2 cm below and 1 cm lateral to the genitocrural fold incisions. The kit needles, or cannula guides, are used to position the mesh arms on two points along each arcus tendineus fascia pelvis; the first mesh arm is approximately 1 to 2 cm from the distal aspect of the pubic bone and the second (the deep arm) is approximately 1 cm distal to the ischial spine. It is imperative to position the mesh in a tension-free manner. If the uterus is in place, a permanent monofilament suture may be used to anchor the graft "mesh" to the cervix near the internal cervical os. A delayed-absorbable suture can be used to anchor the mesh in the midline distally. The vaginal epithelium is closed without trimming. Cystourethroscopy is performed to confirm that the bladder, ureters, and urethra are intact and patent.

TABLE 11.5 Efficacy of Tension-Free Vaginal Mesh Procedures.

Author (year)	*Patients at follow-up/initial presentation*	*Kit*	*Mean follow-up (months)*	*Anatomic cure*	*Reoperation*	*Mesh exposure*	*Surgical drainage of hematoma*
Fatton (2007)[108]	106/110	Prolift™	6 (median)	95%	2.8%	4.7%	1.9%
DeTayrac (2007)[109]	143	Similar to Avaulta™	13	92.3%	0.7%	6.3%	1.4%
Sivaslioglu (2007)[110]	43/45	Anterior only *	12	91%	NS	6.9%	NS
Gauruder-Burmester (2007)[111]	120/145	Apogee® or Perigeee®	12	93%	NS	8%	0

NS, not stated.

Note: Anterior only tension-free vaginal mesh procedure: mesh was hand-cut from a large sheet of lightweight polypropylene mesh (Sofradim, Parietene) and then passed through the levator ani and obturator foramen.

The posterior wall repair differs between the kits. The Prolift (Ethicon, Inc., Johnson & Johnson, Somerville, NJ) includes apical support. To date, the other kits available do not specifically address the apex. All begin the same way. The posterior vaginal wall is opened, leaving the fibromuscularis (rectovaginal fascia) on the epithelium. Dissection is carried out to the ischial spine. The dissection for Prolift continues to the sacrospinous ligament. Two incisions are made for the posterior wall tension-free kit repair, one on each side, 3 cm lateral and 3 cm below the anus. With one hand in the vagina, deflecting the rectum medially, the needle is introduced into the gluteal incision and guided through the ischiorectal fossa. The Prolift procedure has the needle advanced until it passes through the sacrospinous ligament, approximately 3 cm lateral to the ischial spine. The needle in other kit procedures such as Apogee (American Medical Systems, Minneapolis, MN) and Avalta (C.R. Bard, Inc., Covington, GA) exit the iliococcygeus muscle just distal to the ischial spine. Once again, the mesh may be anchored with permanent, monofilament suture to the cervix at the level of the internal cervical os. Distally, the mesh should be trimmed approximately 1 cm from the perineal body to avoid extrusion onto the perineum (Fig. 11.9). Trimming of the epithelium is kept at a minimum, and a pack is placed for 24 to 48 hours.[108] A rectal examination should be performed to confirm that there is not a palpable rectal injury. Prophylactic antibiotics have been reported to be given for up to 7 days.[111] Pre- and postsurgical treatment of the vaginal epithelium with topical estrogen is advocated to decrease the incidence of mesh erosion.[111]

The complication most commonly associated and reported with mesh augmented procedures is erosion. The short-term erosion rate is up to 8% and is bound to be higher the longer these women are followed.[111] The anterior vaginal wall has been found to be more at risk for mesh erosion than the posterior vaginal wall.[109,111] A concomitant hysterectomy or trachelectomy increased the risk of erosion by eight- to ninefold.[109] It has been suggested that dissecting underneath the fibromuscularis, rather than splitting it underneath the vaginal epithelium, is an important step in preventing vaginal erosion. This step places the mesh close to the viscera. Vesicovaginal fistula with mesh erosion into the bladder and vagina has been reported.[112]

The tension-free vaginal mesh kit procedure, if placed anteriorly and posteriorly, involves the blind passage of six needles. Altman et al.[113] found that the overall risk of serious complications of the Prolift procedure is 4.4%(11/248). The majority of the serious complications were visceral perforations (10/11). The bladder injury rates have been reported to vary from 0.9% to 2.8%.[108,109,113] If the bladder is injured, it is repaired and the procedure is continued.[108] Rectal perforation has also been reported to occur in 0.7% to 2.8% of cases.[109,113] Unlike bladder perforations, if the rectum is perforated, the posterior tension-free vaginal mesh placement should be abandoned.[108]

The needles of the posterior pass of Prolift travel through a large expanse of the ischiorectal fossa on the way to the sacrospinous ligament. Reisenauer et al.[114] found in a study in cadavers that the sacrospinous ligament cannulas passes 0.5 to 1 cm medial to the internal pudendal nerve and vessels. The anterior "deep" pass is just proximal to the ischial spine, again, very near the pudendal neurovascular bundle. Profuse vaginal bleeding may occur intraoperatively, in which case consideration of interventional radiologic embolization of the offending vessel can be lifesaving.[115] Hematomas may be more insidious. They may become symptomatic and require surgical drainage days after the original procedure.[108,109,116]

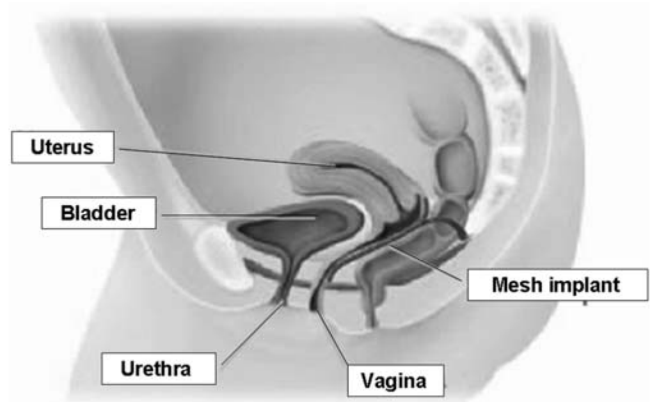

FIGURE 11.9. Rectocele repair with the Prolift procedure. (Courtesy of Ethicon Endo-Surgery, Inc., Cincinnatti, OH.)

Pelvic pain has been associated with many reconstructive surgical procedures. The tension-free vaginal mesh procedures have also been associated with vaginal pain, defecatory pain, and dyspareunia.[109,113] When evaluated, de novo dyspareunia occurs in up to 12.8% of women.[109] De Tayrac et al.[109] reported that vaginal pain and de novo dyspareunia was the reason given in three of five women reporting dissatisfaction with the tension-free vaginal mesh kit procedure. Banding of the mesh may contribute to the pain in some of these women; therefore, release of the sling arm at their point of attachment to the levator plate may help relax the vaginal wall. Surgical management is generally performed after a period of conservative management, consisting of pelvic floor physical therapy and possibly trigger point injections.

The new kit procedures have been introduced and have received widespread acceptance by the gynecologic community of surgeons. The success of the mid-urethral slings should not be directly translated to the tension-free vaginal mesh kit procedures. The surface area of mesh that is placed with the kits is much larger. There are many more blindly passed needles in the total vaginal mesh procedure. And importantly, the possible long-term surgical complications are yet to be determined. The management of complications is potentially more difficult with the mesh in place. The surgeon must weigh the possible gain in anatomic efficacy, efficiency of the procedure, attractiveness of a vaginal approach, and potential durability (yet to be demonstrated) against the potential morbidity associated with mesh erosion and potential unforeseen complications.

Obliterative Procedures

Colpectomy and Le Fort Colpocleisis Procedures

Patient selection is crucial in the performance of obliterative procedures. However, these procedures may be ideal for elderly women with advanced, recurrent prolapse. These women typically are elderly (in their eighth decade or beyond), no longer sexually active, and have multiple medical problems. Additionally, they typically have advanced, stage III or stage IV, pelvic organ prolapse, by the pelvic organ prolapse quantification (POP-Q) system,[117] which has failed conservative therapy. Because these obliterative procedures are performed in a very select group of elderly women who will lose the ability to have vaginal intercourse, it is imperative that thorough preoperative counseling be performed. As people age, short-term memory may be affected; therefore, having a spouse or family member present for counseling (and careful documentation of the counseling) is suggested.

The advantages of performing a colpocleisis procedure over traditional vaginal prolapse procedures are that it can be performed under local anesthesia and may be shorter in duration than a complex, multisite repair that resuspends the vaginal apex and corrects anterior and posterior wall prolapse.[118,119] These advantages are crucial for women with medical problems that result in a relative or absolute contraindication to general anesthesia. Additionally, the efficacy of the procedure is excellent, approximately 90% to 100%.[118–125]

Variations of these obliterative procedures have been performed. The common steps to these procedures include denuding an area of epithelium of the majority of the vagina and reapproximation of the denuded fibromuscularis of the vagina, while reducing the prolapse.

Women with a uterus are treated with a Le Fort procedure or a vaginal hysterectomy with subsequent colpectomy and colpocleisis. The cervical os is concealed following the Le Fort procedure, making evaluation of uterine bleeding difficult following this procedure. A Pap smear and evaluation of the endometrium should be performed prior to a Le Fort procedure. The Le Fort procedure involves denuding a rectangular section of the upper two thirds of the anterior and posterior walls and approximating the edges together while reducing the cervix in a cephalic direction. Two tunnels are created on the lateral sides of the vagina for egress of uterine secretions.

A colpectomy with colpocleisis involves denuding the vaginal epithelium. Sequential interrupted purse-string sutures are placed in the fibromuscularis of the denuded vagina beginning at the apex and progressing distally toward the hymen. As the purse-string suture is tightened, the prolapse is reduced into the abdominal cavity (Fig. 11.10).

Concomitant vaginal procedures are described in addition to the obliterative portion of the procedure. The two areas of focus are urethral support and posterior wall and perineal body support. To address these areas, the distal 3 cm of the vagina is not included in the colpocleisis (this is often termed a "partial colpocleisis procedure").

Cessation of plication sutures proximal to the urethrovesical junction should be performed in an attempt to decrease the likelihood of postoperative de novo urinary incontinence. It may be that altering the urethrovesical angle by flattening or posteriorly deflecting it with plication of the suburethral fibromuscularis leads to stress urinary incontinence. Occult or potential urinary incontinence may be unmasked following colpocleisis. Preoperative urodynamics with reduction of the prolapse may allow the surgeon to identify which patients are at risk for postoperative stress urinary incontinence.

By preserving a vaginal canal under the urethra, access is maintained to perform future suburethral procedures should stress postoperative urinary incontinence develop. De novo stress urinary incontinence has been reported in 0% to 27% of patients undergoing an obliterative procedure.[119–126] The most commonly described procedures to address stress urinary incontinence or occult incontinence are a Kelly suburethral plication or a pubovaginal sling.[118,122,124,126] Additionally, needle suspensions, paravaginal cystourethropexies, and tension-free vaginal tape procedures have been combined with a colpocleisis.[119,123,125,127] Moore and Miklos[123] performed the tension-free vaginal tape procedure under local anesthesia in 30 women undergoing colpocleisis. The tension-free vaginal tape procedure was performed in an average of 19 minutes with a cure rate of 94% at 19.1 months.

Many women with stage III and IV prolapse have a widened levator and genital hiatus. A widened levator hiatus allows for an increased area of transmission of the

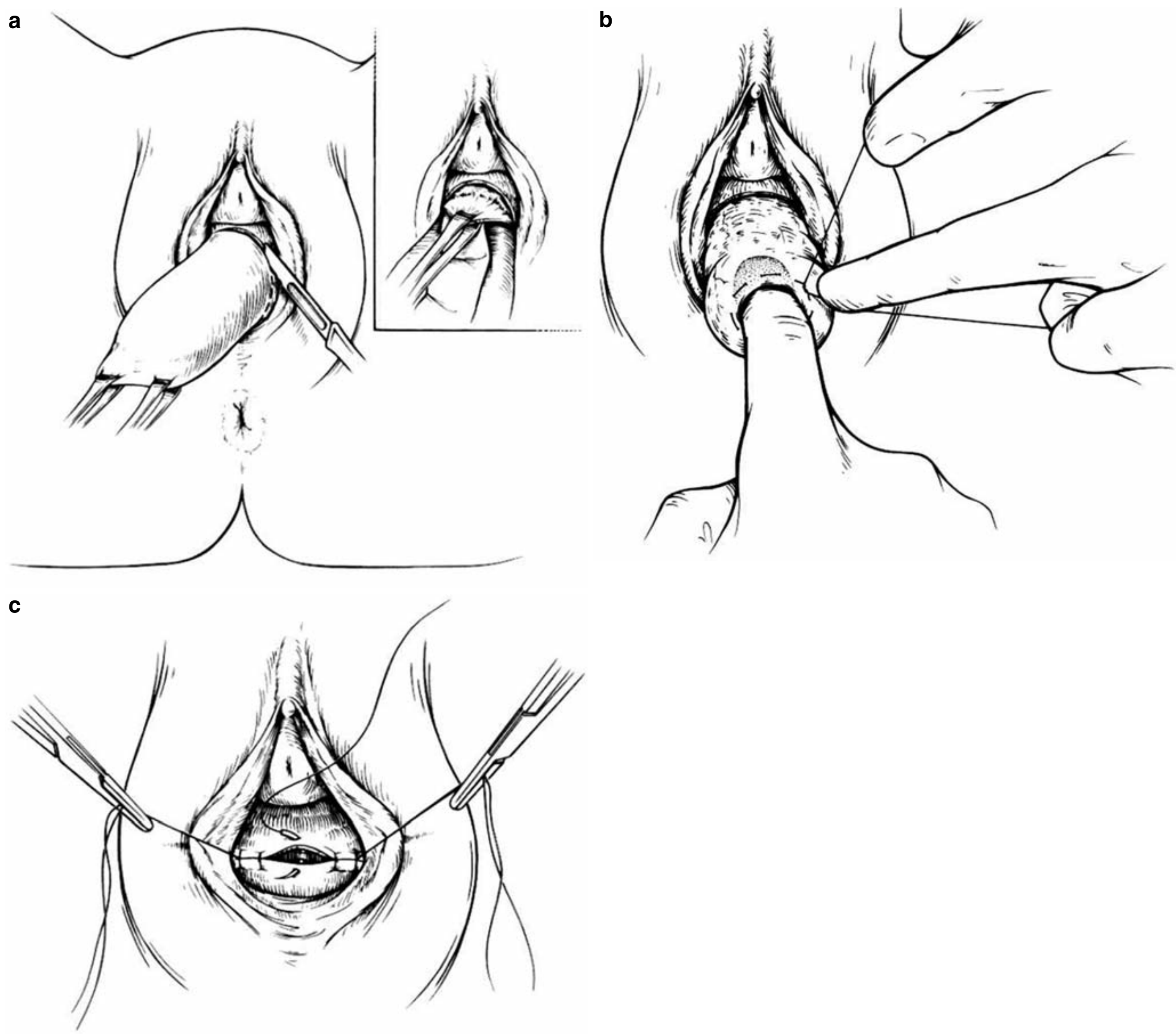

FIGURE 11.10. (**A**) Colpocleisis. An incision that circumscribes the base of the vagina is made. *Inset*: The vaginal epithelium is dissected away from the underlying fibromuscularis. Hydrodissection with saline of a dilute solution containing vasopressin of epinephrine may facilitate this portion of the procedure. (**B**) Purse-string sutures are placed in the denuded fibromuscularis. The prolapse is reduced as the suture is tied down. (**C**) The vaginal epithelium is closed. (From DeLancey JOL, Morley GW. Total colpocleisis for vaginal eversion. Am J Obstet Gynecol. 1997;176:1228–35, with permission from Elsevier.)

abdominal pressures to the organs, which pass through this hiatus: the urethra, vagina, and rectum. An important addition to the colpocleisis procedure is a levator plication and posterior colpoperineorrhaphy. This provides a posterior shelf of support and narrows the levator and genital hiatus. At the conclusion of the surgery, women have a normal external appearance of the vulva and perineal body with a narrowed vagina shortened to approximately 3 cm.

The complications associated with the Le Fort procedure or colpocleisis include injury to the bowel (primarily rectum) and bladder during dissection of the vaginal walls. Plication of the vaginal walls may induce ureteral kinking.[124] Cystoscopy is indicated to evaluate the bladder and ensure ureteral patency. Von Pechmann and colleagues[124] reported an overall blood transfusion rate of 21.7% in women who underwent a colpocleisis procedure. This high rate of blood transfusion likely reflects the lower transfusion threshold in these medically compromised patients. In this series, women who had a concomitant hysterectomy were transfused more frequently than women who had had a prior hysterectomy (35.1% vs. 12.7%).[124]

Regret of the loss of the ability to have vaginal intercourse has been reported in up to 13% of women who have an obliterative procedure.[124] This serves to emphasize the need for thorough preoperative counseling. Counseling should include other family members so that they can further discuss surgical decisions. This is particularly important in the elderly who may have some short-term memory loss or cognitive processing difficulties. Wheeler and colleagues[128] reported that three of 32 women who underwent colpocleisis regretted having had the procedure done. However, regret was related to urinary incontinence symptoms rather than a loss of sexual function.

The quality of life of women undergoing obliterative procedures was prospectively compared to those undergoing reconstructive procedures for prolapse.[129] Women who underwent an obliterative procedure after thorough counseling by their physician had clinically significant improvements in their quality of life, without an increase in depression or a significant alteration in body image.[129] The women undergoing obliterative procedures had similar results to women undergoing reconstructive procedures.[129]

As the number of years in a woman's life increases, so does the complexity of medical problems. The number of women surviving into their eighties and beyond is growing in the United States. The colpocleisis procedures provide a highly efficacious surgical option for the elderly, sexually inactive woman, which may be performed with local anesthesia in a relatively short operative time. This may be an excellent choice for recurrent prolapse in this select group of women.

Anterior Wall Prolapse

The anterior vaginal wall is regarded as the most challenging site to provide a durable repair.[1,53] The anterior vaginal wall may sustain the most injury during childbirth. It may be in position to take the most daily stress and strain, particularly if the axis of the vagina has been deviated posteriorly during prior a prior prolapse repair (as suggested with the sacrospinous vaginal vault suspension). The bladder expands directly over the anterior vaginal wall, filling to several hundred milliliters, several times a day. Correcting the anatomy of the *fallen* anterior vaginal wall and keeping it "fixed" is certainly a challenge. When a woman presents with recurrent anterior wall prolapse, one of the most important segments of support to assess is apical support. The anterior vaginal wall may be swinging down, like a trapdoor, because of a loss of apical support (and paravaginal), in which case it must be resuspended[130] (Fig. 11.11). Management of the bulge may be addressed through plication of the underlying fibromuscularis, a site-specific defect approach, or graft augmentation.

Anterior Colporrhaphy

The anterior colporrhaphy is a plication of the fibromuscularis (pubocervical fascia) of the anterior vaginal wall. This procedure serves to *tighten up* the overdistended anterior vaginal wall. At the conclusion of the procedure, the bulge is tucked up in the midline of the anterior wall. The anterior colporrhaphy has been performed for more than a century, but there are few studies that report the efficacy of the procedure as a primary procedure, and certainly few address it as a procedure for recurrent anterior wall prolapse. The majority of the studies address the efficacy (or lack thereof) of the anterior colporrhaphy with a Kelly plication in the management of stress urinary incontinence. The anatomic cure rate of the procedure for treatment of anterior vaginal wall prolapse varies between 37% and 97% (Table 11.6).[131–140] In a recent survey of multiple practices in the United Kingdom, the anterior colporrhaphy has remained the procedure of choice for the surgical management of recurrent anterior wall prolapse (anterior colporrhaphy was the procedure of choice by 45% and graft augmentation of an anterior colporrhaphy by 34%).[141]

The epithelium of the anterior vaginal wall is incised and dissected away from the underlying fibromuscularis. The dissection is carried laterally to the levator ani muscular sidewall. A midline plication can be performed with interrupted delayed-absorbable or permanent sutures. The aggressiveness of the plication and the longevity of the suture are dependent on the surgeon's preference. Anne Weber and colleagues[137] described a standard plication and an "ultralateral" plication as two different procedures in a prospective, randomized trial. Following a midline plication of the anterior vaginal fibromuscularis, the vaginal epithelium may be trimmed and closed. The apical portion of the anterior colporrhaphy should be attached to the apical support of the vagina.

The complications of the midline plication include hemorrhage, cystotomy, alterations in bladder function, and ureteral kinking. A lateral plication of the fibromuscularis underneath the trigone has been reported to cause ureteral kinking.[142] Kwon et al.[143] reviewed the records of 526 consecutive women undergoing routine cystourethroscopy with intravenous injection of indigo carmine at the time of pelvic organ prolapse or urinary incontinence surgery. Anterior colporrhaphy was the most common cause of unrecognized ureteral compromise during major reconstructive surgery.[143] Stanton and colleagues[132] performed preoperative and postoperative urodynamic assessments in women who underwent an anterior colporrhaphy. They reported no significant urodynamic changes following an anterior colporrhaphy. Sivaslioglu et al.[140] reported the development of de novo stress incontinence in 7% (3/43) of women undergoing anterior colporrhaphy procedures.

Paravaginal Repair

George White[144] described approximately a century ago the repair of the anterior wall by reapproximation of the vagina to the arcus tendineus fascia pelvis. Although he thought that the difficulty of the surgery may limit its use at the time, he foresaw a day when anatomic restoration would include the paravaginal repair. A resurgence of popularity of the paravaginal approach was lead by A. Cullen Richardson et al.[43,145] with a site-specific defect approach to reconstructive pelvic surgery. A site-specific philosophy describes anterior wall defects as breaks in the fibromuscularis occurring transversely at the apex, laterally (paravaginal defect), or in the midline (addressed with a midline plication of the fibromuscularis).[43] The prevalence of paravaginal defects in women with anterior wall prolapse, as determined by retropubic examination of the arcus tendineus fascia pelvis, ranges from 34% to 96%.[130,146] John DeLancey[130] observed that paravaginal defects occurred bilaterally 95% of the time if they were present at all. The anatomic success rate of management of the anterior

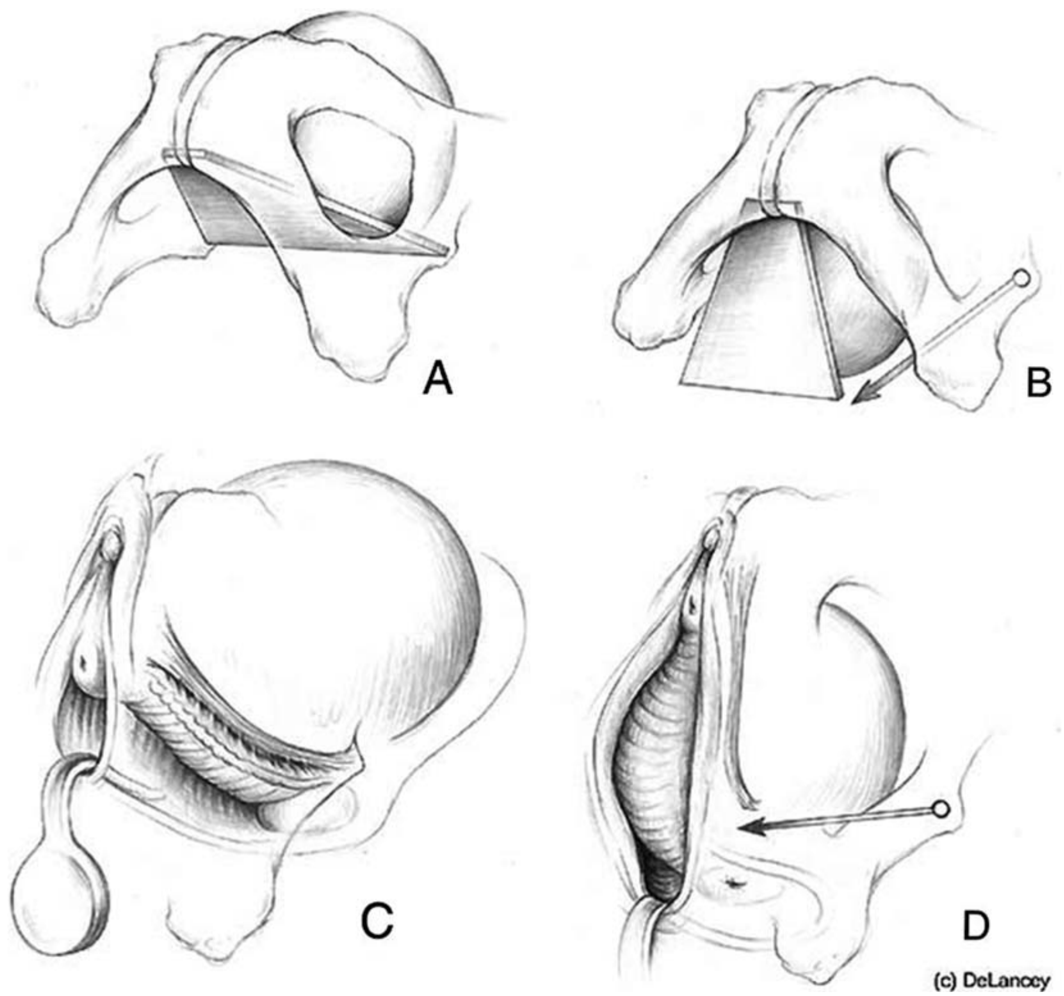

FIGURE 11.11. The development of anterior wall prolapse. (**A**) Normal anterior wall support with the connective tissue intact; the bladder is supported in the pelvis. (**B**) The connective tissue support is disrupted bilaterally from the ischial spines to the back of the pubic bone. There is also an apical loss of support that allows the anterior vaginal wall to swing down like a trapdoor, maintaining only its connective tissue relationship with the back of the pubic bone. (**C**) Intact support view with a speculum. (**D**) Anterior wall prolapse seen on exam. (From DeLancey JOL. Fascial and muscular abnormalities in women with urethral hypermobility and anterior vaginal wall prolapse. Am J Obstet Gynecol. 2002; 187:93–98, with permission from Elsevier.)

segment with the addition of a paravaginal repair is 78% to 100% (Table 11.7).[80,147–150] A recent historical cohort study compared women who had the anterior compartment managed with an anterior colporrhaphy only (between years 1991 and 1995) with women who had an anterior colporrhaphy and a vaginal paravaginal repair (between years 1995 and 2001).[151] When women who had undergone prior pelvic surgery were compared, the time to recurrence of anterior wall prolapse was longer for the anterior colporrhaphy group as compared to the women who underwent the addition of vaginal paravaginal repair (41 vs. 12 months, $p = .022$).[151] These results may be an example of the adage "the enemy of good is better." The addition of the vaginal paravaginal repair may stretch the fibromuscularis, weakening it rather than providing more support. The vaginal approach creates paravaginal defects to access the arcus tendineus fascia pelvis; these defects and the possible denervation may also contribute to recurrence.

The paravaginal repair may be performed laparoscopically, abdominally, or vaginally. However, the literature is sparse on outcomes of the retropubic approach to anterior wall prolapse repair. The goal of the repair is to reattach the anterior vaginal wall to its pelvic sidewall attachment, the arcus tendineus fascia pelvis. In the vaginal approach, an incision is made in the anterior vaginal wall and dissection of the vaginal epithelium off the underlying fibromuscularis is performed. The dissection is extended laterally and the retropubic space entered. The dissection into the retropubic space is bluntly expanded to expose the arcus tendineus fascia pelvis from the back of the pubic bone to a point distal to the ischial spine. Bilaterally, a series of up to six sutures is placed into each lateral pelvic sidewall, perpendicularly inclusive of the arcus tendineus fascia pelvis. The Capio suturing device (Microvasie Endoscopy, Natick, MA) has been used to facilitate placement of these sutures in the arcus tendineus fascia pelvis.[149]

TABLE 11.6. Efficacy of Anterior Colporrhaphy.

Author (year)	*Patients at follow-up/ initial presentation*	*Mean follow-up (months)*	*Anatomic cure*
Goff (1933)[131]	86	12–96 (range)	93%
Stanton (1982)[132]	73	3–24 (range)	89%
Porges (1994)[133]	388/486	31	97%
Julian (1996)[134]	12	24	66%
Colombo (2000)[135]	33	96–204	97%
Sand (2001)+[136]	70/80	12	57%
Weber (2001)*[137]	57/74	23 (median)	37%
Gandhi (2005)#[138]	78	13 (median)	71%
Meschia (2007) †[139]	98/100	12	81%
Sivaslioglu (2007)‡[140]	42/45	12	72%

+Part of a prospective randomized trial that studied anterior and posterior colporrhaphy and anterior and posterior colporrhaphy augmented with polyglactin 910 graft. The anterior and posterior colporrhaphy data was analyzed separately, although performed concomitantly.

*This study described two groups—a standard anterior colporrhaphy and an ultralateral anterior colporrhaphy—which are combined into one group in this table.

#Part of prospective randomized trial—anterior colporrhaphy vs. anterior colporrhaphy with solvent dehydrated fascia lata graft augmentation.

†Multicenter, randomized study comparing anterior colporrhaphy to anterior colporrhaphy with porcine dermis graft augmentation. Study excluded women with recurrent prolapse.

‡Forty of the original 45 patients in the group had an anterior colporrhaphy only, two had a vaginal paravaginal repair only, and three had an anterior colporrhaphy with a vaginal paravaginal repair.

These sutures are then attached to the anterior vaginal wall fibromuscularis and may also be attached to the vaginal epithelium (through the epithelium if an absorbable suture is used). Complications associated with a vaginal paravaginal repair may be significant. Young and colleagues[80] reported a 16% blood transfusion rate (and a 3% rate of intraoperative vascular surgery consultation for hemorrhage) in patients undergoing pelvic reconstructive procedures inclusive of a vaginal paravaginal repair. Mallipeddi and colleagues[150] reported a postoperative hematoma in the retropubic space, which required surgical evacuation. When compared to anterior colporrhaphy only, a higher percentage of women who underwent the addition of the vaginal paravaginal procedure underwent a blood transfusion.[151] Ureteral kinking has been described with the procedure; therefore, cystoscopy to confirm ureteral patency should be considered.[150]

An anterior colporrhaphy has also been used to complement the paravaginal repair for "midline defects."[80,147,150,151] The transverse cystocele is an apical detachment of the connective tissue support of the anterior wall. The support for the anterior vaginal wall is like a hammock with the most important connective tissue supports at the two ends. In the case of the anterior vaginal wall, one end is the back of the pubic bone. During DeLancey's[130] observations, the anterior vaginal wall and arcus tendineus remained attached to the back of the pubic bone. The other end is the apical support. It is only with a loss of apical support that the anterior vaginal wall can fully swing forward like a trapdoor. If apical support is reestablished, the two ends of the hammock are supported; then correcting the paravaginal defects may be less important.

TABLE 11.7. Efficacy of Vaginal Paravaginal Repair.

Author (year)	*Patients at follow-up/ initial presentation*	*Mean follow-up (months)*	*Anatomic cure of anterior segment*	*Postoperative posterior wall prolapse*
Shull (1994)[147]	56/62	19	91%	7%
Farrell (1997)[148]	27	8	80%	NS
Nguyen (1999)[149]	10	12	100%	NS
Young (2001)[80]	100	11	78%	5%
Mallipeddi (2001)[150]	35/45	19	91%	14%

NS, not stated.

Graft Augmentation

In an effort to improve the anatomic durability of the repair, the placement of a mesh to augment the support of the anterior vaginal wall has been performed. This approach has been particularly appealing for women with recurrent prolapse, who likely have already failed an anterior colporrhaphy or site-specific repair approach. The woman may have gained the label of having "poor tissue." The physician now would like to augment their repair to make it better and stronger. Additionally, the vagina may already be reduced in depth and caliber from her prior reconstructive procedures, and the use of graft material may optimize the anatomic outcome and preserve vaginal depth and width.

In the past decade, the variety of mesh products that have become available and used in vaginal pelvic reconstructive surgery has been on a meteoric rise—from allografts and xenografts, to the use of absorbable and permanent synthetic graft material. Each graft material is accompanied by properties that are desirable and others that may be detrimental to the patient. Gibson and Stafford[152] described the ideal properties of a graft (Table 11.8), but despite this explosion of materials available, no ideal graft exists. Complications seen with the use of synthetic

TABLE 11.8 Properties of an Ideal Graft.

Chemically inert
Not physically modified by tissue fluids
Does not induce inflammatory/allergic reaction
Noncarcinogenic
Resists mechanical stress
Easily manufactured and consistent quality
Sterile

Source: From Gibson LD, Stafford CE. Synthetic mesh repair of abdominal wall defects: follow up and reappraisal. Am Surg. 1964;30:481–86, with permission.

grafts, such as erosion, have traditionally encouraged surgeons to use biologic grafts in vaginal surgery. However, over the past decade, the tide has changed.

In general, autografts, harvested from the patient's own body, are well tolerated, with a low erosion rate. The strength of the graft material harvested varies throughout the body. Vaginal epithelium (weak) has been used as a graft for vaginal wall slings, with trends toward yearly decreasing efficacy.[153] Fascia lata autographs have been found to be durable with excellent long-term subjective and objective cure rates.[154] However, there is a varying degree of surgical morbidity associated with obtaining the graft.

Allografts, harvested from cadavers, also have a low erosion rate. Once harvested, the fascia is processed to attempt to remove any infectious material and preserve the graft. However, failure has occurred following use of these grafts secondary to degeneration[155] and detection of genetic material has been described.[156] McBride et al.[154] found a significantly higher rate of recurrent urodynamic stress incontinence when a pubovaginal sling is composed of a fascia lata allograft (Tutoplast) (41.7%) when compared to a fascia lata autograft pubovaginal sling (0%).

Xenografts, derived from an animal, have been introduced into the arena of vaginal surgery. The porcine products have been the most commonly used. The xenografts may be cross-linked or non–cross-linked, which will impact greatly the life of the xenograft within the patient. Pelvicol and PelviSoft (C.R. Bard, NJ) are porcine dermis products that are cross-linked and supposedly permanent biologic products. Small intestine submuscosa (SIS, Cook Biotech, Inc., West Lafayette, IN) is not cross-linked and is meant to serve as a scaffolding for the patient to lay down her own connective tissue to replace the graft.

Synthetic grafts may be permanent or absorbable. They may be made up of different materials, and vary in pore size, flexibility, and architecture (knitted vs. woven). All of this contributes to the strength, flexibility, shrinkage, and erosion rate of the mesh. Pore size is crucial for the clearance of bacteria. If the weave in the graft produces pores >75 nm, macrophages and leukocytes have access to the graft to clean out the bacteria, thereby decreasing graft infection and erosion. A large pore size also promotes fibroblasts migration, collagen deposition, and neovascularization into the graft. The graft may be coated with biomaterials such as collagen.[109] A classification system for permanent synthetic grafts has been devised[157] (Table 11.9). The current evidence favors the use of the type I polypropylene synthetic grafts. The properties associated with these grafts (monofilament mesh with large pore size and large interstices) have apparently allowed these grafts to be associated with fewer infections and erosions than other synthetic grafts. The knitted polypropylene graft is the "gold standard" against which the new synthetic and biologic grafts should be compared.[158,159]

Absorbable synthetic grafts are another option. Polyglactin 910 retains at least 25% of its strength beyond 21 days in vivo and acts as a lattice for the formation of dense granulation tissue.[136] Combination grafts Vypro and Vypro 2 (Johnson & Johnson, NJ), which include absorbable (polyglactin 910) and synthetic (polypropylene) materials, have also been used.

The short-term success rates of repairs that include a reinforcing graft are between 42% and 100% (Table 11.10).[134,136–139,160–172] In a retrospective review of consecutive cases over a 6-year period, graft augmentation (primarily using cadaveric fascia lata) of an anterior or posterior repair did not confer an anatomic benefit and led to higher rates of postoperative granulation tissue, erosion, and infection.[168] Hung et al.[166] report that the factors that affect recurrence after an anterior colporrhaphy augmented with four-corner anchored polypropylene graft is performed are recurrent anterior wall prolapse, diabetes mellitus, chronic cough, and mesh erosion. The first three are typically risk factors that encourage the surgeon to use grafts. Even with "type 1" synthetic graft augmentation, a woman with recurrent anterior wall prolapse has a higher risk of a second recurrence than a woman without a prior failure.[166]

Graft placement to augment an anterior colporrhaphy or to primarily treat anterior wall prolapse has been described with varying techniques. Most surgeons open the anterior vaginal wall of the vagina and dissect the vaginal epithelium off the underlying fibromuscularis laterally. Many break into the retropubic space through the vaginal incision and identify the arcus tendineus fascia pelvis

TABLE 11.9 P.K. Amid Classification of Synthetic Graft Materials.

Type 1	*Type 2*	*Type 3*	*Type 4*
Macroporous >75 nm	Microporous <10 nm	Macroporous/ microporous	Submicronic pores
Examples			
Knitted polypropylene GYNEMESH (Johnson & Johnson Gateway)	Gore-Tex (W. L. Gore & Associates)	Woven polypropylene SURGIPRO (United States Surgical) Woven Dacron (Invista, Inc.), MERSILENE (Ethicon, Inc.)	Silastic (Dow Corning)

Source: From Amid PK. Classification of biomaterials and their related complications in abdominal wall surgery. Hernia. 1997;1:15–21, with permission.

TABLE 11.10 Efficacy of Anterior Repair with Graft Augmentation.

Author (year)	*Patients at follow-up/ initial presentation*	*Mean follow-up (months)*	*Type of graft*	*Anatomic cure*	*Graft .erosion*
Moore (1955)[160]	9/10	6–18 (range)	Tantalum	100%	44%
Julian (1996)[134]	12	24	Polypropylene (Marlex, Chevron Phillips Chemical Co.)	100%	25%
Flood (1998)[161]	140/142	38	Polypropylene (Marlex)	100%	0%
Migliari (2000)[162]	12	20.5	Polypropylene	100%	0%
Groutz# (2001)[163]	21	20	Cadaveric fascia lata	91%	0%
Sand (2001)[136]	73/80	12	Polyglactin 910	75%	0%
Weber (2001)[137]	26/38	23	Polyglactin 910	42%	4%
Clemons (2003)[164]	33	18 (median)	Cadaveric dermal matrix (AlloDerm, LifeCell Corporation)	59%	0%
Gomelsky (2004)[165]	70	24	Porcine dermis	87%	1%
Hung (2004)[166]	38	21	Polypropylene	87%	11%
Powell (2004)[167]	58/69	25 (median)	Autologous or cadaveric fascia lata (patient preference	81%	10%
Gandhi* (2005)[138]	76	13 (median)	Cadaveric fascia lata	79%	None described
Vakili (2005)[168]	74	9 (median)	Primarily cadaveric fascia lata, but others included	59.5 % (includes recurrence and all sites)	28%
Rodriquez (2005)[169]	98	Not stated	Polypropylene	85%	3%
de Tayrac (2005)[170]	84/87	24 (median)	Polypropylene with arms placed tension-free into retropubic space (not through obturator foramen)	79.7% (includes posterior wall defects)	8.3%
Ng (2006)[171]	37	14–19 mean of 3 groups	Polypropylene with bilateral single tension-free arms placed through levator plate, remainder of graft sutured in place	76%	0%
Meschia (2007)[139]	103/106	12	Cross-linked porcine dermis (Pelvicol, C.R. Bard, Inc.)	93%	1%
Amrute† (2007)[172]	76/96	31	Polypropylene with anterior tension-free arms retropubic at midurethra exiting through anterior abdominal wall	95%	3%

#Nineteen of 21 women in the study underwent a concomitant pubovaginal sling at time of anterior repair. The two women with recurrences had apical/posterior wall prolapse (no recurrent anterior wall prolapse noted).

*Prospective randomized trial comparing anterior colporrhaphy vs. anterior colporrhaphy with solvent dehydrated cadaveric fascia lata.

†Postoperative data retrieved through chart review and telephone interview. Women were cured if they did not report prolapse symptoms.

(running laterally from the back of the pubic bone to the ischial spine bilaterally). Sutures are secured to the arcus tendineus fascia pelvis proximally (just distal to the ischial spine) and distally (at the level of the urethrovesical junction). It is also suggested to anchor the sutures below the arcus tendineus fascia pelvis, along the most lateral aspect of the pelvic sidewall dissection, avoiding the morbidity associated with vaginal entry into the retropubic space.[137,169] These sutures are then passed through the graft (which as been trimmed to fit the patient). The graft should be loosely placed without tension. The proximal (apical) portion of the graft is anchored into the vaginal apex or cardinal-uterosacral ligaments. The distal portion may be anchored to the fibromuscularis near the urethral-vesical junction. The vaginal epithelium is closed. Variations in the configuration of the graft abound, including the addition of tension-free arms that are placed vaginally into the retropubic space or fascia of the iliococcygeus muscle.[170–172] The tension-free vaginal prolapse repair kit procedures are discussed in a previous section. The anterior graft support section of the kits is made primarily of a low-weight, porous, knitted polypropylene graft that bridges the anterior segment, from sidewall to sidewall, providing the bladder with support. A non–cross-linked porcine dermis version is also available (Perigee, American Medical Systems). Two sling arms on each side pierce the arcus tendineus fascia pelvis to secure the support in a tension-free fashion through the obturator foramen.

The complications of graft augmentation procedures generally include those of a vaginal paravaginal repair (primarily the risk of hemorrhage and ureteral kinking, and change in bladder function), and those related to the graft (infection, erosion, pain, and allergic reaction to the graft material). Early studies using a tantalum fine wire mesh exhibited an erosion rate of 44%.[160] Recently, short-term graft erosion has occurred in association with an anterior repair in up to 28% of patients.[134,161,165–170,172] Graft erosion and corresponding dyspareunia may be treated simply with vaginal estrogen therapy or with excision and reapproximation of the vaginal epithelium. It is uncommon for extensive excision or removal of the graft to be required. Dyspareunia has been reported to occur in up to 15% of women postoperatively.[139,161] However, the authors of this multicenter, randomized trial stated that there was not a significant difference in the occurrence of postoperative dyspareunia between women who underwent an anterior colporrhaphy and women who had an anterior colporrhaphy augmented with porcine dermis (10% vs. 15%, respectively).[139] Julian[134] reported a case of pain with intercourse experienced by the woman's partner. On colposcopic examination, he discovered projections of the polypropylene mesh that had eroded through the vagina.[134] This has recently been termed "hispareunia."[173]

Multicenter, prospective randomized trials are beginning to be performed to compare surgical procedures. Currently, surgical procedures vary greatly with mesh augmentation procedures. The graft may be used as the primary repair or it may be placed following the performance of an anterior colporrhaphy or site-specific repair. The location of the anchoring points of the graft varies from the iliococcygeus muscle to the arcus tendineus fascia pelvis. Are any tension-free arms created? What type of graft is used? What type of suture is used to anchor the graft? The tension-free vaginal mesh kit procedures may standardize some of the variability seen over the past decade.

Anatomic failures often do not correlate with symptomatic failures. Gandhi et al.[138] found that two thirds of women who were labeled as an anatomic failure following an anterior colporrhaphy were asymptomatic. Anne Weber[137] described a very low anatomic cure rate with three methods of anterior repairs (30–46%); however, women in the study had a significant improvement in function and reduction in prolapse symptoms. This suggests that the anatomic definition of recurrence (POP-Q stage II with Aa and Ba ≥ -1) may be too restrictive in the anterior compartment. The periurethral tissue is often not supported during an anterior colporrhaphy, and Aa (tissue under the bladder neck) may subsequently descend to within a centimeter of the hymen postoperatively. Bladder function should be evaluated and managed concomitantly. Anatomic success has been found to be greater when the anterior repair of choice is combined with an excellent source of urethral support, the pubovaginal sling.[56,136,138]

Posterior Wall Prolapse

Recurrent posterior vaginal wall prolapse is often very challenging. Women often have a variety of defecatory complaints that accompany the bulge. Symptoms of incomplete evacuation, digital manipulation (splinting), constipation, fecal incontinence, or an inability to completely clean the anus following a bowel movement may be present. Sexual function may be compromised because of discomfort secondary to the prolapse and also due to the effect of the woman's altered body image. Due to the complexity of prolapse symptoms, particularly in women with recurrent prolapse, it is imperative to have a firm understanding of the goals of repair that the woman desires prior to proceeding with repair. Surgical repairs are much better at an anatomic cure rather than a functional cure. Preoperative evaluation of significant anorectal symptoms with endoanal ultrasound (in cases of suspected anal sphincter defect) or defecography (in cases of incomplete evacuation or anal blockage) can be used to help identify the pathophysiologic mechanism of the bowel symptoms and help guide management. Nichols et al.[174] found that women with pelvic floor disorders were more likely to report anal incontinence and have anal sphincter defects than women without pelvic floor disorders.

Posterior Colporrhaphy

The posterior colporrhaphy was introduced in the 19th century. The goals of this procedure are to narrow the vaginal tube and genital hiatus and to create a shelf of support. Like the anterior colporrhaphy, it has remained a commonly performed surgical procedure. The traditional posterior colporrhaphy has an anatomic cure rate of 76% to 100% (Table 11.11).[136,175–182]

The posterior colporrhaphy is a plication of the fibromuscularis (rectovaginal fascia) of the posterior vaginal wall in the midline, decreasing the width of the posterior vaginal wall and increasing the fibromuscularis in the midline. The vaginal epithelium of the posterior wall is opened in the midline and dissection of the epithelium off the underlying fibromuscularis is performed. Plication of the fibromuscularis begins proximally and progresses toward the hymen. The plication creates a shelf of support by ensuring that each of the plication sutures is in continuity with the previous one. If continuity is not maintained, transverse ridging of the posterior vaginal wall may occur and be a source of dyspareunia. Adequate caliber of the vagina at the conclusion of the vaginal reconstruction should be maintained throughout the length of the vagina (in general, this is 2.5 to 3 finger-breaths in sexually active

TABLE 11.11. Efficacy of Posterior Colporrhaphy for Treatment of Posterior Wall Prolapse: Anatomic Cure and Functional Results.

Primary author (year)	*Patients at follow-up/initial presentation*	*Mean follow-up (months)*	*Anatomic cure*	*Incomplete evacuation preoperatively*	*Incomplete evacuation postoperatively*	*Sexual dysfunction preoperatively*	*Sexual dysfunction postoperatively*
Arnold (1990)[175]	22	24	77%	20%	NS	NS	23%
Francis (1961)[176]	243	>24	94%	NS	NS	9%	50%
Mellgren (1995)[177]	25	12	80%	48%	0%	6%	19%
Kahn (1997)[178]	140	44	76%	27%	38%	18%	27%
Sand (2001)[136]	70/80	12	90%	NS	NS	NS	NS
Lopez (2002)[179]	25	9	100%	68%	36%	18%	23%
Maher (2004)[180]	38	12.5	87%	100%	13%	37%	5%
Abramov (2005)[181]	183	12	82%	NS	NS	8%	17%
Paraiso (2006)[182]	28/37	17.5	86%	62%	45%	30%	20%

NS, not stated.

women). Traditionally, a perineorrhaphy is included in this repair. This includes plication of the bulbocavernosus and transverse perinei portion of the perineal membrane. Care should be taken to avoid ridging at the vaginal introitus. The perineorrhaphy may not be necessary and may increase the risk of dyspareunia. Each woman should be evaluated for the need of a concomitant perineorrhaphy.

The plication of the fibromuscularis may include a plication of the levator ani muscles. Interrupted sutures are placed in the muscular sidewall near the attachment of the fibromuscularis and brought to the midline. This is not an anatomic position of the levator ani muscles but rather a compensatory way to close the genital hiatus. This provides a sturdy posterior shelf, but may further constrict the vaginal caliber or serve as a source of postoperative pain or dyspareunia.[178]

Complications associated with this procedure include injury to the underlying rectum during dissection, changes in defecatory function, and dyspareunia. Constipation is a common complaint preoperatively and postoperatively. Constipation has been a co-conspirator in the development of prolapse. It is important to stress the importance of postoperative management of constipation in the prevention of recurrence. Mellgren and colleagues[177] prospectively evaluated women undergoing a posterior colporrhaphy with respect to their defecatory function. They found that constipation improved in 21 of 24 patients (88%). Maher et al.[180] prospectively followed 38 women undergoing a posterior colporrhaphy. They found that following the posterior colporrhaphy, 87% (33/38) of women had resolution of their obstructed defecation symptoms. Kahn and Stanton[178] reported that the majority of women undergoing a posterior colporrhaphy noted an improvement in bowel symptoms; however, more women reported fecal incontinence postoperatively than preoperatively.

Postoperative sexual dysfunction has been of significant concern for a number of decades with the surgical management of posterior wall prolapse. Francis and Jeffcoate[176] observed a high rate of sexual dysfunction following prolapse surgery. Seventy of 140 (50%) sexually active women reported apareunia or dyspareunia after an anterior and posterior colporrhaphy and perineorrhaphy. On postoperative examination, 43 of the 70 women were found to have a significantly narrowed vagina that would only admit one finger. Haase and Skibsted[183] noted increased or de novo dyspareunia in 21% (5/24) of women who had undergone an anterior and posterior colpoperineorrhaphy. Kahn and Stanton[178] routinely plicated the levator muscles and attributed an increase in sexual dysfunction from 18% to 27% to pressure atrophy of the levator muscles and associated scar formation. However, the transanal route of rectocele repair is also associated with dyspareunia. Arnold and colleagues[175] found similar rates of dyspareunia among women who had undergone a transvaginal approach (23%) vs. an endoanal approach to rectocele repair (21%).

Site-Specific Defect Repair

The site-specific defect repair approach to posterior repair relies upon a theory advocated by A. Cullen Richardson et al.[43] that the herniation of the rectum into the vagina is the result of identifiable defects in the fibromuscularis (rectovaginal fascia). Defects of the posterior vaginal wall may occur as an isolated defect in the lateral, distal, midline, and superior portions of the wall or as a combination of defects. The anatomic cure rate of the site-specific posterior repair is 82% to 100% (Table 11.12).[181,182,184–188]

The vaginal epithelium is opened with a transverse incision at the posterior vaginal introitus. The posterior vaginal epithelium is then opened in the midline to a level cephalad to the bulge and dissected away from the underlying fibromuscularis (rectovaginal fascia). The dissection is extended laterally to the pelvic sidewall. The fibromuscularis is carefully inspected to identify breaks. A rectal finger anteriorly accentuates the defects. Irrigation

TABLE 11.12. Efficacy of Site-Specific Posterior Repair for Treatment of Posterior Wall Prolapse: Anatomic Cure and Functional Results.

Primary author (year)	*Patients at follow-up/ initial presentation*	*Mean follow-up (months)*	*Anatomic cure*	*Incomplete evacuation preoperatively*	*Incomplete evacuation postoperatively*	*Sexual dysfunction preoperatively*	*Sexual dysfunction postoperatively*
Cundiff (1998)[184]	43	12	82%	39%	25%	29%	19%
Kenton (1999)[185]	46	12	77%	30%	9%	28%	6%
Porter (1999)[186]	89	18	82%	24%	14%	67%	46%
Glavind (2000)[187]	65	3	100%	40%	6%	12%	6%
Abramov (2005)[181]	124	12.2	56%	NS	NS	10%	20%
Paraiso (2006)[182]	27/37	17.5	78%	69%	51%	9%	14%
Sardeli (2007)[188]	51	26.7	69%	59%	45%	6%	8%

NS, not stated.

of the fibromuscularis may also be helpful. Allis clamps are placed on the defects and the defects are reduced. The rectal finger is brought forward again to see if reduction of the prolapse is accomplished with correction of the defect. Delayed-absorbable or nonabsorbable suture may be used. If a distal defect is present, such as a separation of the fibromuscularis from the perineal body, the defect is repaired with absorbable suture in an attempt to reduce the incidence of postoperative dyspareunia. Proximal loss of support of the fibromuscularis may be present. In this case, the proximal portion of the fibromuscularis may be reattached to the arcus tendineus fascia pelvis, just distal (the surgeon's side) to the ischial spine. This is the proximal portion of DeLancey's level II support. A Capio device is helpful in placing these sutures in a tight space. Following repair of the defects, the rectal examination is repeated to confirm completion of the defect repair. If more defects are identified, these are addressed with delayed-absorbable suture. Repair of perineal body defects are addressed with interrupted sutures. A levator plication is not performed. The vaginal epithelium is closed with running absorbable suture.

Complications associated with the site-specific repair are associated with the surgical dissection of the posterior vaginal wall over the rectum. They involve rectovaginal hematoma, rectal injury, and rectovaginal fistula.[188] Additionally, the posterior repair may affect defecatory and sexual function (positively and negatively)[181,182,184–188] (Table 11.12).

The primary reason that this method of repair of posterior wall prolapse has been embraced is that is an "anatomic repair"—fixing what is broken—and that this repair has the potential to avoid the risk of postoperative dyspareunia. There was no change or a decrease in dyspareunia in the initial series involving the site-specific posterior repairs, which was thought to be an advantage over the posterior colporrhaphy.[184–187] Recently when the site-specific posterior repair and posterior colporrhaphy have been directly compared retrospectively and prospectively, the postoperative dyspareunia rates were similar in both groups of women.[181,182] Importantly, Abramov et al.[181] found that the site-specific posterior repair was associated with a higher anatomic and symptomatic recurrence rate when compared with posterior colporrhaphy. They conducted a retrospective study evaluating the charts of 368 women who underwent a posterior repair between July 1998 and June 2002 with at least 1-year follow-up. The site-specific posterior repair was associated with an anatomic recurrence rate of 44% vs. 28% for posterior colporrhaphy and the recurrence of a symptomatic bulge of 11% vs. 4%, respectively ($p = .02$).[181] Paraiso et al.[182] found in a prospective randomized trial found that the anterior colporrhaphy and site-specific repair groups had similar anatomic cures (86% vs. 78%, respectively) and functional outcomes at 17.5 months. The major weakness of the site-specific defect repair is that it cannot be standardized from patient to patient (it is tailored to the patient). Like many other prolapse procedures, standardization between surgeons is very difficult, because of varying suture selection and the inclusion of perineorrhaphy or midline plications. Some disagreement exists concerning whether repaired defects are present prior to or occur as a result of the surgical dissection.

Graft Augmentation

Graft augmentation to a posterior colporrhaphy, or more commonly, to support a site-specific repair, has been met with mixed reviews. In a prospective randomized trial comparing site-specific defect repair with a cross-linked, small intestine submucosal graft vs. site-specific posterior repair vs. posterior colporrhaphy, the graft augmented group had the lowest anatomic cure rate (54% vs. 78% vs. 86%, respectively).[182] It was suggested that the graft served as a barrier to healing or perhaps stimulated a foreign-body reaction and degradation.[182] The wide variety of grafts are being placed without understanding what reaction they stimulate in the vagina. Graft augmentation varies with surgical technique, the graft that is selected, and the amount used. Grafts have also been sutured in place without the addition of a colporrhaphy or site-specific defect repair.[189] The short-term efficacy has been reported to be up to 92%[136,182,190–195] (Table 11.13).

TABLE 11.13. Efficacy of Graft Augmented Posterior Repair for Posterior Wall Prolapse: Anatomic Cure and Functional Results.

Primary author (year)	*Patients at follow-up/initial presentation*	*Mean follow-up (months)*	*Graft*	*Anatomic cure*	*Erosion rate*	*Sexual dysfunction preoperatively*	*Sexual dysfunction postoperatively*
Sand (2001)[136]	73/80	12	Polyglactin 910	91.8	0%	NS	NS
Altman (2005)[190]	29/32	12	Transvaginal placement of Porcine dermis (Pelvicol, C. R. Bard Inc.)	62%	0%	84%	86%
Kobashi (2005)[191]	50/73	13.7	Fascia lata	92%	0%	36%	23% (de novo in 10%
Altman (2006)[192†]	23/32	38	Transvaginal placement of porcine dermis (Pelvicol)	59%	0%	NS	No deterioration
Paraiso (2006)[182]	26/32	17.5	Porcine small intestinal submucosa graft (Foragen)	54%	0%	0%	6%
Smart (2007)[193]	10	9	Transperineal placement of porcine dermal collagen (Permacol, Tissue Science Laboratories)	70% *	10%‡	NS	One case of postoperative de novo dyspareunia
Leventoğlu (2007)[194]	83	14 (median)	Transperineal placement of polyglycolic acid mesh (Soft PGA Felt, Alpha Research GmbH)	87%		16%	8%
Lim (2007)[195]	37/78	35.7	Polyglactin 910 and polypropylene mesh in equal parts (VYPRO II, Johnson & Johnson)	78%	30%	43%	60%

*Anatomic cure actually symptomatic cure defined in the study by improvement in vaginal bulging.

†Reported on same patients as in 2005 study.

‡Authors describe porcine dermis graft protruding out of the perineal body and feel the graft was cut too long rather than a true erosion. For purposes of this table, it has been counted as an erosion.

The placement of a graft may be to overlay the fibromuscularis, as an augmentation to the repair, or to serve as the support of the posterior vaginal wall. The graft material is attached laterally to the endopelvic attachment on the levator ani muscles in a proximal to distal fashion, ensuring that no tension is placed on the graft material. Each graft material has its own properties, which range from being replaced by the woman's native tissue to fibrosis or shrinkage. Polypropylene will shrink due to ingrowth of the fibroblasts, and subsequent collagen deposition and neovascularization. It is important to anticipate what changes will happen to the size of the mesh following placement. If the patient is concurrently undergoing an apical suspensory procedure, the apical portion of the graft may be attached to the suspensory support sutures.

The tension-free vaginal prolapse repair kit procedures are discussed in a previous section. The posterior mesh support section of the kits is made primarily of a low-weight, porous, knitted polypropylene graft that provides support of the posterior segment, from sidewall to sidewall. A non–cross-linked porcine dermis version is also available (Apogee, American Medical Systems). The Prolift provides apical support with the posterior pass through the sacrospinous ligaments bilaterally. The remaining kits (to this point) pierce the iliococcygeus, just caudad to the ischial spine.

The complications of this procedure include the additive risk of those associated with a posterior colporrhaphy or site-specific posterior wall repair and those associated with the mesh. Rectocele repairs, which include a biologic or synthetic mesh, have complications related to the specific mesh material that is used. The potential complications that have been described with the use of graft material are erosion into the surrounding tissue (in this case the vagina and rectum), infection, scarring (which may increase the occurrence of dyspareunia), allergic reaction to the material used, and failure.[196,197]

It is important to have a thorough understanding of the graft material that is used. Long-term efficacy and safety outcomes for these procedures have not been established. Randomized trials comparing posterior colporrhaphy and site-specific defect repair with and without graft placement are underway. With so many graft materials available, when a trial is published, the outcomes apply to that graft material surgically placed in the manner described in the trial. Graft materials have been used as a bulking agent, bunched up in the middle of an anterior and posterior colporrhaphy,[136] tacked in the posterior compartment with sutures through a perineal body approach in a "tension-free" fashion,[189] or used more traditionally as an augmentation to a repair,[182] or simply as the repair itself.[191] Although the clinical trials to this point have been small and have not adequately evaluated the use of graft augmentation in the posterior compartment,[107] the majority of gynecologists and urogynecologists surveyed in the United Kingdom would use a graft-augmented posterior repair for women with recurrent posterior wall prolapse.[141]

Sexual Function and Posterior Repair

Sexual function is a complex issue that involves a woman's physical and emotional health, as well as the physical and emotional health of her partner, packaged together with the intimacy of their relationship. Weber and colleagues[198] evaluated sexual function and vaginal caliber, and length and degree of vulvovaginal atrophy in 104 women. Sexual activity was not found to be associated with vaginal length or introital caliber. In a follow-up study, Weber et al.[199] reported that sexual function improved or stayed the same in the majority of women undergoing prolapse surgery. However, the performance of a posterior colporrhaphy, particularly if it was performed in conjunction with a Burch retropubic urethropexy, was the only predictor of postoperative dyspareunia. In this study, 26% of women who underwent a posterior colporrhaphy reported dyspareunia, and when the posterior colporrhaphy was combined with a Burch retropubic urethropexy the dyspareunia rate rose to 38%.[199]

Insight into the relationship between sexual function and pelvic organ prolapse has been enhanced through the development of validated disease-specific questionnaires such as the PISQ (Pelvic Organ Prolapse/Urinary Incontinence Sexual Function Questionnaire).[200] Novi et al.[189] compared the preoperative and postoperative sexual function in women undergoing a site-specific posterior repair with women undergoing a posterior repair with porcine dermis graft using the PISQ. They found that both repairs significantly lowered the rate of dyspareunia; the site-specific repair lowered the dyspareunia rate from 36% preoperatively to 10% postoperatively, and the graft repair lowered it from 40% preoperatively to 8% postoperatively. While both repairs significantly improved the sexual function in women postoperatively, the women undergoing the porcine dermis repair (which was simply suture in place with and emphasis on "tension-free" placement) had a significantly greater increase in sexual function than the site-specific repair.[189]

Correction of prolapse (and concomitant improvement of body image) may be a dominant factor in postoperative sexual function, despite postoperative dyspareunia. Azar et al.[201] found that sexual function significantly improved following anterior and posterior colporrhaphy, which included a levator plication. The domains of desire, arousal, lubrication, orgasm, and satisfaction were all significantly increased 3 months postoperatively. Unfortunately, pain with intercourse did increase in this immediate postoperative period (three levator plication sutures were included during the posterior colporrhaphy procedure).

Graft placement can have a negative effect on sexual function. Lim et al.[195] described a 27% incidence of de novo dyspareunia in women 3 years after a posterior repair using a polyglactin 910/polypropylene soft mesh (Vypro 2). The high erosion rate of 30% was thought to contribute to the dyspareunia. Even if erosion does not occur, the "behavior" of the graft underneath the epithelium of the vagina after it is placed may also be a cause for discomfort with intercourse. The graft may shrink or have been placed under tension and be a source of pain. The graft may become encapsulated and fibrotic, or completely disappear.[202] These factors may have a profound effects on the function of the vagina as a sexual organ.

Conclusion

The lifetime risk for a woman to undergo a procedure for pelvic organ prolapse or urinary incontinence is 11.1%.[2] This is the tip of the iceberg in truly defining the prevalence of these disorders. Many more women have prolapse and have elected to pursue conservative management. Many women may not have access to surgical treatment of their prolapse. However, as women undergo surgery to "fix" their prolapse problem, recurrence is common. Surgery for recurrence accounts for approximately 30% of our operative cases.[2]

To summarize the literature that is available, abdominal sacrocolpopexy has been found to be superior to the sacrospinous vaginal vault suspension in prospective, randomized trials and should be considered for cases that include recurrent apical prolapse.[29,104,105] This is an ideal approach if the vagina is foreshortened from prior prolapse surgery. The abdominal procedure should preserve or enhance vaginal length. However, the abdominal approach is associated with increased hospital stay, costs, and short-term morbidity. This may be mitigated by a traditional or robotic laparoscopic approach. Graft erosion occurs with abdominal placement of the graft during the abdominal sacrocolpopexy. The rate of erosion varies dependent on the graft used,[89] and the erosion rate was found to be higher if some of the sutures of the graft or the graft itself were introduced vaginally.[97]

Vaginal graft augmentation in pelvic reconstructive surgery has exploded. The temptation is to extrapolate the superior results of the abdominal sacrocolpopexy data to vaginally placed grafts. This is particularly true for the women with recurrent prolapse. Many surgeons turn to compensatory surgeries for recurrent prolapse. A national survey of practitioners in the United Kingdom revealed that a third used graft augmentation for recurrent anterior wall prolapse.[141] A survey of members of the American Urogynecologic Society found that 44% used graft augmentation in repair of anterior and posterior wall prolapse. Inadequate native tissue and recurrent prolapse were the most common indications for graft augmentation in the survey.[203] The surgical procedures in graft placement have varied widely and the grafts themselves have varied and evolved. When results become available, the graft itself may be off the market. Therefore, familiarity with a graft product and how it is supposed to react once it is implanted in the vagina is vital prior to using that product. An evaluation of the anticipated gain in efficacy of the procedure weighed against the possibility of the complications associated with the graft selected should be discussed with the patient.

Postoperatively, there is a discrepancy between anatomic and symptomatic recurrence. Pelvic organ prolapse is much more complex than the presence or absence of a bulge. Therefore, it is vital that we try to understand what brings the woman back into the surgeon's office for correction. In a recent study of women's urogynecologic goals, two thirds were symptom related, while the other third ranged from wanting "emotional stability" to lifestyle goals.[204] After a thorough evaluation and discussion, the selection of the optimal procedure for a given patient will often depend on her own goals for her surgical outcome. While the "cure" for recurrent pelvic organ prolapse has not been obtained, more prospective randomized trials are being conducted that will help surgeons better evaluate the surgical procedures we currently have and the ones that are newly introduced. Functional and quality-of-life data as well as patient goals should also be addressed in these studies.

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12

Recurrent Rectal Prolapse

Harry T. Papaconstantinou

Rectal prolapse has been a challenging problem for surgeons throughout history, and represents a clinical entity that is poorly understood. There are a multitude of operations that have been described for the management of rectal prolapse, and include abdominal and perineal approaches. Transabdominal approaches involve repair of loose presacral rectal attachments with or without resection of redundant sigmoid colon, while the perineal approach eliminates the redundant rectum (perineal proctectomy) or rectal mucosa (Delorme). Each procedure has its advantages and disadvantages; however, the ultimate goal should be a safe, complete, and durable correction of the anatomic and physiologic problem. Despite multiple operations available, recurrence rates have consistently been reported as high as 50%.[1–4] Given these data, it may be surprising to learn that there are few studies that have specifically addressed the management of recurrent rectal prolapse.[5–8] Each of these studies is a retrospective review, where no algorithm was followed and patients with recurrent prolapse were treated according to the discretion of the operative surgeon. The management of recurrent rectal prolapse requires a basic understanding of the operative procedures utilized for rectal prolapse repair, and it has been suggested that the operation chosen for primary repair of the rectal prolapse may influence the type of operative repair for recurrence.

Etiology

The cause of primary rectal prolapse is not well defined; however, complete rectal prolapse or procidentia is a circumferential, full-thickness descent of the rectum that may also include the sigmoid colon.[1] The prevailing theory is distal intussusception of the rectum. Anatomic findings associated with rectal prolapse include an abnormally deep cul-de-sac, lax and atonic levator ani muscle, loss or stretch of rectal attachments to the sacrum, redundant sigmoid colon, and weak and atonic anal sphincter muscles. These findings are also found in recurrent rectal prolapse, suggesting inadequate primary repair or progression of the condition. Evacuation disorders such as constipation and chronic straining are found in up to 67% of patients with rectal prolapse. After primary repair constipation may become more pronounced, and is thought to be a significant contributing factor to prolapse recurrence.

Other causes of recurrent rectal prolapse have been proposed according to the surgical approach for primary repair. It is well documented that recurrence rates are lowest after an abdominal repair.[1] Perineal procedures are performed on patients with higher perioperative risk, and appear to be less durable operations with higher recurrence rates.[9] The reasons for this advantage in the abdominal approach is not clear, but is likely due to the improved ability to perform a complete rectal mobilization and fixation under direct vision. Higher recurrence rates for perineal proctectomy may be a direct result of poor visualization with subsequent inadequate mobilization and resection of the redundant rectum and sigmoid colon. In the Delorme procedure, an incomplete mucosectomy of the prolapsing rectum or inadequate plication of the muscle wall of the rectum may predispose patients to prolapse recurrence.

Finally, rectal prolapse may be a single component of pelvic floor dysfunction. Pelvic floor weakness may be a constitutional finding, and other pelvic floor disorders such as vaginal prolapse, rectocele, cystocele, and enterocele may be present as well, and are discussed in the preceding chapter. A careful evaluation of the pelvic floor is of paramount importance in planning treatment or repair.

Symptoms and Physical Findings

The development of recurrent rectal prolapse is usually gradual. Recent reports indicate that the mean time to recurrence ranges between 24 and 33 months, with up to one third of recurrences occurring within the first 7 months after primary repair.[5,7] Early recurrences likely represent technical failure. For example, in perineal proctectomy, the nature of the procedure makes it difficult to know whether an adequate length of rectum has been resected. Inadequate resection can lead to excess redundant rectum or sigmoid colon, leading to early recurrence of rectal prolapse. Recurrent rectal prolapse can manifest as internal intussusception, rectal mucosal prolapse, or full-thickness rectal prolapse. Internal intussusception results in symptoms of incomplete evacuation and obstructive defecation.

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Recurrent prolapse of the rectum exhibits a reducible protrusion with the Valsalva maneuver, and with progression may result in an increased frequency and extent of prolapse protrusion. External exposure of the rectal mucosa results in mucus discharge and soiling, and prolonged exposure may progress to mucosal bleeding and ulceration. Even in recurrent rectal prolapse it is critical to differentiate between full-thickness prolapse and mucosal prolapse before deciding treatment approach. Full-thickness rectal prolapse, also known as procidentia, is the circumferential protrusion of the entire rectal wall through the anal orifice. Mucosal prolapse is a result of breakdown or laxity of the connective tissue between the submucosa and muscularis of the rectum with subsequent protrusion of the mucosa through the anal orifice. The key difference here is that the underlying muscle of the rectal wall remains in its normal anatomic position with mucosal prolapse. On examination full-thickness rectal prolapse exhibits circumferential folds of the protruding segment, while mucosal prolapse presents with radial folds from within the anal opening (Fig. 12.1). Palpation can frequently provide differentiation between the double rectal wall thickness found in complete rectal prolapse, from the double mucosal layer found in mucosal prolapse.

Other symptoms of recurrent rectal prolapse may include the sensation of incomplete evacuation, tenesmus, and fecal incontinence. In fact fecal incontinence has been reported in up to 70% of patients with rectal prolapse.[1,10] It is important to note that incontinence improves after primary surgical repair of rectal prolapse, and this improvement may continue for up to 6 months. This improvement is believed to be the direct result of the elimination of the prolapsing rectal segment through the anal sphincter complex, which allows the chronically dilated sphincter to regain its normal configuration and function. Patients with recurrent rectal prolapse have persistent stretch to the anal sphincter complex and surrounding structures such as the pudendal nerves that may result in continued incontinence.

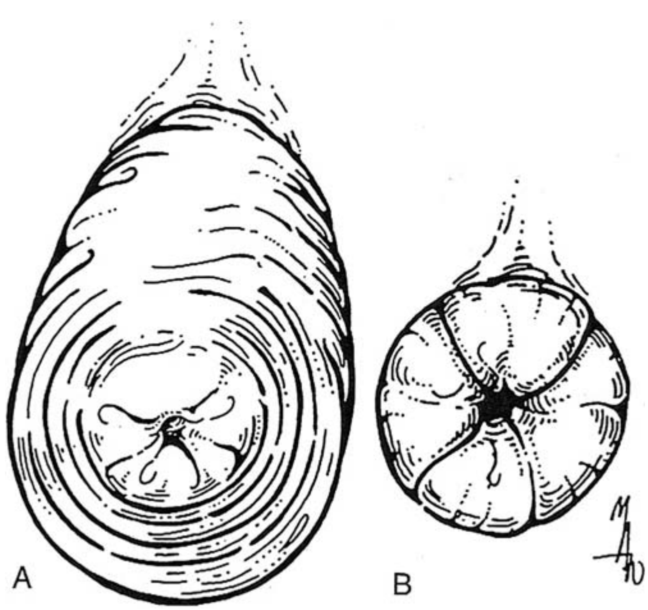

FIGURE 12.1. Diagnosis of complete rectal prolapse versus mucosal prolapse. (**A**) Complete rectal prolapse with circumferential folds. (**B**) Mucosal prolapse with radial folds. (From Karulf RE, Madoff RD, Goldberg SM. Rectal prolapse. Curr Probl Surg 2001;38(10):780, with permission).

Evaluation

Evaluation of patients with recurrent rectal prolapse is similar to those with primary rectal prolapse and is summarized in this section. Cardiac and pulmonary risk factors should be addressed, because patients with high operative risk due to poor cardiopulmonary reserve benefit from less invasive perineal procedures for rectal prolapse. A colonoscopy is routinely performed to rule out a lead point causing rectal prolapse. In patients with constipation, a barium enema is performed to evaluate the sigmoid colon. Redundancy of the sigmoid colon may influence the choice of procedure.

Patients with rectal prolapse can manifest with a wide range of incontinence and constipation; therefore, an assessment of pelvic floor anatomy and physiology is required. Tests should include cinedefecography, anorectal manometry, and endoanal ultrasonography. Many of these studies may have been performed at the time of primary repair and their use for evaluation for recurrence should be tailored to individual patient conditions.

Cinedefecography has the ability to detect occult intussusception and rectal prolapse, and is useful for visualizing the movement of the pelvic floor during defecation. Patients with symptomatic constipation may have paradoxical puborectalis with inability to straighten the anorectal angle. These patients require biofeedback therapy to correct their difficulty with evacuation. Furthermore, this test is also particularly effective in identifying coexistent pathologic features including pelvic floor weakness including rectocele, enterocele, and cystocele.

Fecal incontinence in patients with chronic rectal prolapse is believed to be a direct result of stretch effect on the anal sphincter and pudendal nerve.[11,12] In these patients, obstetric injury or trauma to the anal sphincter should be ruled out. Evaluation of the anal sphincter with endoanal ultrasonography will identify disruption of the external anal sphincter, which can be repaired by sphincteroplasty. Anal manometry and physiology studies are used to test anal sphincter pressures. In patients with primary rectal prolapse, 50% to 70% of patients show an improvement in bowel control following surgery[1]; however, patients with poor resting anal pressure of less than 10 mm Hg and impaired maximal voluntary contraction of less than 50 mm Hg are associated with persistent incontinence. In patients with recurrent rectal prolapse, these tests may have been performed at time of primary repair, and repeat testing has limited value and should be considered on an individual basis. Currently there are no data to support predictive tests for improved postoperative fecal continence in patients undergoing recurrent rectal prolapse repair. In fact, one study has shown little improvement in fecal incontinence scores for recurrent rectal prolapse repair, suggesting that incontinence may be persistent in these patients.[7]

Choice of Operative Repair

Operative repair is the treatment of choice for both complete rectal prolapse and mucosal prolapse. The treatment goals for recurrent rectal prolapse are the same as for primary disease, and include elimination of the symptoms of prolapse and constipation with a low recurrence and complication rate. With over 100 different operations reported for rectal prolapse repair, it should be understood that no one procedure completely addresses the spectrum of symptoms and physiologic disorders that is associated with this disease process. Therefore, the best approach is to tailor the type of repair to individual patients needs.

It is well established that perineal repair of primary rectal prolapse has a higher rate of recurrence than the abdominal approach. In fact, this has held true in reports of recurrent rectal prolapse repair. In the largest series to date, Steele et al.[5] reported on 78 patients with recurrent rectal prolapse that were managed operatively. In this series the recurrence rate was 37.3% (19/51) for perineal repairs, and 14.8% (4/27) for abdominal repairs. Others have reported similar findings.[6–8] These data strongly highlight the success of the abdominal repair and suggest that recurrent rectal prolapse should be repaired by an abdominal approach when feasible and if the patients risk profile permits. Patients with poor cardiopulmonary reserve require a perineal repair with an accepted higher risk of recurrence.

The most common approaches for recurrent rectal prolapse repair are rectopexy with or without resection, perineal proctectomy, and rectal mucosectomy (Delorme procedure). In our practice, we use a selection strategy similar to that reported by Brown and colleagues.[9] Elderly patients who are of poor operative risk are offered a perineal procedure with thorough explanation of risk of recurrence. Fit patients are offered an abdominal procedure regardless of age. Abdominal procedure type is chosen according to associated functional symptoms. Patients with incontinence that have intact anal sphincter and pudendal nerve function are treated with rectopexy alone. Patients with symptomatic constipation without incontinence are treated with resection rectopexy. These guidelines are general, and special considerations must be made according to the type of initial repair.

Recurrent rectal prolapse after perineal proctectomy is common. The perineal approach performed at the initial operation was likely a direct result of significant medical comorbidities resulting in high operative risk. These risk factors are usually persistent indicating that a perineal procedure for recurrent rectal prolapse will be indicated. In this situation we choose between a repeat perineal proctectomy or Delorme procedure depending on the degree of recurrent prolapse. The Delorme procedure is chosen for patients with mucosal prolapse, a short segment of full-thickness prolapse (usually <5 cm), or internal intussusception of the distal rectum. Repeat perineal proctectomy is used for all other patients. In either procedure, the previous anastomosis in the distal rectum should be included in the resection to prevent stricture formation.

Occasionally, we have encountered patients who have been referred with recurrent rectal prolapse after perineal proctectomy who are medically fit and good candidates for repair through an abdominal approach. In these patients our preference is either rectopexy or resection rectopexy due to the superior durability of these procedures. The type of surgery performed is made according to the selection criteria described above; however, in these patients the greatest concern is the risk of creating a devascularized segment of rectum.[5,7] The rectum obtains its blood supply from three sources: the superior rectal artery (continuation of the inferior mesenteric artery), middle rectal artery, and inferior rectal artery. After perineal proctectomy the superior rectal artery is the primary blood supply to the remaining neorectum. Therefore, rectopexy and resection rectopexy should be performed with preservation of the inferior mesenteric and superior rectal artery. If the patient has significant vascular disease or history of aortic aneurysm repair, then there is concern for patency of these arteries. These patients should receive a preoperative angiogram or magnetic resonance angiogram (MRA) to determine vascular anatomy and flow. Occlusion of the inferior mesenteric artery or superior rectal artery may result in significant collateral flow through marginal arteries. In this situation resection rectopexy should be avoided due to risk of ischemia. In this situation consideration of rectopexy alone may decrease risk of ischemic complications because resection and manipulation of the blood supply is not required. Alternatively, perineal proctectomy or Delorme procedure may be the best option while accepting the increased risk of recurrence.

Recurrent rectal prolapse after anterior resection rectopexy can be repaired by either an abdominal or perineal approach. An abdominal approach is preferred because of decreased risk of recurrence. Rectopexy or anterior resection rectopexy is chosen according to the presence of incontinence or constipation as described above. Repeat resection rectopexy must include the previous anastomosis within the resected specimen to prevent an ischemic segment of bowel between the two anastomosis. Rectopexy alone preserves the proximal blood supply to the rectum, and can be performed safely in these patients without concern of ischemic complications. The perineal approach may be required if the patient is a poor operative risk. In this case resection of the previous anastomosis may not be possible. If the anastomosis cannot be included in the perineal proctectomy (i.e., prolapsed down to the anal orifice before resection) or the proximal arterial blood supply to the rectum is suspicious, a Delorme procedure should be considered, as a mucosectomy will preserve the existing blood supply to the remaining rectum.

Primary repair by rectopexy or Delorme procedure spares the normal blood supply to the rectum. Recurrent rectal prolapse following these procedures can be safely repaired through either abdominal or perineal approaches with minimal concern of ischemic complications. The decision of procedure type for repair of the recurrence is determined primarily by the selection criteria previously described.

Operative Technique: Abdominal Approach

Successful repair of recurrent rectal prolapse through an abdominal approach requires mobilization and upward fixation of the rectum to the presacral fascia. In patients with recurrence after primary abdominal repair, the mesorectal plane and retroperitoneum along the sigmoid colon has been violated and likely resulted in significant scarring. In this situation preoperative ureteral stenting may be of benefit. In patients with recurrence after perineal proctectomy, use of the abdominal approach for repair requires preservation of the inferior mesenteric and superior rectal artery to minimize risk of vascular compromise. Posterior mobilization of the rectum should continue to the levator ani muscles. It is necessary to open the peritoneal covering laterally and anteriorly to allow adequate mobilization of the rectum out of the pelvis. Division of the lateral stalks is followed by a higher incidence of constipation and poor rectal emptying than if they were preserved.[13,14] Therefore, when the lateral stalks are short and prevent adequate mobilization of the rectum out of the pelvis, partial division may be necessary. Inadequate mobilization leaves a portion of the redundant rectum in the pelvis and increases risk of prolapse recurrence.

Rectopexy

Suture rectopexy can be performed through a lower midline or Pfannenstiel incision with the patient in the supine position. A right-handed surgeon stands on the left side of the patient to facilitate placement of suture in the curved pelvis. Once exposure of the pelvis is achieved, dissection begins by incising the peritoneum on each side of the rectosigmoid starting superiorly about 5 cm above the pelvic brim and extending distally to the cul-de-sac. In patients with previous rectopexy or resection rectopexy, the peritoneum, retroperitoneum, and posterior mesorectal plane have been previously dissected, resulting in significant scar. We recommend incising the peritoneum below the level of the sacral promontory and initially traveling cephalad, opening the retrorectal space to prevent injury to the superior rectal artery and ureters. The ureters are identified and protected. The superior hemorrhoidal artery is identified at the sacral promontory, and the loose areolar tissue posterior to the vascular bundle is opened to expose the presacral space and mesorectal plain of dissection. Anterior traction of the rectosigmoid opens the presacral space, and is identified as loose areolar tissue between the mesorectum and presacral fascia. The sympathetic and parasympathetic nerves, or nervi erigentes, should be spared. This is achieved by identifying the nerves and maintaining a dissection plain anterior close to the mesorectum. Special care should be taken not to disturb the presacral plexus of veins. Posterior mobilization is taken down to the level of the levator ani muscles. Next, anterior mobilization is performed by continuing the lateral peritoneal incisions distally to join anteriorly at the deepest portion of the cul-de-sac with dissection down to the level of the vaginal vault.

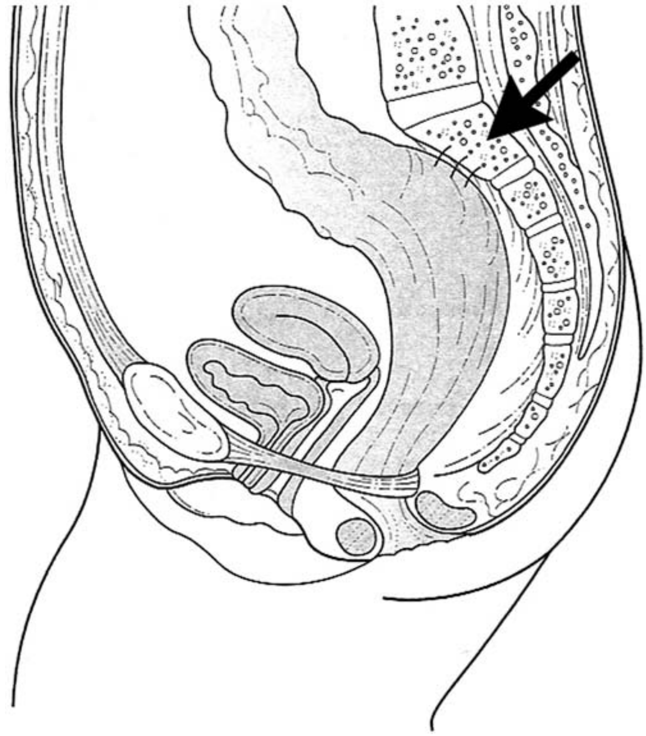

FIGURE 12.2. Rectopexy for full-thickness rectal prolapse repair. After full mobilization of the rectum posteriorly, the rectum is lifted into the abdomen. The lateral rectal stalks are sutured to the periosteum of the sacrum (*black arrow*). (Modified from Meagher AP, Lubowski DZ, Kennedy ML. Rectal prolapse. In: Pemberton JH, Swash M, Henry MM, eds. The Pelvic Floor: Its Function and Disorders, 1st ed. London: WB Saunders; 2002:276, with permission from Elsevier.)

This frees the anterior rectum and allows for complete mobilization of the rectum out of the pelvis and into the abdomen. At this point the lateral stalks become more prominent. Partial division may be required to fully mobilize the rectum out of the pelvis. The lateral stalks are then sutured to the periosteum of the sacrum using heavy nonabsorbable suture (Fig. 12.2). The stitch should first be placed in the periosteum of the sacrum, because if bleeding occurs it can be controlled by tying the stitch. A total of four to six sutures are placed from the middle sacrum to the sacral promontory to achieve adequate fixation. Care must be taken not to narrow the bowel lumen since this may lead to an obstruction. Finally, the cul-de-sac is obliterated anterior to the rectum with interrupted sutures on the endopelvic fascia.

Resection and Rectopexy

Rectopexy with sigmoid resection is used for fit patients with recurrent rectal prolapse who have symptomatic constipation and a redundant sigmoid colon on preoperative evaluation. This procedure is performed with the patient in the lithotomy position for access to the anus for stapled anastomosis. Rectal mobilization is performed as described above. The inferior mesenteric and superior rectal arteries are preserved. This is critical in patients who have had a perineal proctectomy for primary repair to prevent ischemic complications to the rectum and anastomosis. The left colon is mobilized to the splenic flexure. Excess sigmoid colon is resected, and the mesentery is taken close to the bowel wall. Patients with prior resection rectopexy require resection of the anastomosis to minimize risk of an intervening ischemic segment. Heavy, nonabsorbable suture is used for the rectopexy and should be placed in the periosteum of the sacrum prior to creation of the anastomosis. The anastomosis is performed without tension, and is interrogated with gentle pneumoinsufflation under saline irrigation fluid. The presence of bubbles indicates need for reinforcement or recreation of the anastomosis. The sacral periosteal sutures are used to grab the lateral stalks below the level of the anastomosis. The sutures are tied securely, taking special care not to create tension on the anastomosis. Constipation improves in approximately 50% of patients with sigmoid resection and rectopexy, and there is a low incidence of recurrence.[13,14]

Operative Technique: Perineal Approach

Perineal approaches used to repair recurrent rectal prolapse include the Delorme and perineal proctectomy, and are the procedures of choice for elderly patients with high operative risk. These procedures can be performed with local, spinal, or epidural anesthesia with mild intravenous sedation, and results in decreased perioperative physiologic stress. Patients with recurrent rectal prolapse that manifests with mucosal prolapse, short segment rectal prolapse, or internal intussusception will benefit from the Delorme approach. The perineal proctectomy is preferred for patients with a longer segment of rectal prolapse. The cost to the patient for the minimal risk during surgery is a higher re-recurrence rate for prolapse after repair.

Delorme

The Delorme procedure is the circumferential sleeve resection of rectal mucosa with plication of the underlying denuded rectal muscular wall, and reanastomosis of the mucosal rings. This procedure does not interrupt rectal blood flow and can be performed safely in patients with recurrent rectal prolapse regardless of type of primary repair. The patient is positioned in either the lithotomy or prone-jackknife position. A Lone Star® retractor (Lone Star Medical Products Inc., Stafford, TX) provides excellent exposure. The rectum is easily prolapsed and the submucosa is infiltrated with local anesthetic with 1:200,000 epinephrine to facilitate identification of dissection planes and reduce bleeding. A circular incision is made through the mucosa approximately 1 cm above the dentate line (Fig. 12.3A). In patients with previous perineal proctectomy, the incision is made distal to the previous anastomosis. Allis clamps are placed on the mucosal edge to facilitate traction and exposure. Bleeding is meticulously controlled with electrocautery. The mucosal and submucosal sleeve is circumferentially dissected proximally off of the muscle of the rectal wall until resistance is met (Fig. 12.3B). Failure to adequately excise redundant mucosa can lead to early recurrence of prolapse. As much as 10 to 25 cm of rectal mucosa may be stripped. The denuded rectal muscle is then pleated longitudinally like an accordion using 2-0 Vicryl in each quadrant (Fig. 12.3C), with two more sutures placed between each quadrant for additional support. This suture should not involve proximal or distal rectal mucosa. The prolapsed bowel is then reduced above the anal canal and the sutures tied. The excess proximal mucosa is excised, and the mucosal edges are reapproximated with 3-0 Vicryl suture (Fig. 12.3D).

Perineal Proctectomy

Perineal proctectomy is the procedure of choice for recurrent full-thickness rectal prolapse in high-risk and elderly patients. If resection rectopexy was performed for primary repair, then it is important to ensure the proximal anastomosis can be included in the resected segment of rectum. Inability to prolapse the previous anastomosis to the level of the anus suggests that the previous anastomosis cannot be resected, and therefore, the Delorme procedure should be performed.

Perineal proctectomy is performed with the patient in lithotomy or prone-jackknife position. A slight Trendelenburg position is used to decompress hemorrhoidal tissue and minimize operative bleeding. The rectum is prolapsed and a circumferential full-thickness incision is made 1 cm above the dentate line (Fig. 12.4A). If a perineal proctectomy was performed at primary repair, the incision is made to include the previous anastomosis in the resected segment. A Lone Star retractor facilitates exposure. The proximal end of the rectum is grasped with an Allis clamp to facilitate traction and maintain orientation of the rectum and sigmoid colon. The anterior wall of the hernia sac (deep cul-de-sac) is identified and entered (Fig. 12.4B), and the rectum freed circumferentially so the only attachments are the mesorectum posteriorly. The mesentery of the redundant bowel is serially clamped, divided, and suture ligated (Fig. 12.4C) until the redundant bowel cannot be pulled down further. Care should be taken not to lose control of these vessels since they will retract up into the pelvis and are subsequently hard to identify and control. Anteriorly, the levator ani muscles are plicated to create a snug fit of the pelvic diaphragm around the rectum and surgeon's finger.

The redundant bowel is then transected, and stay sutures of 2-0 Vicryl are placed full thickness in each quadrant of the proximal and distal transected rectum (Fig. 12.4D). Two more sutures are placed between each quadrant to complete the anastomosis (Fig. 12.4E).

Conclusion

Recurrence rates after primary repair of rectal prolapse have been consistently reported as high as and 50%.[1–4] Few studies have specifically addressed the surgical management of recurrent rectal prolapse, and most patients are treated according to the discretion of the operative surgeon.[5–8] Abdominal repair, such as rectopexy and resection

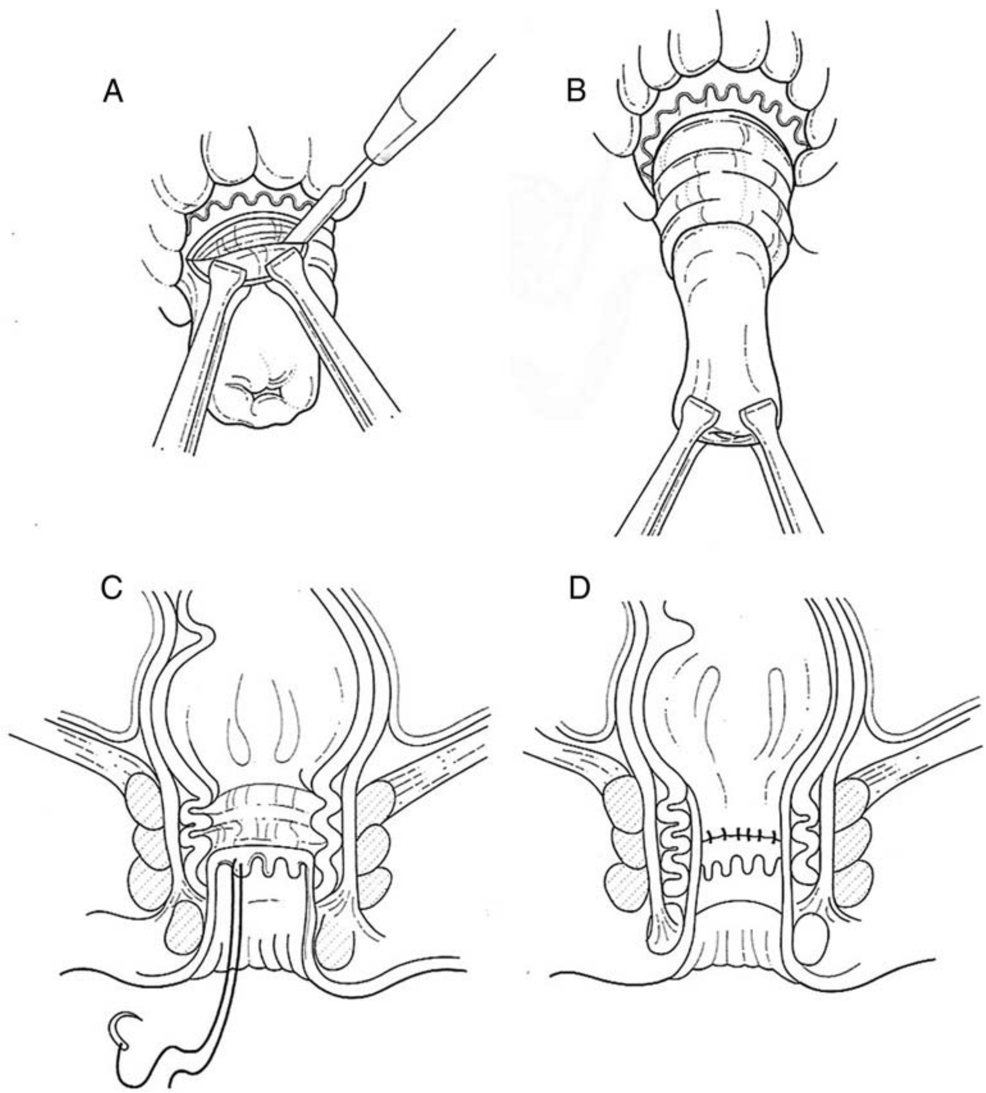

FIGURE 12.3. Delorme procedure for mucosal prolapse. (**A**) The mucosa is circumferentially incised above the dentate line. (**B**) Submucosal stripping is carried out cephalad until resistance is met. (**C**) Plication of the denuded muscle wall. (**D**) Reapproximation of the mucosal edges. (Modified from Meagher AP, Lubowski DZ, Kennedy ML. Rectal prolapse. In: Pemberton JH, Swash M, Henry MM, eds. The Pelvic Floor: Its Function and Disorders, 1st ed. London: WB Saunders; 2002:269, with permission from Elsevier.)

rectopexy, is preferred for recurrent rectal prolapse due to the decreased incidence of recurrence. However, special considerations must be made according to the primary rectal prolapse repair.

Most patients who have received a perineal procedure for primary repair of rectal prolapse are likely high risk for abdominal repair of recurrent rectal prolapse. Therefore, most of these patients require either a perineal proctectomy or Delorme procedure. Patients who develop recurrence with short-segment full-thickness rectal prolapse (<5 cm), mucosal prolapse, or distal internal intussusception of the rectum should be considered for a Delorme procedure. Longer full-thickness rectal prolapse requires repeat perineal proctectomy. These procedures are safe in the setting of previous perineal proctectomy, and the resection should include the previous anastomosis to prevent stricture formation. The abdominal approach is feasible for the treatment of rectal prolapse recurrence after perineal proctectomy; however, patients must be carefully selected and be medically fit. Following perineal proctectomy the superior hemorrhoidal artery is the primary blood supply to the rectum, which requires preservation during rectopexy or resection rectopexy in these patients.

Rectal prolapse recurrence after resection rectopexy can be repaired by either abdominal or perineal approach. In medically fit patients, persistent symptoms of constipation and a redundant sigmoid colon indicate the need for resection rectopexy. Resection should include the previous anastomosis to prevent an intervening ischemic segment of bowel. Rectopexy is preferred if the patient does not have symptomatic constipation. Patients with poor cardiopulmonary reserve should be treated through the perineal approach. Perineal proctectomy is preferred for longer segment prolapse; however, it should include the previous anastomosis to prevent intervening ischemic segment. If this is not possible, a Delorme procedure is necessary, as a perineal mucosectomy will not interrupt the blood flow to the distal rectum.

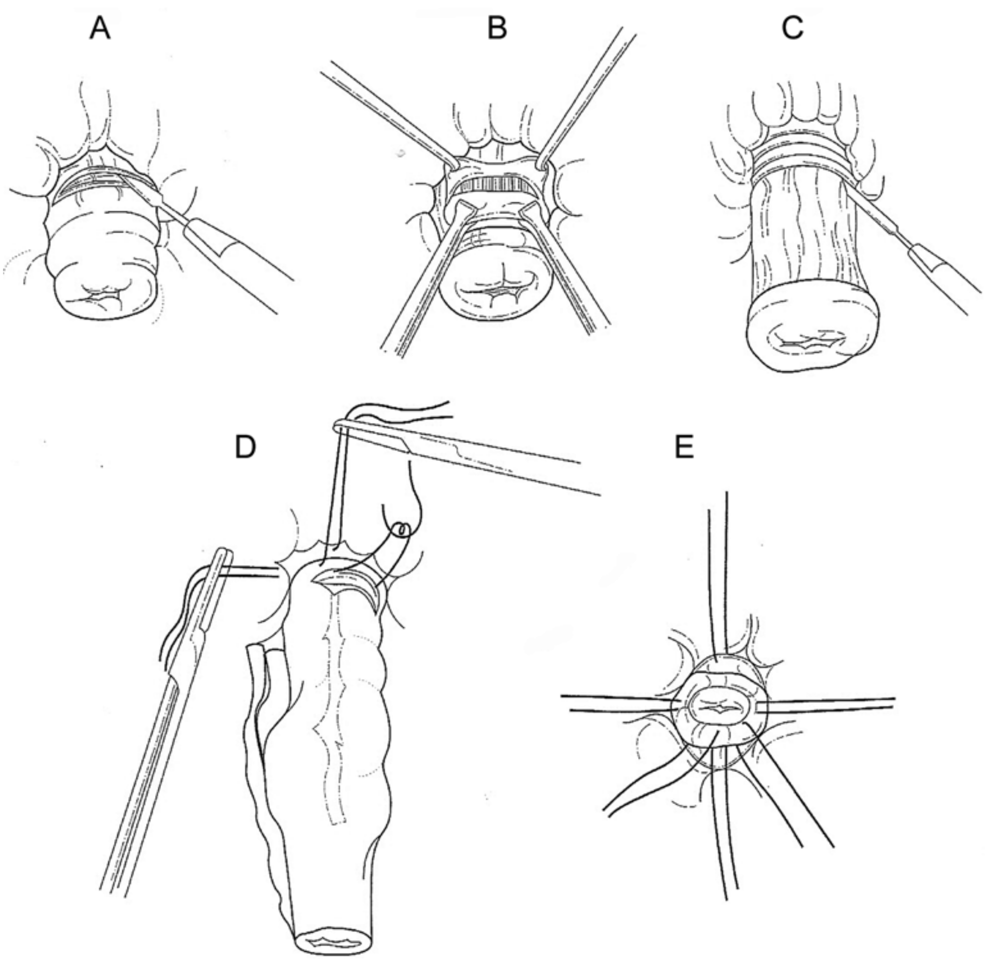

FIGURE 12.4. Perineal rectosigmoidectomy for complete prolapse. (**A**) The outer layer of the rectum is incised circumferentially above the dentate line. (**B**) Anteriorly, the edge of the peritoneal reflection is opened. (**C**) The rectum and any mobile part of the sigmoid colon are drawn down and segmental blood vessels are sequentially ligated. (**D**) The redundant bowel is transected and full-thickness stay sutures are placed in each quadrant of the proximal and distal transected rectum. (**E**) The anastomosis is completed. (From Meagher AP, Lubowski DZ, Kennedy ML. Rectal prolapse. In: Pemberton JH, Swash M, Henry MM, eds. The Pelvic Floor: Its Function and Disorders, 1st ed. London: WB Saunders; 2002:271, with permission from Elsevier.)

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13

Suburethral Sling Failures and Complications

Joanna M. Togami and J. Christian Winters

Since the introduction of the tension-free midurethral sling by Ulmsten and Petros,[1] an estimated 1 million cases have been performed worldwide. Since then, new operative techniques have been developed, with a variety of trocars, sling materials, and anatomic areas through which the trocars are passed. As an alternative to the retropubic approach, Delorme et al.[2] introduced the transobturator midurethral sling that is passed through the obturator foramen, a method lauded to have fewer complications.[3]

The ease and relative low incidence of complications with synthetic slings have deemed these procedures desirable to both patients and surgeons. With increased public awareness and interest in addressing incontinence issues, a growing number of women have been undergoing sling surgery to correct their stress urinary incontinence (SUI). Accordingly, there has been an increasing incidence of sling failures encountered by clinicians. As with any procedure, there are potential complications. This chapter addresses sling failures and complications of slings, and offers a systematic approach to the incontinent patient who has already undergone sling placement.

Evaluation of Sling Failures

Published success rates of anti-incontinence surgeries can vary significantly according to patient selection, surgical technique, and investigator definition of outcomes.[4] Patient satisfaction from suburethral sling procedures is not determined by the elimination of SUI alone. Factors that can adversely impact patient satisfaction include voiding dysfunction, obstructive voiding symptoms, recurrent urinary tract infections (that can potentially be related to an intravesical foreign body), pelvic pain, vaginal extrusion of the sling, and nerve entrapment. De novo detrusor overactivity has been reported to account for the difference between a 90.6% objective cure rate and a 70.4% subjective cure rate.[5]

When evaluating sling failures, it is important to establish that a failed sling is a sling that fails to correct SUI. Leakage following a sling can result from recurrent or persistent SUI (sling failure) or complications such as de novo detrusor overactivity or obstruction. The incidence of recurrent SUI following sling procedures was reported to be 7% to 16% in the meta-analysis of the literature reported by the 1997 American Urological Association (AUA) Clinical Guidelines Panel. The incidence was lower with autologous compared to synthetic slings.[6] It should be noted, however, that the 2007 Clinical Guidelines Panel, whose recommendations are imminent at the writing of this chapter, established more stringent requirements on which the updated guidelines have been based. Factors that may contribute to recurrent SUI include a change in the position of the sling, remodeling of the graft material in such a manner as to compromise urethral support, or sling erosion that may result in a scarred, patulous urethra or fistula.

Recurrent Stress Urinary Incontinence After Sling

When a clinician is faced with a patient experiencing recurrent SUI after a sling, a complete comprehensive evaluation to understand the mechanism(s) behind the recurrent incontinence should be performed. Proper evaluation is necessary to determine the most effective treatment options available for the individual patient. When performing this evaluation, one should consider all factors that can lead to sling failure and rule out other complicating factors such as detrusor overactivity or bladder outlet obstruction.

It is useful to classify SUI into one of two categories: simple or complex.[4] Complex sphincteric incontinence includes SUI with concomitant urge incontinence, a fixed "pipe-stem" urethra, fistula, urethral diverticulum, large cystocele, or neurogenic bladder. Patients with simple sphincteric incontinence are those who do not meet the criteria for complex incontinence. Included in this category are detrusor overactivity without urge incontinence and previous surgical failure. Those patients with complex

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incontinence often require reconstructive pelvic surgery in addition to an anti-incontinence procedure, while simple cases need no more than a repeat anti-incontinence procedure.[4]

As with all clinical conditions, evaluation begins with a thorough history and physical examination. As part of the history, one should define the character of the leakage (stress, urge, or mixed incontinence). Women may have obstructive-type lower urinary tract symptoms after a sling; thus one should screen for the presence of concomitant emptying symptoms. Also, symptoms of urgency and frequency with (or without) urge incontinence may suggest the presence of detrusor overactivity. The physical examination should assess the following: vaginal healing (extrusion, infection), urethral support, cough stress test, prolapse, and fistula. In many instances, a cotton swab test can be useful. A positive cotton swab test, which signifies urethral hypermobility, is associated with a deflection of the cotton swab greater than 30 degrees. In most women, this finding is obvious, and the test is not necessary. However, a negative (downward) deflection of the cotton swab implies a possibility of urethral overcorrection, and this may be an important test in women with refractory obstructive or irritative symptoms following a sling procedure, suggesting obstruction.

The role of urodynamics in primary cases of genuine SUI remains controversial. However, few question the role of multichannel urodynamics in the evaluation of incontinent women who are still experiencing incontinence after a pubovaginal sling. There are a number of factors that must be evaluated to determine the cause of incontinence. It is important to examine bladder storage characteristics. These patients may develop detrusor overactivity in the form of involuntary bladder contractions that cause leakage or a compliance abnormality signified by abnormally high bladder storage pressures during filling. Also, the abdominal (Valsalva) leak point pressure (ALPP) or urethral pressure profile (UPP) should be performed to assess the competence of the urethra to prevent SUI. Lastly, a close inspection of the pressure-flow analysis should be performed to rule out sling-induced bladder outlet obstruction or some other form of dysfunctional voiding. Therefore, the major reasons for performing urodynamics in these patients are to identify the cause of incontinence, and determine if any sling complications have occurred.

Once the evaluation is complete, the management of these patients is individualized. A number of factors must be considered when selecting therapy for these patients. Each intervention must be selected based on an analysis of the following factors: presence of urethral hypermobility, degree of sphincteric dysfunction, presence of detrusor storage abnormalities, associated urogenital prolapse, and any existing sling complications (vaginal exposure, erosion, or obstruction).

In patients experiencing incontinence because of a bladder storage abnormality, therapy must be directed at treatment of overactive bladder. Initially, treatment consists of anticholinergic medications and behavioral modification. In patients who fail to respond to these conventional overactive bladder (OAB) treatments, increasing the dosage[7] or adding another medication (imipramine)[8] may improve outcomes. Patients with refractory OAB who do not improve in spite of these measures may then be offered off-label botulinum toxin injection of the bladder or sacral neuromodulation.[9]

In women experiencing recurrent SUI after a sling procedure, a number of interventions can be considered. Urethral injection therapy is commonly considered in this patient population (Fig. 13.1). In the original Food and Drug Administration (FDA) multicenter trial of Contigen (glutaraldehyde cross-linked collagen; C.R. Bard, Covington, GA), the ideal candidate for injectable therapy was described as a patient with intrinsic sphincter deficiency (ISD) and an immobile urethra.[10] Commonly, these were patients who had failed previous anti-incontinence procedures due to ISD who had immobile urethras from the previous procedure. However, several authors have subsequently confirmed the efficacy of injections in women with urethral hypermobility (lack of urethral support).[11,12] Currently, several products are available for urethral bulking injection therapy: Contigen, Durasphere (pyrolytic carbon coated zirconium oxide beads; Carbon Medical Technologies, St. Paul, MN), and Coaptite (calcium hydroxylapatite; Boston Scientific Corp., Natick, MA). Cure rates of approximately 20% to 30% have been reported with approximately 50% improved. There appears to be no significant advantage of one material over the others as neither Durasphere[13] nor Coaptite[14] have been demonstrated to be superior to Contigen. In Europe, studies have confirmed the efficacy of ZUIDEX (nonanimal stabilized hyaluronic acid/dextronomer; Q-Med AB, Uppsala, Sweden) in the management of SUI in women.[15] This agent is currently not available in the United States.

Several limitations exist when considering the use of injections in women with recurrent SUI. First, multiple injection sessions are usually required to achieve the desired clinical result. If a beneficial effect is achieved, the durability of the response is temporary.[12] On the other hand, complications are rare. De novo overactivity of the

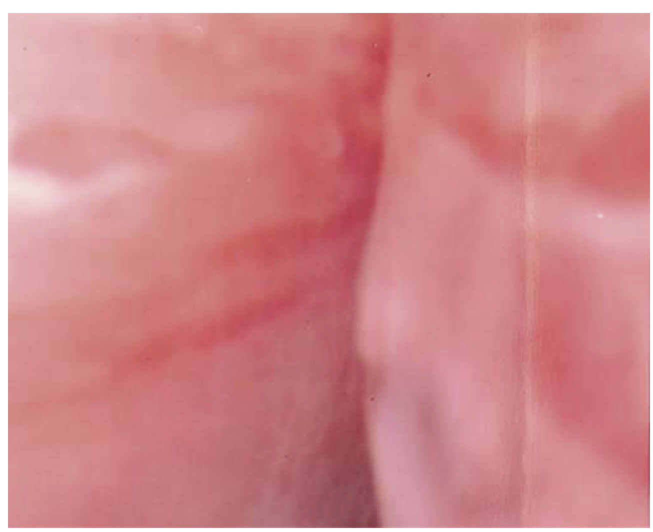

FIGURE 13.1. Appearance of urethra after Coaptite injection.

bladder can occur,[16] as can urinary retention, but this is typically transient and not problematic.[16] When considering injectables, patients must be informed that multiple injections may be required, the results may be temporary, and the major advantage of injectable agents is to avoid another surgical procedure.

Although midurethral slings are emerging as the new gold standard in the surgical treatment of uncomplicated cases of SUI, the autologous pubovaginal sling should be considered the gold standard for surgical correction of recurrent SUI. Autologous slings can be used in all situations of recurrent SUI regardless of the severity of ISD and the degree of urethral support. Unfortunately, studies of outcomes of autologous slings in women who have failed a previous sling are rare. Limited data suggest that the success rates may be less and the incidence of voiding dysfunction or detrusor overactivity is higher when compared to primary sling procedures.[17] In patients who have experienced local wound complications (infection/or extrusion) from a graft material (biologic or synthetic), autologous slings are the usual procedure of choice. The degree of urethral mobilization and tension adjustment depends on the anatomy and sphincteric function as determined urodynamically. If the urethra is fixed or the urethral pressure is poor, a formal urethral mobilization (urethrolysis) and bladder neck compression may be necessary. In patients with recurrent SUI and associated urethral hypermobility, less urethral mobilization is necessary. In addition, if the urethral pressures are not severely low, bladder neck compression may not be needed. In these patients, repeat midurethral slings may be considered.[18] When performing a repeat pubovaginal sling, the authors usually place a suprapubic tube due to a higher incidence of incomplete bladder emptying often encountered postoperatively.

When considering a midurethral sling (MUS) procedure (TVT, SPARC, Lynx, Monarc, Aris, Prefyx, TOT, TOT-O, TVT-S) in a woman who has failed a previous sling procedure, several factors should be considered. First, not all MUS procedures are equal. Because tension-free vaginal tape (TVT) was introduced first, it has the most data and the longest follow-up to date of all the MUSs. Reports on the success of TVT following a previous sling procedure demonstrates the value of TVT in this setting.[19,20] The SPARC procedure is another retropubic MUS procedure. There are controlled studies demonstrating that the SPARC procedure achieves comparable results to the TVT.[21,22] The Monarc, TOT, TOT-O, and Aris procedures are among the most commonly performed transobturator tape (TOT) procedures. One obvious advantage of this technique is the avoidance of the retropubic space. The simplicity and minimal morbidity of these procedures seem to favor the TOT MUS as the procedure of choice in women with recurrent SUI.[23] However, there are concerns about decreased success rates of MUSs in patients with immobile urethras,[24] as is the case in patients with low ALLPs. The success of repeat TVT in women who have failed SUI surgery varies between 70% and 90%, with relatively few complications,[18] although there are few data specific to secondary procedures following failed slings. Currently,

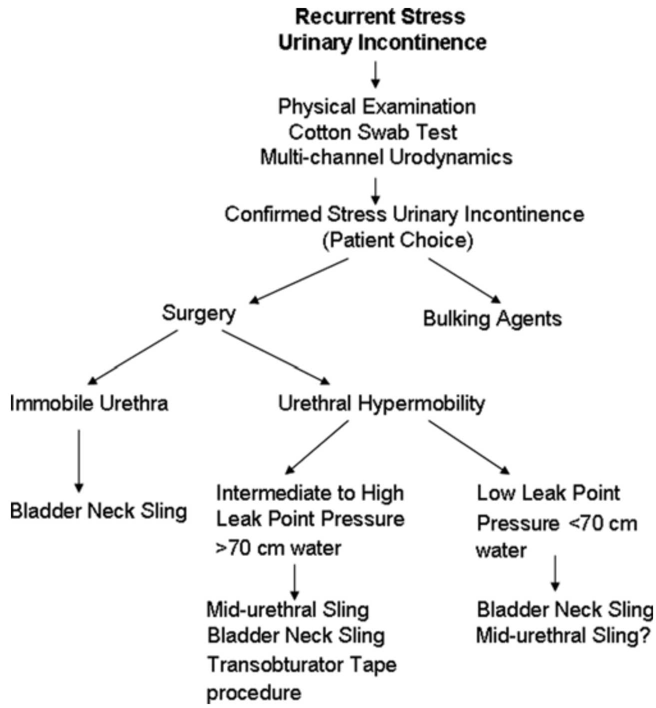

FIGURE 13.2. Algorithm to consider in surgical management of recurrent SUI.

the authors avoid MUS procedures in women with immobile urethras, particularly in the presence of low VLPPs (about $\leq$70 cm water). There are studies suggesting that TOT procedures[25] are not as efficacious as retropubic MUS procedures in patients with low VLPPs; thus, it is important to consider these factors when selecting therapy (Fig. 13.2).

Complications of Slings

Complications of slings can be divided into major and minor complications. Major complications include injury to large vessels and bowel perforation. Major complications are generally considered to be potentially life threatening and require laparotomy. All other complications fall into the minor category. Complications can be recognized intraoperatively, perioperatively, and postoperatively. The following is a discussion of these complications, and, where appropriate, advice on avoiding specific complications is offered.

Visceral Perforation

Bowel perforation can occur with retropubic passage of the trocars. Adhesion of bowel to the pubic bone can increase this risk.[26] Symptoms indicative of bowel injury can range from abdominal pain to a painless greenish discharge at the trocar site. Abdominal computed tomography (CT) scan may reveal free air. When bowel injury is suspected, a general surgical consultation should be obtained and exploratory laparotomy should be strongly considered.

Bleeding

Bleeding can occur intraoperatively. Blood loss of >250 mL has been reported in 5.4% of 241 patients, with 2.5% having blood loss >500 mL. None required blood transfusion.[27] Pelvic hematoma is often diagnosed when urinary retention is accompanied by either pelvic or suprapubic pain that is greater than expected.[27] Often, such hematomas can be managed conservatively, though larger hematomas may require drainage. In a series of 140 patients, Kobashi and Govier[26] reported on one patient who presented with vaginal bleeding and pelvic pain 1 week after discharge. Pelvic CT revealed a large retropubic hematoma that was drained percutaneously. The patient experienced immediate relief of symptoms, was placed on empiric antibiotics, and required no other intervention. There were no voiding symptoms. In one series of 24 patients who underwent postoperative magnetic resonance imaging (MRI), 25% were found to have a retropubic hematoma in the space of Retzius above the levator ani muscles measuring 2 to 8.5 cm in diameter.[28] The source of these hematomas is believed to be either small veins in the retropubic space or the epigastric vessels.[29] In another study, injury to the inferior epigastric artery was noted in 0.1% of patients, requiring open retropubic exploration and blood transfusion.[30]

Perforation of large vessels (external iliac, femoral, and epigastric vessels) has been described rarely. These injuries tend to occur with exaggerated flexion of the thighs on the pelvis and excessive lateral positioning of the trocar during insertion of the sling.[31]

Bladder and Urethral Perforation

Injuries to the bladder and urethra generally occur as a result of perforation during dissection or placement of the trocar through the bladder or urethra during passage. Abouassaly et al.[27] reviewed 241 patients, and noted a 5.8% bladder perforation rate; the range in the literature is noted to be between 0% and 25%. They noted that there is a significantly higher risk in patients who have previously undergone anti-incontinence surgery. Tamussino et al.[32] noted an injury rate of 4.4% in patients with previous anti-incontinence surgery versus 2% in patients who had not undergone prior anti-incontinence procedures.

In a study of 38 hospitals with 1455 patients, Kuuva and Nilsson[30] noted that bladder perforation occurred at a rate of 3.8% of patients. Risks include concomitant reconstructive surgery, previous pelvic surgery, and passage of the trocar opposite the surgeon's dominant hand.[33] If the perforation is recognized at the time of injury, it can be managed with withdrawal of the needle and repositioning the needle laterally, and catheter drainage for 24 to 72 hours postoperatively.[34] Care must be taken not to place the needles too far laterally, to avoid injuring the external iliac vein.[34] Prevention of bladder perforation may be accomplished by emptying the bladder and providing finger guidance during needle passage through the retropubic space.[34]

The transobturator approach does not protect against bladder or urethral perforation.[35] Several series have reported bladder and urethral injury from needle passage, the incidence of which is generally less than 1%,[36–38] although one series reported a bladder perforation rate of 4%. All injuries were recognized at the time of surgery, emphasizing the necessity of cystoscopy, and were managed by removal of the tape and repositioning of the trocar. All were managed by bladder drainage for 7 days.[39] One patient was noted to be obese, and two had undergone previous surgery.

Bladder laceration can occur during dissection of the vaginal epithelium from the pubocervical fascia or during perforation of the fascia into the retropubic space as performed during placement of bone anchors or for repair of a lateral cystocele. A two-layer closure should be performed using absorbable suture. Catheter drainage for ≥7 days and anticholinergics may facilitate healing.[34]

In cases of urethral perforation, the urethra should be repaired primarily over a catheter, and the surgery should be aborted. Healing should be permitted over a minimum of 6 weeks before attempting another sling.[34]

Voiding Dysfunction

While it is well recognized that sling operations are effective in treating stress incontinence, postoperative voiding dysfunction is a large contributor to decreased patient satisfaction. Voiding dysfunction can manifest in both storage symptoms and voiding symptoms. Storage symptoms, previously referred to as irritative symptoms, consist of frequency, urgency, nocturia, and urge incontinence, and may occur de novo, persist, or worsen compared to the preoperative status. Voiding symptoms or problems emptying manifest in urinary hesitancy, the need to strain or change position in order to void, the sensation of incomplete emptying, or urinary retention.

Symptoms of bladder storage failure have been reported at a range of 2% to 25%.[3,40–43] These symptoms are a source of decreased patient satisfaction following treatment for SUI.[43] It is imperative to determine the etiology of these symptoms, as urinary obstruction, urethral injury, bladder injury, and urethral erosion may all present with irritative symptoms. In a retrospective study of 51 patients undergoing urethrolysis, Carr and Webster[41] reported that most patients had irritative symptoms (75%), while 61% had obstructive symptoms, and 24% complained of urinary retention. Although many of these women were obstructed, many emptied well. The mechanism has been demonstrated by ultrasound to be due to hypersuspension or urethral kinking.[44,45] In addition, periurethral scarring following inadvertent suture placement through the urethral lumen or dissection beyond the pubocervical fascia too close to the urethra can lead to subsequent obstruction and voiding dysfunction.[35,45] Tsivian et al.[42] reported on a series of 14 patients who underwent excision of tension-free vaginal tape for irritative symptoms and found that seven had rolling of the tape, resulting in a string configuration, and three had obstruction from proximal displacement of the tape under the bladder neck.

Postoperative bladder dysfunction has been reported following transobturator procedures at rates of 2.8% to

21%.[2,36,46] One prospective multicenter study demonstrated symptoms of urgency in 2.8% and de novo urge incontinence in 4%.[36] Botros et al.[47] found that the trend toward resolution of detrusor overactivity was greater with TOT (65%) compared to TVT (48%) and SPARC (43%), and de novo detrusor overactivity (DO) was less frequent following TOT (8%) compared to TVT (32%) and SPARC (19%) at 9 months.[47] Two possible mechanisms were postulated by their group. First, the tendency toward a more proximal position of the retropubic MUSs may contribute to detrusor overactivity, though more study is needed to support this theory. Second, the more vertical position (U-shape) of the MUSs placed in the pubovaginal position compared to the horizontal orientation of the TOTs leads to a more circumferential compression of the urethra and can cause more voiding dysfunction postoperatively. It was suggested that the lateral vector may not provide as much tension beneath the urethra as that accomplished by the tighter retropubic U-shaped configuration.[48]

Many patients experience resolution of resultant irritative symptoms within the early postoperative period. The initial therapy includes fluid management, timed voiding, and anticholinergic medication. Also urinary infection should be ruled out with a catheterized urine specimen. For those with persistent symptoms, formal evaluation should be carried out. In the history, it is useful to compare the patient's preoperative voiding symptoms to the postoperative symptoms as preoperative DO and urge urinary incontinence (UUI) were the biggest predictors of postoperative DO and UUI in several studies.[47] Careful physical examination of the anterior vaginal wall with both visualization and palpation may reveal exposed mesh. Documentation of urethral mobility, visible incontinence, and pelvic organ prolapse are also important. Cystoscopy is recommended to rule out sling erosion into the urethra or bladder or both,[35] and gives the clinician a sense of urethral suspension.[45] Sling erosion should be suspected in patients whose symptoms are not responsive to anticholinergic therapy or are persistent. While there is a lack of consensus for the definition of female bladder outlet obstruction, urodynamic testing is useful, particularly in patients who have a significant postvoid residual in whom the study can provide information regarding detrusor activity and bladder compliance. Postvoid residual volumes alone cannot differentiate between outlet obstruction and a hypotonic detrusor. Videourodynamics add an extra dimension to the analysis of incomplete bladder emptying. Elevated detrusor voiding pressures may suggest obstruction, whereas inability to produce detrusor pressures may suggest detrusor hypocontractility. In patients found to be obstructed, sling incision or urethrolysis may be beneficial (see discussion of urinary retention, below).

Sacral neuromodulation has been used successfully in the treatment of refractory UUI, nonobstructed urinary retention, and urgency/frequency syndromes. Its safety and efficacy have been demonstrated in long-term clinical studies.[49,50] Because of the proven efficacy in these patients, expansion of the indication to more complex patients is the next step.[51] Several small studies have addressed this issue. Sherman et al.[52] examined 34 patients with refractory nonobstructive UUI after stress incontinence surgery, to evaluate the response to sacral neuromodulation. Using a positive response defined as 50% or more improvement in baseline urge incontinent episodes or a 50% or more reduction in pad weight during the testing period, 22 women went on to have the permanent lead and pulse generator implanted. Factors that predicted positive response were younger age (less than 55), shorter duration of symptoms (less than 4 years), and good pelvic floor muscle tone. The type of anti-incontinence surgery and whether or not the patient had sling incision were not statistically significant. In a study examining a more mixed population, Starkman et al.[53] examined 25 patients with refractory UUI following urogynecologic surgery who underwent the two-stage implantation technique. Of these, 22 went on to the second stage. Fifteen patients had a greater than 80% improvement, while five patients maintained a minimum of 50% symptom improvement at 7.2 months. Two patients did not maintain the initial response from screening to the second stage. Again, number and type of prior lower urinary tract surgical procedures did not correlate with response to neuromodulation. Although the exact mechanism by which sacral neuromodulation works is not known, the underlying principle is based on somatic afferent inhibition of interneuronal and ascending sensory processing within the spinal cord.[54] The last study examining sacral neuromodulation examined eight patients with refractory overactive bladder symptoms following urethrolysis.[51] Eight patients were identified: five had undergone a bladder neck sling, and three had undergone midurethral sling. Using a two-stage technique, the authors reported that six of the eight patients went on to have implantation of the pulse generator. Three patients had complete resolution of OAB, while three had significantly improved symptoms, having one or two urgency incontinent episodes per week. All were able to discontinue antimuscarinic agents after sacral neuromodulation. While this study is small, the results are promising for treatment of this difficult population.

Urethral Erosion

Urethral erosion can manifest with urinary retention, urge incontinence, or mixed incontinence. One study reported 35% of patients with urinary tract mesh erosion were asymptomatic.[55] In addition, 33% of patients did not present until after the first postoperative year, emphasizing the importance of long-term follow-up and the high index of suspicion needed to make the diagnosis.[55] Mechanisms for erosion include placement of the sling deep in the periurethral fascia, excessive tension of the sling causing ischemic necrosis, or unrecognized urethral injury.[34,56] Predisposing factors such as excessive dissection around the urethra, particularly in patients with a history of previous surgery, local infection, and rolling of the tape into a narrow band have been described.[55] Management can be tailored dependent on the material used. Amundsen[57] reported on a series of patients with urethral erosion who were examined, with the focus on locating the sling and evaluating the resultant retropubic angulation of the proximal urethra. Cystourethroscopy was performed to examine the bladder and urethra for foreign bodies. A short beaked cystoscope with a 0- or 30-degree lens should be used to evaluate for urethral erosion with or without urethrovaginal fistula. A 70-degree lens is used to evaluate the bladder for perforation, as well. In patients with synthetic slings, the entire sling was removed and a multilayer closure was performed with selective use of a Martius flap. The nonsynthetic (autologous or allograft fascia) slings were incised and the urethra was closed in multiple layers. In the first reported case of urethral sling erosion, the arms of the sling were left in place to promote continence and the patient remained continent after removal of the sling.[58] During repair of the urethral erosion, if a synthetic sling was used, the sling and all other foreign materials should be removed if possible. Bone anchors may be difficult to remove in the absence of a superative bone infection. In their review of urethral reconstruction after sling erosion, Blaivas and Sandhu[59] recommended the following principles of surgical repair: "(1) clear visualization and exposure of the operative site; (2) creation of a tension-free, multiple layered closures; (3) assurance of an adequate blood supply; and (4) adequate bladder drainage." Bladder drainage can be done with a suprapubic catheter. A urethral catheter is used to stent the urethral repair for 3 to 5 days, leaving the suprapubic tube to drain the bladder for 2 weeks. Primary closure of the urethra should be done using a 4-0 or 5-0 absorbable suture. Blaivas and Sandhu recommend chromic, as sutures that are longer lasting may cause dysuria. When primary closure is not possible, three techniques can be utilized to achieve vaginal reconstruction advancement flaps, lateral tube flaps, and labia minora pedicle flaps. The selection of the individual technique is dependent on the location of the tissue loss and whether or not an anti-incontinence surgery is planned at the same time. While several authors[60] recommend delaying anti-incontinence surgery at least 5 months, Blaivas and Sandhu advocate placing a sling an autologous or xenograft at the time of urethral reconstruction. Placement of another synthetic graft was not recommended.[59]

Vaginal Erosion/Extrusion

The erosion rates for all sites combined (urethra, vagina, and bladder) ranges from 0.3 to 23%.[31] Vaginal erosion can manifest with a serous vaginal discharge, bleeding, groin pain, recurrent urinary tract infection, persistent SUI, dyspareunia, or pain experienced by the patient's partner during intercourse.[5] Presentation can vary from immediate postoperative period to many months postoperatively.[5,61] The rate of erosion for autologous slings had been reported to be 0.003% versus 0.02% with synthetic slings.[6] The exact mechanism of vaginal erosion is unclear, but is theorized to involve poor tissue integration, local ischemia, poor mesh incorporation, subclinical infection, small mesh pore size, or early return to sexual intercourse.[5] Slings utilizing monofilament, macroporous (greater than 80 μm) polypropylene mesh allow for collagen deposition, tissue incorporation, and migration of macrophages. Physical examination may reveal a vaginal granuloma, eroded tape or suture, vaginal tenderness, or palpable mesh on bimanual exam.[5] Treatment depends on the degree of symptoms. Patients may be managed with observation,[62] application of topical estrogen cream or metronidazole gel, excision of the exposed mesh, removal of the suburethral component, or removal of the entire mesh.[61]

Infection and Abscess

Infected sling and resultant abscess formation can occur after vaginal erosion. Presenting symptoms include vaginal discharge, fevers and chills, and pain at the level of the sling, and may be delayed for days to several years.[5] Ishiorectal fossa and perineal abscesses have been reported with the transobturator approach. Removal of the infected sling material and incision and drainage of the abscess cavity allow for healing. Generally, due to the infection the sling will easily be removed. Myositis and cellulitis require complex surgical treatment that can be associated with significant morbidity.

Obstruction

The incidence of iatrogenic urethral obstruction varies in the literature. In contemporary sling series, the incidence is less than 5%, manifesting with urinary retention or urodynamically proven obstruction.[6,40,63,64] Diagnosing bladder outlet obstruction can be problematic, as patients may manifest with both storage and emptying difficulties. Obstructive symptoms include urinary hesitancy, intermittency, slow urinary stream, or need to strain or change positions. Storage symptoms include urinary frequency, urgency, and urge incontinence. Patients may be obstructed even though they demonstrate adequate emptying. In addition to these symptoms, patients may have persistent SUI and recurrent urinary tract infection. The mechanisms of voiding dysfunction associated with obstruction stems from urethral compression due to excessive sling tension. In addition, sling malpositioning or migration may also lead to bladder outlet obstruction. Several investigators have suggested this is due to denervation hypersensitivity secondary to bladder outlet obstruction.[65,66] However, others have postulated that the surgical dissection alone leads to denervation hypersensitivity in the absence of bladder outlet obstruction.[67] Yet another theory may be related to decreased cholinergic sensitivity and increased purinergic signaling via neuronally released adenosine triphosphate during the early phase of obstruction.[68]

Evaluation And Intervention

Most women begin voiding effectively within days to weeks after sling surgery. Due to ultrastructural changes in the detrusor muscle, return to normal voiding may take longer in women who have been chronically obstructed. The timing for evaluation and intervention may be delayed to allow adequate time for spontaneous resolution of symptoms and to minimize the risk of recurrent SUI, respectively. Some have advocated waiting 3 months to intervene following a pubovaginal sling, as return to normal voiding has been documented up until 3 months postoperatively.[69] After 3 months, the probability of the symptoms resolving without intervention is low. Most surgeons tend to intervene within 3 to 4 weeks following synthetic MUS procedures, and some as early as 1 week postoperatively. After 10 to 14 days significant tissue ingrowth into the mesh materials has occurred, and it therefore appears that there is little value in waiting beyond that time frame.[40] During this waiting period, patients may be managed with intermittent or continuous catheterization. Evaluation begins with a focused history and physical exam. It is useful to evaluate the preoperative voiding status with regard to storage and voiding symptoms, timing of the onset of symptoms relative to surgery, and number and types of previous pelvic floor reconstructive surgeries the patient has undergone. Assessment of urethral mobility, demonstrable incontinence, pelvic organ prolapse, and bladder emptying is important, as these factors can contribute to suboptimal results. Postoperative urodynamics may be helpful in demonstrating bladder outlet obstruction or hypocontractility of the bladder.

The diagnosis of obstruction in women can be difficult to make as there is no consensus regarding a urodynamic definition of outlet obstruction in women. Chassagne et al.[70] proposed combined cutoff values of detrusor pressure greater than 20 cm H_2O at maximum flow rate less than 15 mL/sec. Blaivas and Groutz[71] used a free maximum uroflow of $\leq$12 mL/sec with detrusor pressure at maximum flow rate $\geq$20 cm H_2O to develop a nomogram for women with lower urinary tract symptoms. Classic high-pressure, low-flow voiding is not a consistent finding, and several studies have failed to correlate urodynamic findings with the likelihood of successful voiding after urethrolysis.[57,72] Consequently, urodynamic findings should not preclude a patient from surgical intervention, even if detrusor contractility is impaired or absent.[69,73] Formal urodynamics is preferred for patients with de novo or worsened irritative symptoms, including urge incontinence without a significant postvoid residual. If patients have urinary retention and incomplete emptying, performing urodynamics may not be necessary, especially if the patient was known to have normal contractility and emptying preoperatively. Nevertheless, urodynamics are useful in providing information about pelvic floor relaxation during voiding (or lack thereof) that can be helpful in establishing the diagnosis of dysfunctional voiding. Additionally, the etiology of concomitant incontinence may be elucidated to facilitate planning of concurrent surgery during urethrolysis. Figure 13.3 illustrates the urodynamic study of an obstructed patient.

Obstruction caused by MUSs may be prevented at several points in the procedure. Limiting the dissection at the level of the midurethra minimizes the risk of sling migration. Space adequate to allow the sling to lie flat should be developed. Sling tension is adjusted over a right-angle clamp or Metzenbaum scissors placed between the sling and the urethra, with a catheter in place to prevent excess sling tension. If the patient is under general or spinal anesthesia, keep in mind that the muscles are in a relaxed state, and the increased tone when the patient has recovered may also tighten the sling.

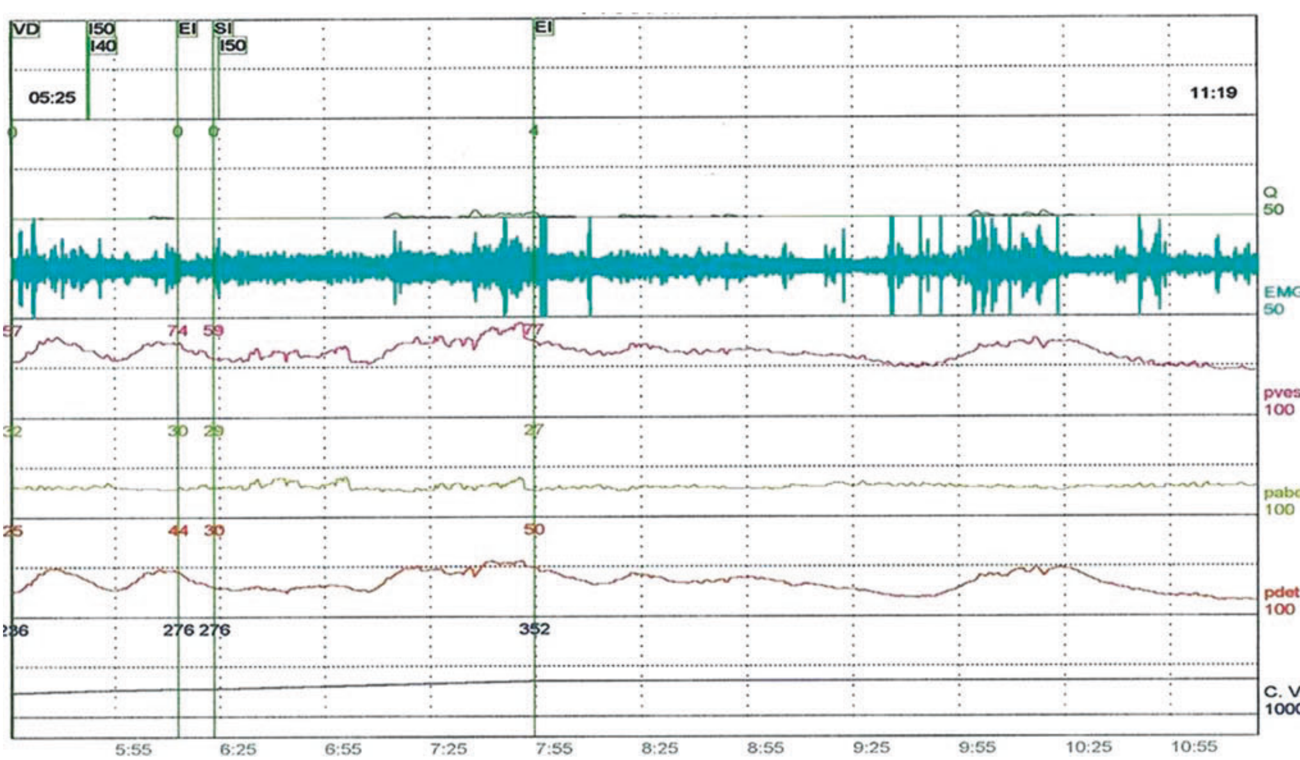

FIGURE 13.3. Pressure flow study in an obstructed patient.

Treatment

Treatment is dictated by the degree of bother and the patient's preference. For instance, an obstructed patient may opt for conservative management rather than undergo another surgery and risk recurrent SUI.[69] The approach and treatment should be tailored to the patient dependent on the type, previous pelvic surgical history, including prior attempts at urethrolysis, and other complicating factors such as prolapse or presence of a fistula.

Incision of Sling

While much has been written about formal urethrolysis, sling incision has the advantage of being technically easier, requiring less recovery time, and decreasing the risk of recurrent incontinence. Ghoniem and Elgamasy[74] in 1995 first described incision with placement of a vaginal patch interposition graft between the cut edges of the sling.[74] The technique was developed in an effort to preserve the integrity of the suburethral sling and maintain continence. Nitti et al.[75] described a transvaginal technique through an inverted-U incision to expose the bladder neck and proximal urethra.[75] When the sling is difficult to identify, a cystoscope, urethral sound, or Lowsley retractor[76] can be placed intraurethrally to facilitate identification. Urethral or bladder injury can be avoided by beginning the dissection distally, identifying normal urethra, and proceeding proximally.[69] Once located, the sling should be separated from the underlying periurethral fascia with sharp or blunt dissection. A right-angle clamp is placed behind the suburethral sling (Fig. 13.4), and it is mobilized off the periurethral fascia to, but not through, the endopelvic fascia, with or without an attempt at excising the entire sling. In cases of extreme tension the ends can retract into the retropubic space. The vaginal wall is closed and the Foley catheter removed. Sling lysis was successful in 85% of the patients. All of the patients with irritative voiding symptoms had improvement or resolution of their symptoms. Three of 19 patients had no improvement of urinary retention or incomplete emptying. Three of 18 patients who were continent preoperatively had recurrent stress incontinence, two of whom responded to transurethral collagen injection. Sling incision can be performed as early as 6 weeks postoperatively,[76] but optimal timing is yet to be established.

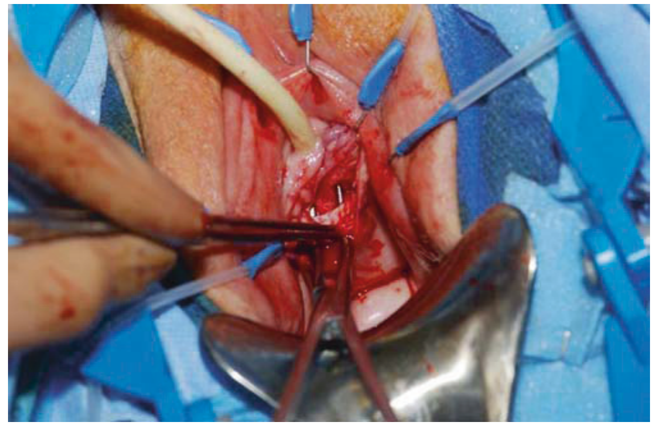

FIGURE 13.4. Incision of sling, note right-angle clamp mobilizing sling off of periurethral fascia.

Urethrolysis

When the sling cannot be identified, a formal urethrolysis is recommended. In most series, urethrolysis is performed after 3 months. This waiting period is somewhat arbitrary,[69,77] as many report resolution of symptoms within 6 weeks of surgery. Symptoms of urinary obstruction are unlikely to resolve after 3 months. In addition, this time period allows for retropubic scarring and fibrosis, which may contribute to a low rate of recurrent stress incontinence after urethrolysis. However, a number of reports advocate early rather than delayed urethrolysis after midurethral sling procedures.[27,40,78] Leng and Chancellor[78] retrospectively reviewed 15 patients who underwent urethrolysis for iatrogenic urethral obstruction. The mean time to urethrolysis was delayed at 17.3 ± 22.9 months. The patients were stratified according to those with storage symptoms and those without storage symptoms. A statistically significant difference in time between the original surgery and urethrolysis was noted between the two groups, with the storage symptom group undergoing urethrolysis at a mean of 31.25 ± 21.9 months, and the nonstorage symptom group undergoing intervention at a mean of 9 ± 10.1 months. This led to the conclusion that prolonged bladder outlet obstruction may lead to permanent bladder dysfunction.

As with most reconstructive surgery, the technique selected to relieve bladder outlet obstruction should be tailored to patient specific findings. Factors to take into account include type and number of anti-incontinence procedures, previous attempts at sling incision or urethrolysis, associated complicating factors such as bladder injury, retropubic hematoma, urethral or vaginal erosion, history of pelvic irradiation, or sling infection. Several approaches to urethrolysis may be utilized, including retropubic, transvaginal, and suprameatal (infrapubic) and combinations of these. All data that have been reported are from retrospective surgical series. There are no randomized controlled trials comparing surgical approaches, nor are there direct comparisons of urethrolysis outcomes with or without resuspension of the bladder neck.

The most commonly used transvaginal technique was originally described by Zimmern et al.[79] An inverted-U incision, approximately 3 cm in length is made in the anterior vaginal wall, placing the apex midway between the bladder neck and urethral meatus. Lateral dissection is performed on the periurethral fascia to the pubic symphysis. The endopelvic fascia is entered bluntly or sharply lateral to the bladder neck on each side, separating the urethra off the underside of the pubic symphysis. The urethra and bladder neck are freed completely from the previous adhesions and sutures or sling. If the dissection between the pubic symphysis and urethra is particularly difficult, the approach may be accomplished suprapubically (see below). Cystourethroscopy should be performed to ensure that the bladder and urethra are intact and uninjured. A Martius labial fat pad may be placed between the pubic bone and urethra to prevent readherence of these structures. This may be especially useful in cases of repeat urethrolysis or when scarring is particularly dense.[69] The advantage of the transvaginal approach is decreased morbidity to the patient compared to the retropubic approach. Success rates from 72% to 84% have been described with a low incidence of recurrent stress incontinence.[77] Patients should be counseled about the potential need to continue clean intermittent catheterization following urethrolysis in cases of failure.

Suprameatal transvaginal urethrolysis was first described by Petrou et al.[80] After placement of a Foley catheter, a semilunar, inverted-U incision is made through the vestibular epithelium between the 9 o'clock and 3 o'clock positions, 1 cm from the urethral meatus. Allis clamps are placed on the inferior and superior margins of the incision. The perineal membrane is incised in the midline, facilitated by placing the perineal membrane on tension. The plane above the urethra is dissected with Metzenbaum scissors. The urethra, bladder neck, and bladder are freed from the pubic bone and pelvic attachments laterally and the pubovesical ligament medially. An index finger can be placed ventral to the bladder into the retropubic space of Retzius to facilitate identification of the obstructing tissue, which is incised under direct vision as the index finger moves from the midline laterally. The wings of the sling are then identified laterally and incised. If sutures from a previous retropubic or transvaginal suspension are present, dissection is performed to free the urethra from the posterior aspect of the pubic bone and identify these sutures, which can then be palpated and divided. Cystourethroscopy is performed to confirm the integrity of the bladder and urethra. In some cases an omental or Martius labial fat pad may be placed to prevent fibrosis and recurrent obstruction. The advantage of this approach includes preservation of the lateral endopelvic fascia and urethropelvic ligament, which provides continued urethral support, thereby minimizing the risk of recurrent stress incontinence. In addition, the obstructing sling or sutures may be more easily identified and divided. In the original description, Petrou et al.[80] reported a 65% success rate in treating urinary retention, and 67% of those with urinary urgency had resolution of this symptom. Carr and Webster[41] used the suprameatal approach in a subset of their patients observing a successful outcome in only one of four patients undergoing this technique.

The role of retropubic urethrolysis has diminished with the development of transvaginal techniques; however, it has a role in cases of recurrent or persistent obstruction. The goal of a retropubic urethrolysis is to restore mobility to the urethra, bladder neck, and anterior vaginal wall. A low Pfannenstiel incision is made to gain access to the retropubic space of Retzius. Once exposed, all of the retropubic adhesions are sharply incised, and all suspension sutures and sling materials are completely divided. By releasing the fibrous attachments to the pubic symphysis, vesicourethral mobility is facilitated. With significant scarring and fibrosis, the dissection may need to be taken laterally to create a paravaginal defect. A formal paravaginal repair was then performed in the original series. Intraoperatively, a Crede maneuver demonstrating free flow of urine through the urethral meatus confirms urethral patency. If paravaginal sutures have been placed and prevent the free flow of urine, they are released. In their original description, Webster and Kreder[81] created a peritoneal window, and a pedicled omental flap was placed as an interposition graft to prevent readherence. Outcomes with retropubic urethrolysis are excellent, with resolution of preoperative voiding dysfunction achieved in 93% of patients, and 13% had recurrent SUI.[81] Carr and Webster[41] used a retropubic approach in 65% of clinically obstructed patients with postoperative voiding dysfunction, and noted successful outcomes in 86%.

Conclusion

Suburethral slings are an important part of the pelvic surgeon's armamentarium for the treatment of stress urinary incontinence. However, as with all procedures, it is not without its complications. The key to appropriate treatment of these complications begins first by recognizing the potential for these problems, followed by the appropriate workup and selection of therapy. The ease in performing the procedures should not lull surgeons into thinking that the procedures are without their complications. Patients and their physicians should understand the potential for these complications before choosing this procedure, keeping in mind that this therapy is for the treatment of a quality-of-life issue.

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14

Reoperative Surgery for Anal Incontinence

Christina J. Seo, Steven D. Wexner, and G. Willy Davila

The plague of fecal incontinence with its associated social and economic encumbrances has fueled a drive over the past few decades to find new innovations in its management. Numerous surgical therapies have been developed and advanced to help ameliorate this problem and improve the quality of life of the patients who suffer from it. Despite these advances, the need for reoperation exceeds 50% of patients who undergo these procedures. Therefore, the colorectal surgeon must have surgical options to restore or improve anal continence after failure of a primary, secondary, or tertiary repair. Indications include obstetric and other iatrogenic trauma, noniatrogenic trauma, imperforate anus and other congenital abnormalities, as well as neurogenic and idiopathic fecal incontinence.

After the failure of a primary operation, the patient can be evaluated and often treated in the much same manner as a patient who has not undergone surgery. The same tests, including anorectal manometry with rectal capacity and compliance testing, cinedefecography, endosonography, magnetic resonance imaging (MRI), electromyography with pudendal nerve latency assessment, and endoscopy, can still be useful in determining which secondary repair remains an option for the patient. The initial management can also begin conservatively, depending on the severity of symptoms. Medical management of diarrhea such as dietary modifications and colonic irrigation are common first-line treatments. Biofeedback therapy can often be an effective modality, improving function in up to 75% of patients, although cure has only been reported in 50%.[1] Balloon training and electrostimulation are also alternatives.

Surgical options are varied and are somewhat dictated by the etiology. An older method, the Thiersch anal encirclement procedure, is now rarely used because of problems with band erosion, though a modified version using Silastic mesh showed some efficacy.[2] While the Thiersch procedure was initially described for patients in full-thickness rectal prolapse, it has also been employed in patients with fecal incontinence, since full-thickness rectal prolapse and fecal incontinence often coexist. The encirclement operation can be effective in either scenario. Anterior sphincteroplasty is well suited for obstetric and iatrogenic disruption of sphincter defects, but is less suitable in a denervated pelvic floor. This technique can initially have good results in 50% to 80% of patients, but function may degenerate over time, resulting in a long-term success rate of only 10% to 15%.[3] Injectable bulking agents, the subject of some recent trials, show promise as a less invasive procedure.[4] The Malone antegrade continence enema (MACE) procedure has also been described for those individuals with neuropathic dysfunction, especially in children with congenital disorders of the colon and rectum.[5] Artificial bowel sphincter, both adynamic and stimulated graciloplasty, and sacral nerve stimulation are other options and are discussed in this chapter. Regardless of what method is used, each is successful to various degrees, and implementation of one or more does not preclude subsequent surgical options. The decision to use one modality over another is based mostly on surgeon training and preference, and multiple techniques may be employed to achieve the final goal of continence. The last resort after repeated treatment failures, a diverting colostomy, is still an option for those patients quality of life cannot be improved by other methods.

Redo Anterior Sphincteroplasty

The choice of procedure, contingent on findings by physical examination, physiologic testing, the history, and a fecal incontinence score such as the Wexner Fecal Incontinence Score (Table 14.1), is a redo sphincteroplasty.[6] Primary anterior overlapping sphincteroplasty is generally the standard first-line surgical therapy for the treatment of sphincter defects, particularly those from obstetric complications or iatrogenic injury from anal or low rectal surgery. The failure rate, defined as the recurrence of symptoms with or without an associated sphincter defect, is only 20% at initial operation but escalates to as high 50% at 5 years from the time of surgery and then up to 85% at 10 years.[7,8] Generally, it is advisable to wait at least 6 months, and preferably 12 months, following the initial sphincteroplasty procedure before attempting the second. Ample time is needed to allow edema and friability to subside and enhance fibrosis, especially of the divided sphincter ends.

This operation is generally undertaken with the patient in the prone-jackknife position. A transverse incision over

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TABLE 14.1. Wexner Fecal Incontinence Score.

Type of incontinence	*Never*	*Rarely (<1/mo)*	*Sometimes (<1/wk, >1/mo)*	*Usually (<1/mo, 1/day)*	*Always (>1/day)*
Solid	0	1	2	3	4
Liquid	0	1	2	3	4
Gas	0	1	2	3	4
Wears pad	0	1	2	3	4
Alters lifestyle	0	1	2	3	4

0 = perfect continence; 20 = complete incontinence.

Source: From Jorge and Wexner,[6] with kind permission of Springer Science + Business Media.

the perineal body exposes the sphincters and the scar from the prior defect. The scar is then divided and each end mobilized enough to allow overlap and be secured in the "forward 6" or "reverse 6" configuration, best seen on endoanal ultrasonography. It is important to note that great care should be taken to preserve rather than excise any scar. The incision is then closed, leaving an open area in the center for drainage and healing by secondary intention (Fig. 14.1).

Repeat overlapping sphincteroplasty is by far the most common and least morbid method of restoring anal function provided a residual or recurrent sphincter defect is present. There may be some trepidation in repeating this procedure after an initial breakdown, but the success rates after a secondary sphincteroplasty have proven to be similar to those after the initial surgery.[9,10] One study from Cleveland Clinic Florida showed that bowel function, as measured by the CCF/FISS, was equivalent in patients who underwent initial repair with those who had reoperation. However, the authors noted that success rates declined somewhat after three or more attempts (Table 14.2).[11]

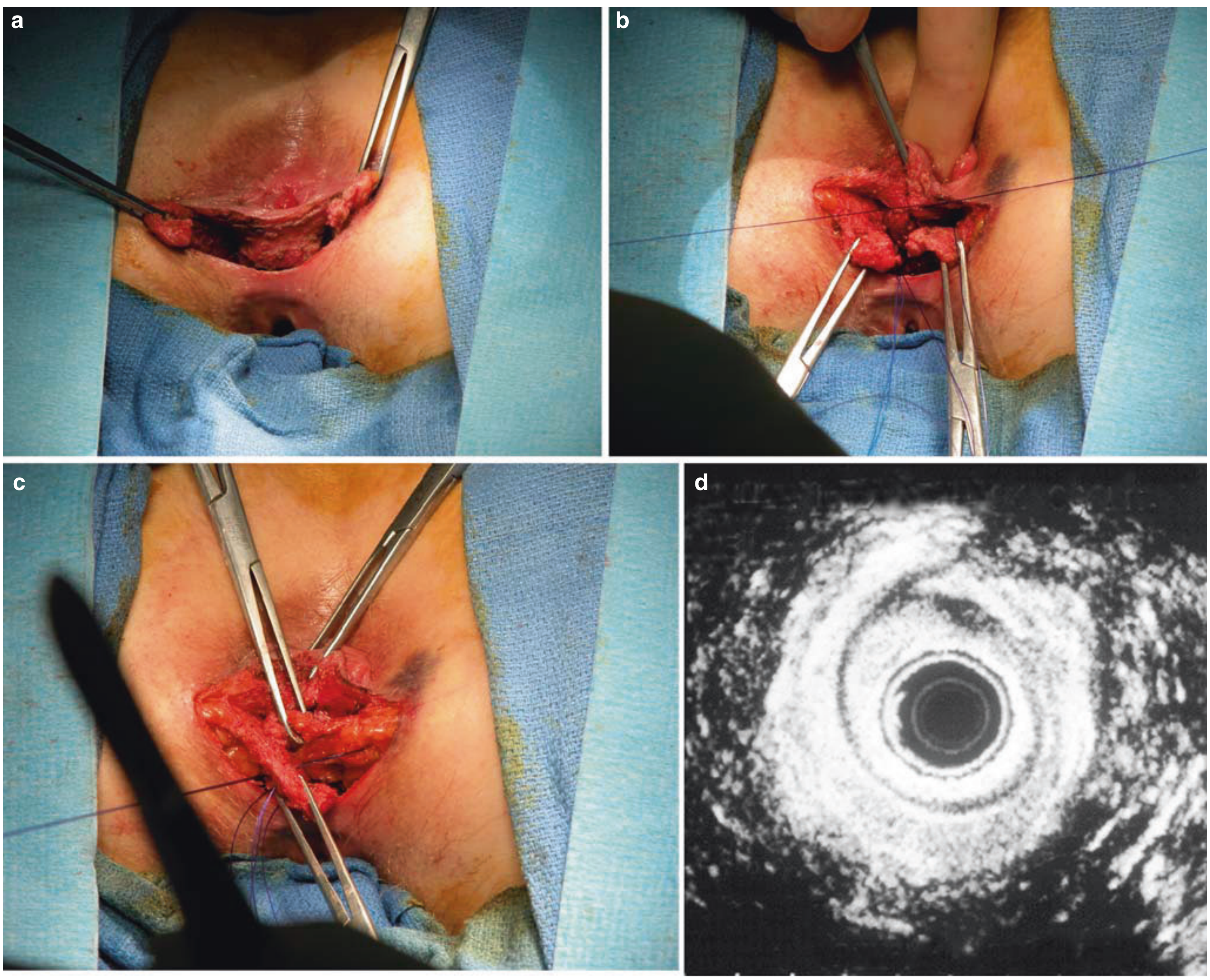

FIGURE 14.1. Overlapping sphincteroplasty. (**A**) Exposure of external anal sphincter and division of scar. (**B**) Posterior levatorplasty. (**C**) Overlapping of cut ends external anal sphincter. (**D**) Appearance of overlapping sphincteroplasty on postoperative endoanal ultrasound in a "figure-6" configuration.

TABLE 14.2. Repeat Sphincteroplasty Series.

Author	*Year*	*Patients (n)*	*Good outcome (%)*
Yoshioka[13]	1989	7	4 (57.1)
Pinedo[10]	1999	23	15 (65.2)
Giordano[11]	2002	36	18 (50)
Vaizey[9]	2004	21	13 (61.9)

Some relative contraindications do exist for a repeat sphincteroplasty operation, which are essentially the same as for the initial surgery. The lack of a clinical, radiologic, or endoscopically documented defect in the sphincter complex is predictive of poor results. Results also tend to be worse when there are sphincter defects in quadrants other than the anterior segment, which is usually where these defects are seen with obstetric injury. Preoperative defects in lateral or posterior quadrants tend to show persistent defects on postoperative ultrasonography. An overlapping repair functions by restoring the high-pressure zone of the anal canal, but deficits in the innervation to the reapproximated muscle may result in continued postoperative symptoms. The physical overlapping of the sphincters by itself may improve symptoms, however, so that even patients with significantly delayed pudendal motor latencies or undetectable electromyographies may still benefit from this procedure. Therefore, given the relatively low morbidity and technical facility of sphincteroplasty it is always offered as an option even to patients with severe pudendal neuropathy. Should this approach be selected by such patients, they are usually counseled that their prognosis is worse than if they had bilaterally normal nerve function.

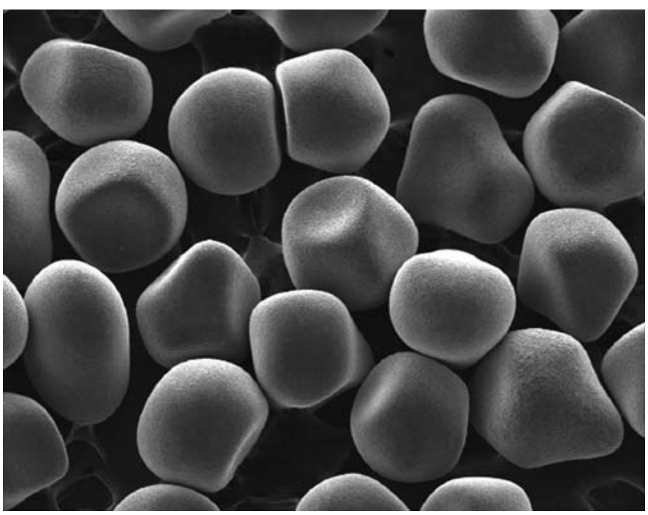

FIGURE 14.2. Injectable carbon beads.

The injection of biomaterials such as carbon or silicone has been used with varying degrees of success in the area of urinary incontinence. These materials have also been employed in institutional review board–approved trials for the treatment of fecal incontinence and can be used as an adjunct to a sphincter repair, by passively working to increase anal bulk and tone (Fig. 14.2). Studies to assess the efficacy and safety of some of these products are still underway, although initial trial results have been promising (Table 14.3).[12]

While not standard for an initial anterior sphincteroplasty, some consideration should be given to a diverting stoma with a secondary or tertiary repair. Fecal diversion may be helpful in wound healing following reoperative surgery, with the ideal goal of stoma reversal after complete healing. There is little evidence-based medicine to support this method; however, the surgeon's judgment may factor into its utility at the time of a third or more reoperation.[13–15] In general any patient with an isolated anterior defect has the potential to benefit from, and therefore should be offered, an overlapping sphincteroplasty. All of the remaining options discussed in this chapter can be potentially offered to patients who have had anatomic success but functional failure following overlapping sphincteroplasty. In addition, patients who have no defect, multifocal defects, or neuropathic or idiopathic incontinence may benefit from any of the remaining procedures.

Postanal Repair

A less often used but sometimes useful repair of posterior sphincter defects, the postanal approach, is an option for failed sphincteroplasty. Postanal repair is a useful procedure in patients without a documented sphincter defect, or ironically in those with multifocal sphincter defects, and in those individuals whose incontinence is either idiopathic or neurogenic.[16] One of the main advantages of this method is that it avoids the scar tissue created from an anterior

TABLE 14.3. Injectables.

Injectable	*Trade name*	*Author*	*Success rate (%)*
Polytetrafluoroethylene	Teflon, Polytef	Shafik[41]	7/11 (63.6)*
Autologous fat	N/A	Shafik[42]	14/14 (100)*
Collagen	Contigen	Kumar[43]	11/17 (64.7)
		Stojkovic[44]	46/73 (63.0)
Silicone	Bioplastique	Maluof[45]	2/10 (20.0)*
		Tjandra[46]	45/82 (54.9)
Carbon	Durasphere	Weiss[47]	6/10 (60)
Dextranomer/hyaluronic acid	Q-Med	Trial ongoing	N/A

*Some after multiple injections.

repair. The exposure it affords is quite extensive, as noted by surgeons who have used it for resection of rectal or presacral tumors. It has also been preferentially used after low anterior resections for patients in whom fecal incontinence was thought to be a late complication due to the transanal stapling technique.[17]

The postanal repair approach is through a transverse or U-shaped incision approximately 5 to 8 cm posterior to the anal verge with the patient in either the prone position or the high lithotomy position with steep Trendelenburg. The intersphincteric plane is entered and the Waldeyer's fascia is incised. The sphincter repair is undertaken in conjunction with the apposition of the pelvic floor muscles posterior to it, namely the ileococcygeus, pubococcygeus, and puborectalis (Fig. 14.3).[18]

Parks et al.[19,20] reported the first major series of the results from these surgeries, with a success rate of more than 80%. He attributed much of the success of this technique to the restoration of the anorectal angle, although this did not prove to be a factor in subsequent studies.[21] In 1984, Keighley's[22] series of 89 patients reported a complete success rate of 63%, with 21% claiming some improvement, while 16% had no improvement; the most common reason for lack of improvement was related to wound sepsis. Another factor seemed to be male gender; 50% of the male subjects did not report improvement after the operation at 6 months follow-up. In a subsequent study in 1999, Yoshioka and Keighley[23] evaluated 124 patients over a mean of 5 years. While overall incontinence and bowel frequency was found to be improved, manometric pressures did not change, with postoperative continued complaints of urgency and seepage, which led the authors to conclude that the long-term results of this repair were in fact poor. A more recent single-surgeon series from Cleveland Clinic Florida reported a similarly poor 3-year success rate of 35%. However, the authors also concluded that a morbidity rate of below 5% and a mortality rate of 0% made the operation an attractive option in selected patients (Table 14.4).[16]

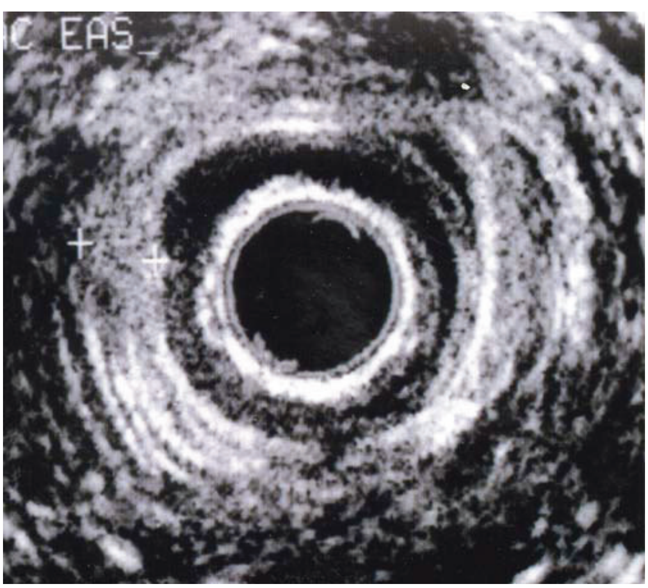

FIGURE 14.3. Endoanal ultrasound of prefecal incontinence without obvious defects.

TABLE 14.4. Postanal Repair Series.

Author	*Year*	*Patients (n)*	*Excellent/ good outcome (%)*
Parks[19]	1966	–	–
Browning and Parks[20]	1983	42	34 (81.0)
Keighley[22]	1984	105	56 (63.0)
van Vroonhaven[48]	1984	16	12 (75.0)
Ferguson[49]	1984	9	6 (66.7)
Henry and Simson[50]	1985	204	118 (57.8)
Habr-Gama[51]	1986	42	22 (52.3)
Womack[52]	1988	16	14 (87.5)
Yoshioka[23]	1989	116	94 (81.0)
Scheuer[53]	1989	39	17 (43.6)
Rainey[54]	1990	42	13 (31.0)
Orrom[55]	1991	17	10 (58.8)
Engel[56]	1994	38	19 (50.0)
Setti-Carraro[57]	1994	34	9 (26.5)
Jameson[58]	1994	36	10 (27.8)
Tsugawa[59]	2000	16	12 (75.0)
Matsuoka[16]	2000	20	7 (35.0)
Abbas[60]	2005	44	30 (68.2)
Shafik[61]	2007	19	10 (52.6)

Postanal repair is a technically easy, low-risk procedure that is far less expensive and complex than are muscle transpositions, neuromodulation procedures, injectable, or the artificial bowel sphincter.

Pediatric surgeons who perform colorectal surgery on children with congenital malformations such as imperforate anus and persistent cloaca use various approaches to repairing complex anal variations. It has been suggested that some of these techniques might be used on adults with acquired complications. The posterior sagittal approach was described in great detail by Alberto Peña in his Harry E. Bacon Lectureship published in 1994, in which the malformed rectum and anus is surgically redirected into the sphincter complex, often requiring division of the sphincters to complete the operation.[24] Interestingly, in Peña's experience of nearly 700 procedures, there was no observed decrease in fecal continence with the latter procedure. This technique and others have often been successful in the management of fecal incontinence in patients who have already undergone one or several prior attempts at repair, or who have experienced complications from prior surgeries. Candidates for this approach must have evidence of normal pelvic musculature and sacral structure. However, this technique has thus far remained the exclusive domain of pediatric surgeons. There are no criteria by which to establish inclusion or exclusion criteria or to evaluate results in adult patients.

Gluteoplasty

Several methods of reconstructing the sphincter complex with autologous muscle have been attempted, with varying popularity and success. One of the first muscle flaps used with this procedure was the gluteus maximus. Its proximity to the anus and overall strength seemed to make it an attractive choice. Different methods in creating the flaps

TABLE 14.5. Gluteoplasty Series.

Author	*Year*	*Patients* (n)	*Good results (%)*
Chetwood[26]	1902	1	1 (100)
Schoemaker[29]	1909	6	6 (100)
Bistrom[27]	1944	3	2 (66.7)
Prochiantz and Gross[62]	1982	15	9 (60.0)
Hentz[28]	1982	5	4 (80.0)
Chen and Zhang[63]	1987	6	3 (50.0)
Pearl[64]	1991	7	4 (57.1)
Christiansen[65]	1995	7	0 (0)
Devesa[30]	1997	17	9 (52.9)
Madoff[31]	1999	11	5* (45.5)
Hultman[66]	2006	25	18 (72.0)

*Gluteoplasties were electrically stimulated.

have been described, but most are adynamic and involve local transfer of the muscle around the anal canal.[25] Since Chetwood[26] first described this technique in 1902, many variations on the theme have been developed over the last century. The muscle-splitting wrap by Bistrom,[27] the keyhole by Hentz,[28] the 180-degree bilateral wrap by Schoemaker,[29] and the pantaloon by Devesa et al.[25] are possible configurations with which to surround the sphincters. Naturally, the greatest concern with these methods is suture line tension and preservation of neurovascular supply. The most common morbidity associated with this procedure, however, is wound infection (Table 14.5).[30]

The patient is placed in the prone-jackknife position and incisions are made on each side of the anus and over each gluteus incision into the sacrum. The lower 10% to 15% of each gluteus, with its intact fascia, is longitudinally split and wrapped around the anus as deeply as possible. The longitudinally split fascia is then sutured to itself on the contralateral side. All wounds are closed in layers over drains.

The gluteus muscle has fallen somewhat out of favor in recent years with the advent of the graciloplasty. Unlike the gracilis muscle, the gluteus maximus is essential to range of motion, namely in extension and abduction of the thigh. It is broad-based and is less amenable to wrapping around the anal canal than the slimmer and more mobile gracilis. Lastly, it remains a skeletal muscle and cannot maintain tonic contraction as effectively as a stimulated graciloplasty, which is described later in this chapter. The results that Madoff et al.[31] observed when using stimulated gluteoplasty were no better than those results of unstimulated gluteoplasty. However, muscle transposition gluteoplasty is still a useful modality for patients who have failed other measures.[18] Specifically, patients who have experienced anatomic success but continue to experience functional failure as well as patients with no defect or multifocal defects may be candidates. The surgeon must be careful to harvest only the lower 10% to 15% of each muscle due to its bulk. Moreover, there is little ability to gain additional length if needed.

Graciloplasty

Graciloplasty is rarely a first-line surgical treatment for fecal incontinence, but is another option for the same group of patients with end-stage fecal incontinence in whom the only remaining option would be a permanent stoma. Graciloplasty is most helpful for those patients who congenitally or iatrogenically lack a sphincter complex, those individuals who have a structurally normal but neuropathic sphincter, or those operative candidates who have a sphincter that cannot be repaired in any of the more conventional ways, such as in a case of multifocal sphincter defects.

The gracilis muscle has redundancy in function, rendering it non-essential for locomotion or stability of the lower extremity. It is also superficial in the thigh, usually has adequate length, and relies upon a single proximal neurovascular supply. The main disadvantage is that, like the gluteus, it is a skeletal, fast-twitch, easily fatigable muscle that needs to function as a chronically contracted sphincter. It was found that stimulating a skeletal muscle with a slow-twitch, fatigue-resistant muscle nerve would slowly transform the fibers of the skeletal muscle to the fatigue-resistant type. Similar results were found using electrical stimulation at a low frequency; the skeletal muscles resembled sphincter muscles after chronic inducement.[32] The results of the nonstimulated graciloplasty are detailed in Table 14.6, and of the stimulated graciloplasty in Table 14.7.

For the graciloplasty procedure, the patient is placed in the lithotomy or frog-leg position on the side of the muscle harvest. An incision is made near the insertion of the gracilis distally on the medial tibia. The tendon and muscle are identified by their superficial position and proximity to the groove posterior to the quadriceps muscles on the inner thigh. The muscle is then isolated and followed proximally, taking care to recognize and divide the perforating vessels. A midthigh counter-incision may be required to completely mobilize the muscle. The tendon is then divided from the tibial attachments and brought through the incisions to the groin. The neurovascular pedicle is identified and protected. With the legs in high lithotomy position, either a perineal incision or two incisions on either side of the sphincter complex are made. The sphincter complex is dissected away from the surrounding perineal tissue by a combination of blunt dissection and electrocautery. The tunnel should be as lateral and as cephalad to any preexisting sphincter as possible to help limit the opportunity for erosion through the perineal wound or into the anus. The gracilis muscle is then delivered and wrapped around the anal canal in the newly created tunnel and anchored into an alpha, epsilon, or gamma configuration to the contralateral

TABLE 14.6. Nonstimulated Graciloplasty Series.

Author	*Year*	*Patients* (n)	*Good results (%)*
Simonson[67]	1976	22	19 (86.4)
Leguit[68]	1985	10	9 (90.0)
Corman[69]	1985	22	18 (81.8)
Wang[70]	1988	5	4 (80.0)
Yoshioka[23]	1989	6	0 (0)
Christiansen[71]	1990	13	10 (76.9)
Faucheron[72]	1994	22	19 (86.4)
Silezneff[73]	1996	8	8 (100)

Source: Adapted from Rotholtz and Wexner;[74] with permission.

TABLE 14.7. Stimulated Graciloplasty Series.

Author	*Year*	*Patients* (n)	*Good results* (%)	*Morbidity* (%)
Kosten[75]	1993	26	17 (65.4)	11 (42.3)
Baeten[76]	1995	52	38 (73.1)	7 (13.5)
Kumar[77]	1995	10	9 (90.0)	5 (50.0)
Wexner[78]	1996	10	6 (60.0)	n/a—10 events*
Wexner[79]	1996	15	9 (60.0)	15 (100)
Mavrantonis[34]	1999	27	13 (48.1)	22 (81.5)
Mander[35]	1999	52	29 (55.8)	22 (42.3)
Madoff[31]	1999	128	85 (66.4)	n/a—138 events*
Rongen[80]	2003	200	145 (72.5)	138 (69.0)
Pennickx[33]	2004	60	47 (78.3)	44 (73.3)

*Authors list morbidity by events; multiple events may have occurred in individual patients.

ischial tuberosity; the incisions are then closed (Fig. 14.4). The insertion of the electrostimulator can be undertaken during the same surgery or at a later date.

Unfortunately, Food and Drug Administration (FDA) approval of the stimulator, leads, and electrodes was not pursued by the manufacturer (Medtronic Stimulator, Medtronic, Inc., Minneapolis, MN) (Fig. 14.5). Thus, the electrostimulator is no longer available in the United States, as the stimulator, leads, and electrodes are used to convert the fast-twitch muscle into a slow-twitch muscle by chronic stimulation. Connecting the gracilis muscle to electrodes that were tunneled through the skin and into the muscle for a time prior to repair slowly changed the nature of the skeletal muscle to that of a tonically contracted smooth muscle, making it more suitable as a substitute sphincter. Stimulation continued afterward as the source was tunneled subcutaneously, with the electrodes still in place. The main difficulty arose from the conjunction of a foreign object with a surgical field in the perianal area and the mechanical and infectious complications inherently possible.

The Belgian experience reflects the challenging nature of this procedure.[33] This study of 60 patients who underwent this surgery included 75 complications requiring 61 surgeries—on average, one extra surgery for each graciloplasty. At long-term follow-up, however, the success rate was 66%, illustrating the high morbidity rate associated

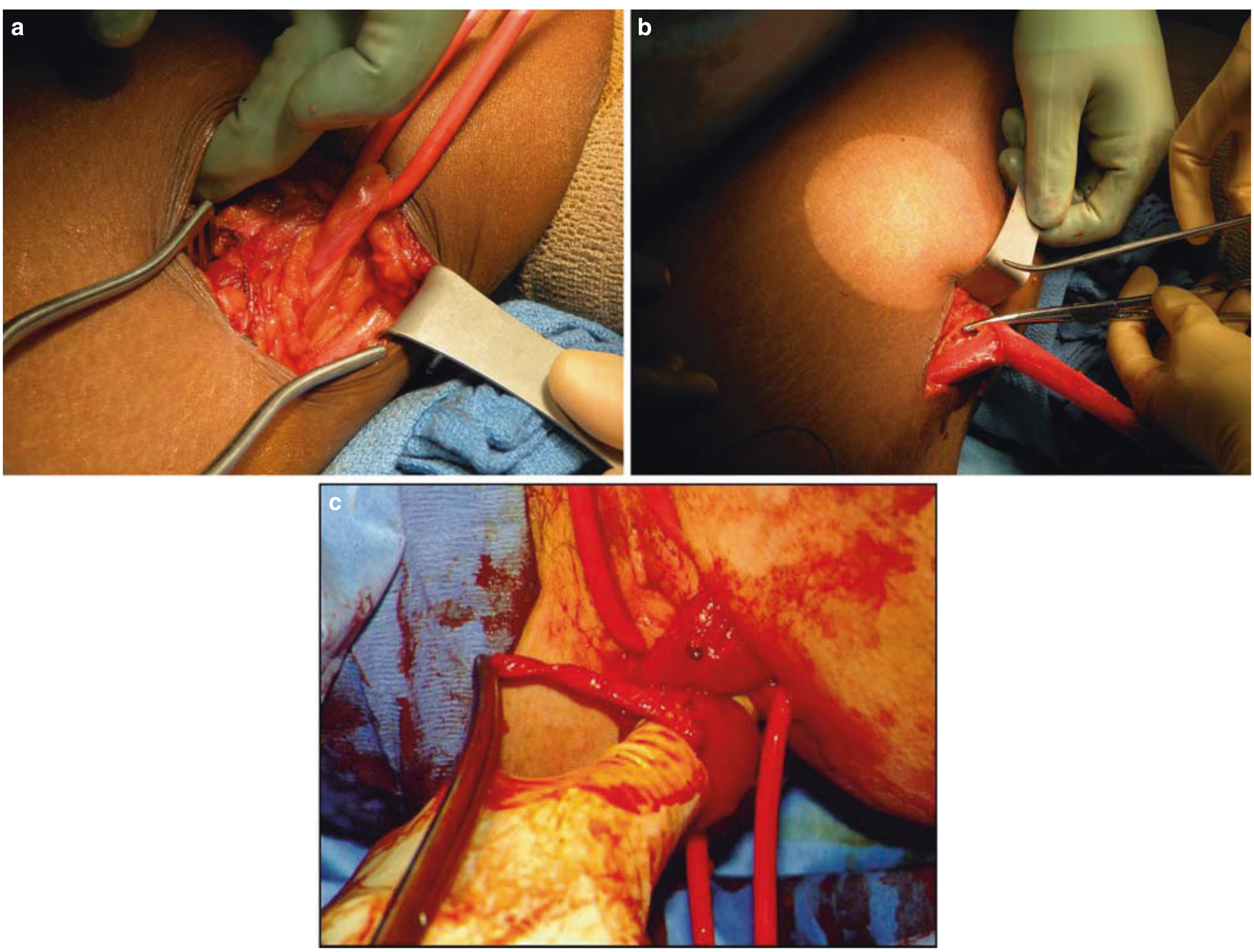

FIGURE 14.4. Gracilis interposition. (**A**) Exposure of tendinous insertion of gracilis muscle at knee. (**B**) Ligation of perforations to gracilis muscle. (**C**) Determination of configuration of gracilis wrap.

FIGURE 14.5. Electrical stimulator for gracilis transposition. (With permission of Medtronic, Inc., © 2008.)

with this procedure. Most studies describe a success rate of 42% to 85%, with morbidity rates per patient similar to those of the Belgian study. However, by some calculations, it may overall be more cost-effective than a permanent stoma, which is still remains the alternative to a failed graciloplasty.[32]

Other authors have reported similar results. Mavrantonis and colleagues[34] from Cleveland Clinic Florida found that the method of stimulation affected the success of the graciloplasty. Specifically, the direct nerve stimulation technique of Williams (NICE Technology, Inc., Fort Lauderdale, FL) was associated with increasing impedance secondary to perineural fibrosis. The indirect (intramuscular) technique of Baeten (Medtronic, Inc., Minneapolis, MN) had no such problem. Mander et al.[35] had a success rate of 56% after closure of the diverting ileostomy; however, their population experienced 16 hardware-related complications and 27 battery-related problems during follow-up.

An international forum, the Dynamic Graciloplasty Therapy Study Group, reviewed the complications associated with this surgery, and the impact of these complications on continence. Their census of 121 patients had a total of 211 adverse events in 93 patients; 89 were named severe in nature, requiring hospitalization or reoperation.[33] The consensus was that although excellent results could be achieved in some patients, a very high morbidity was expected.

Because of the surgical involvement of a lower extremity and the need for postoperative bed rest, thromboembolic events are known complications. Thus, appropriate deep venous thrombosis prophylaxis with anticoagulation or sequential pneumatic compression devices is strongly encouraged.

Dynamic graciloplasty has also been used to reconstruct the sphincter mechanism after the excision of the anal sphincters during oncologic surgery such as abdominoperineal resection. It is a necessary step in the complex creation of a neo-rectum and pelvic floor for anal defecation after total exenteration or abdominoperineal resection. Although rarely performed, it is an option for those very specific patients who are young, concerned about the aesthetic result, in good health, and willing to learn to manage the reconstructed pelvic anatomy to achieve relatively normal function. It can also be combined with a colocutaneous anastomosis.

Both the nonstimulated and the stimulated graciloplasty procedures can be performed as either unilateral or bilateral muscle transpositions. Graciloplasty may have several advantages over gluteoplasty. First, more opportunity exists to gain length both along the tendon and at the neurovascular pedicle. Second, the muscle thickness is predetermined as the entire muscle is harvested and transferred. Conversely, significant judgment must be exercised in the harvest of the appropriate amount of the gluteus muscle. Third, the gracilis is wrapped 360 degrees around the anus, which seems more physiologic than the 120-degree coverage of each gluteus muscle. Fourth, the single proximal neurovascular pedicle can be better stimulated than the gluteus.

Sacral Nerve Stimulation

A modification of a procedure done by urologists for urinary incontinence, the sacral nerve stimulator (SNS) (Medtronic, Inc., Minneapolis, MN) has been shown to simultaneously improve fecal incontinence through neuromodulation. Patients undergoing treatment for one problem often have other pelvic dysfunction, and it was noted incidentally that after SNS for urinary incontinence, there was also improved control of feces. It is thought that the stimulated pelvic floor muscles that control urinary continence also affect fecal continence. This stimulation works more centrally than the stimulator for a gracilis or gluteus transposition; the leads are placed at the third sacral foramina. A temporary lead is placed to evaluate its possible efficacy in the long term. Once the patient is seen to have improvement in symptoms, the leads can be exchanged for a permanent stimulator. This modality seems to improve not only the muscular function of defecation, but unlike other procedures, also rectal sensation, thereby affording even more control.[12] The improved sensory and motor function is attributable to neuromodulation.

Preliminary testing of the SNS is done to ensure that the placement of a permanent electrode will continue to function appropriately. In the operating room, the patient is placed in the prone jackknife position; no paralysis is administered by anesthesia. The second, third, and fourth sacral foramina are identified and a needle placed into each. A

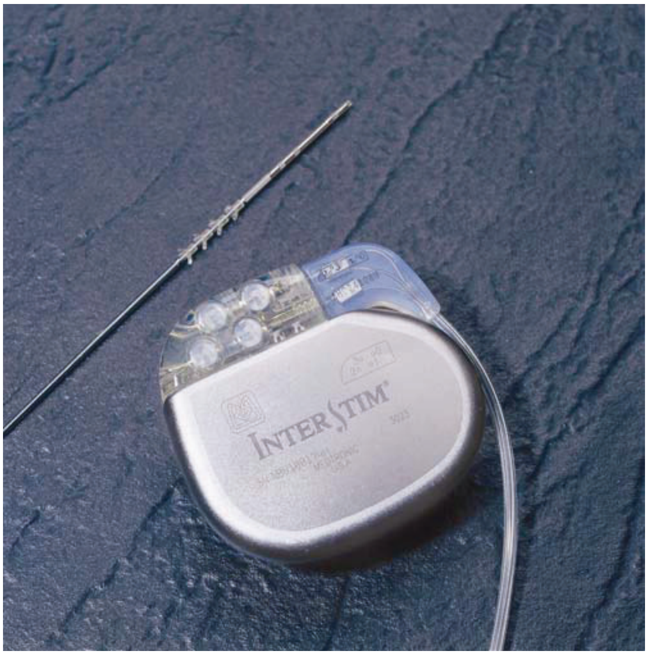

FIGURE 14.6. SNS InterStim device. (With permission of Medtronic, Inc., © 2008.)

stimulator is then attached and the contraction of the perineal muscles and the ipsilateral first toe is observed. The weakest signal to elicit these reflexes is noted, as is the foramen with the best response. A lead is then passed through the needle and attached to the skin.

At a later date, once sufficient stimulation is noted with the temporary electrode, a permanent replacement is passed through the same foramen as the original lead, and then tunneled to the buttock on the same side. At that site, a pocket is created to hold the pulse generator and the lead attached. Finally, it is activated while the patient is awake postoperatively.

Variations to the above method include percutaneous placement of the leads, or placement of the permanent pulse generator at the first surgery rather than using a temporary electrode.[36]

Interestingly, in a double-blinded crossover study, the efficacy of the stimulator was tested by setting the device to "on" or "off" with each limb for 1 month. The observation of symptomatic improvement by the patients and documented by the staff correlated well with the actual status of the stimulator, thereby proving that a functional device was more effective than placebo (Fig. 14.6 and Table 14.8).[37]

The SNS method shows great promise and significant results in complete or improved continence. As with the stimulated graciloplasty, the stimulator and the electrode are currently not available in the United States. It is hoped that the very promising results of the recently updated 120-patient institutional review board–approved FDA-supervised trial will result in availability of this technique. However, even when available the cost of these devices (for both stimulated graciloplasty and SNS) may be prohibitive, and nonstimulated graciloplasty, gluteoplasty, and postanal repair still remain more cost-effective options.

TABLE 14.8. Sacral Nerve Stimulation Series.

Author	*Year*	*Patients* (n)	*Good results (%)*	*Complete continence (%)*
Matzel[81]	1995	3	3 (100)	2 (66.7)
Vaizey[82]	1999	9	8 (88.9)	7 (77.8)
Malouf[83]	2000	5	5 (100)	n/a
Matzel[84]	2001	6	6 (100)	n/a
Ganio[85]	2001	25	22 (88.0)	11 (44)
Kenefick[86]	2002	15	15 (100)	11 (73.3)
Jarrett[87]	2004	46	45 (97.8)	n/a
Kenefick[88]	2006	19	19 (100)	14 (73.7)
Hetzer[89]	2007	37	34 (91.9)	n/a
Holtzer[90]	2007	29	28 (96.6)	n/a

Artificial Bowel Sphincter

The artificial bowel sphincter (ABS) (American Medical Systems®, Minneapolis, MN) is another method for end-stage fecal incontinence. ABS is usually considered after other treatment options have failed and is especially feasible in those patients whose incontinence is due to neurologic damage or disorders.[38] In addition, it is also possible to offer the patient a repeat ABS after a failed one has been explanted.

The function of the ABS is to behave as a true, tonically contracted anal sphincter, directly controlled by the patient. Its greatest advantage is its ability to allow the patient to evacuate normally and discreetly, and thus keep some socially acceptable schedules.

There are three major parts that are pressurized by fluid and connected by plastic tubing. The first is the cuff, which is most like the native sphincter, which is wrapped around the anal canal. The balloon is a reservoir filled with radio-paque fluid buried in the subfascial plane over the bladder. The pump is connected to both the balloon and the cuff and controls the flow of fluid between them. This is placed in the scrotum or labus majorus of the patient and can be manipulated by the patient to inflate or deflate the cuff (Fig. 14.7). The results are presented in Table 14.9.

Perioperative intravenous antibiotics are continued during the hospital stay, followed by outpatient oral antibiotics. The ABS is deactivated for at least 6 weeks after implantation to promote healing and incorporation, and then activated after confirmation of wound healing.

Morbidity associated with this apparatus includes post-operative infection, constipation, pain, and cuff slippage or erosion. These problems usually require explantation or at least surgical revision of one or more components. The explantation rate can range anywhere from 16% to 41%, including those cases in which multiple ABS devices were explanted, reimplanted, and reexplanted.[39] It is not unreasonable to revise a portion of the system in cases of erosion of the tubing or cuff through the skin; however, it may ultimately require explantation of the entire ABS at a later date. Conservative measures have been successful at managing postoperative hematoma and superficial dehiscence.[40] Malfunction of the cuff is also possible, by leakage of fluid, failure to deflate, or unbuttoning; these problems generally require operative intervention. This procedure is

FIGURE 14.7. Artificial bowel sphincter.

technically much easier than either the gluteoplasty or graciloplasty but more challenging than the SNS.

Gynecologic Approaches to Fecal Incontinence

The gynecologic approach to fecal incontinence has always been focused on restoration of anatomic integrity to the external anal sphincter musculature. This is in sharp contrast to the colorectal approach, which is based on a functional assessment of the fecal continence mechanism. As such, gynecologists have traditionally addressed recurrent fecal incontinence with a repeat sphincteroplasty. Various reasons underlay this marked difference in philosophy.

TABLE 14.9. Artificial Bowel Sphincter Series.

Author	*Year*	*Patients (n)*	*Good results (%)*	*Reoperation/ explant (%)*
Christiansen[91]	1987	5	n/a	n/a
Christiansen[38]	1992	12	8 (66.7)	4 (33.3)
Lehur[92]	1996	13	9 (69.2)	4 (30.8)
Wong[93]	1996	12	9 (75.0)	4 (33.3)
Christiansen[94]	1999	17	7 (41.1)	9 (52.9)
Lehur[95]	2000	24	18 (75.0)	7 (29.2)
Savoye[96]	2000	12	12 (100)	n/a
Altomare[97]	2001	28	21 (75.0)	7 (25.0)
Lehur[98]	2002	16	11 (68.8)	4 (25.0)
Devesa[99]	2002	53	43 (81.1)	10 (18.7)
Ortiz[39]	2002	22	5 (22.7)	11 (50%)
Wong[100]	2002	112	52 (46.4)	51 (45.5)
Michot[101]	2003	37	19 (51.4)	11 (29.7)
Romano[102]	2003	8	7 (87.5)	n/a
Parker[103]	2003	45	23 (51.1)	18 (40.0)
Casal[104]	2004	10	9 (90.0)	3 (30.0)
Altomare[105]	2004	28	3 (10.7)	16 (57.1)

Bias Toward Obstetrical Surgical Experience

To most obstetricians/gynecologists, repair of a sphincter laceration at the time of the vaginal delivery is a simple procedure, commonly delegated to a lower level resident. After perineal trauma resulting from vaginal delivery, "reapproximating" the sphincter edges is deemed a very simple procedure. Fortunately, most women do well with this simple repair and the rate of postpartum fecal incontinence is much lower than one would expect after that degree of trauma. Postoperative sonographic evaluation has revealed that an obstetrical-type repair of the sphincter laceration is suboptimal. In fact, there is an underlying occult anal sphincter tear rate, which is not identified in the intrapartum process likely due to the lack of an overlying tissue tear.

Lack of Experience with Sonographic and Functional Assessment Tools

Obstetricians/gynecologists, although significantly versed in the use of ultrasound for obstetrical and gynecologic indications, do not perform endoanal ultrasound to assess the anal sphincter. Instead, this test has been limited to the realm of colorectal surgeons. However, this expertise should require a simple training process for obstetricians/gynecologists, although this has not yet occurred to date. In addition, neurophysiologic evaluation is not typically performed by gynecologists. As such, gynecologists generally resort to a simple anatomic assessment.

Absence of Colorectal Expertise in Many Communities

As early as during residency training, most obstetricians/gynecologists are not exposed to the scope of practice of colorectal surgery, especially as it is related to fecal incontinence. These colorectal-type clinical problems are typically kept "in-house" and thus obstetricians/gynecologists are not exposed to the potential referral to another clinician with expertise in this area. In addition, many communities lack a colorectal surgeon who is well versed in the sonographic and functional evaluation of the anal sphincter mechanism. Furthermore, if indeed there is a colorectal surgeon within the community, many do not have an interest in defecatory dysfunction in women.

The advent of the subspecialty of Urogynecology and Reconstructive Pelvic Surgery has created an increased level of awareness regarding the intricacies of the fecal continence mechanism in women. As more urogynecologists are trained and practicing within a given community, it is clear that recurrent fecal incontinence will be seen in a more comprehensive manner by practicing obstetricians and gynecologists. It is likely that an obstetrician/gynecologist will need to attain subspecialty training in urogynecology in order to reach a level of comfort in the repair of a recurrent anal sphincter tear. Despite changes in practice style and greater availability of urogynecologists, it is unlikely that the practicing obstetrician/gynecologist will add the treatment of recurrent fecal incontinence to his or her clinical practice spectrum.

Reparative Surgery

The gynecologic approach to repair of an anal sphincter tear is simply a modified episiotomy with an attempt at identification of the torn sphincter ends and their reapproximation. This is typically done by clinical examination rather than sonographic evaluation; the patient is placed in a high lithotomy position, after which a small midline incision is made.

For the practicing colorectal surgeon, there are significant differences including surgical exposure due to positioning of the patient and type of incision, which can enhance the ability to reapproximate the ends of a sphincter muscle in an overlapping fashion. There is very limited literature in terms of repair of recurrent anal incontinence by gynecologists.[1,2] However, success rates are not remarkably low, and not significantly different from the long-term success rates reported by colorectal surgeons with increased preoperative evaluation, increased surgical exposure, and more robust reapproximation of the sphincter ends.

Alternate Surgical Approaches

Obstetricians/gynecologists are not typically versed in the performance of bulking agent injections, radiofrequency therapy, artificial sphincter placement, or other novel approaches to sphincter dysfunction—be it fecal or urinary. Urogynecologists do perform a large amount of bulking agent injections; however, the limited success rate with collagen bulking injections for urinary incontinence leads to a significant amount of skepticism regarding the use of bulking agents for fecal incontinence. Limited success with liquid medium continence has led to a reduced acceptance of bulking agents for urinary incontinence. An ideal bulking agent for this purpose does not exist to date.

It is expected that as Urogynecology and Reconstructive Pelvic Surgery expands its clinician base and more obstetric/gynecologic residents are exposed to the appropriate evaluation and management of female pelvic floor dysfunction, recurrent fecal incontinence may well attain a greater level of sophistication as related to obstetric/gynecologic approaches. This, however, will likely be restricted to the clinical scope of practice of trained urogynecologists.

Colostomy

Despite multiple attempts, there are cases in which restoration of complete continence cannot be achieved. Recurrent lapses into incontinence can cause skin breakdown and nonhealing wounds. Even if further repairs were to be contemplated, a period of regeneration of healthy tissue is desirable before attempting further intervention. Fecal diversion, temporary or permanent, is often a safe option for those patients who once again experience incontinence after failed surgical therapy. In these cases, laparoscopic stoma creation is often the preferred modality.

Conclusion

The best approach to addressing patients with persistent fecal incontinence after sphincter repair is to think in an algorithmic method. Figure 14.8 shows that there are fundamentally two groups of patients—one of which has a persistent or recurrent anterior sphincter defect. Generally, this group of patients can undergo repeat overlapping sphincteroplasty, although the success or failure may depend on the status of the pudendal nerves. The second group of patients is made up of individuals in whom the sphincter repair was deemed anatomically successful but who continue to have persistent incontinence. In addition, the second group can include patients with multifocal defects not amenable to sphincter repair. This second group of patients is somewhat more challenging as the options are more extensive than repeat sphincter repair when a persistent or recurrent defect is present. In this group of patients, the decision must be made among the use of injectables, sacral nerve stimulation, artificial bowel sphincter, stimulated or nonstimulated graciloplasty, gluteoplasty, or perhaps a stoma; other options such as the MACE procedure exist. By reviewing the materials

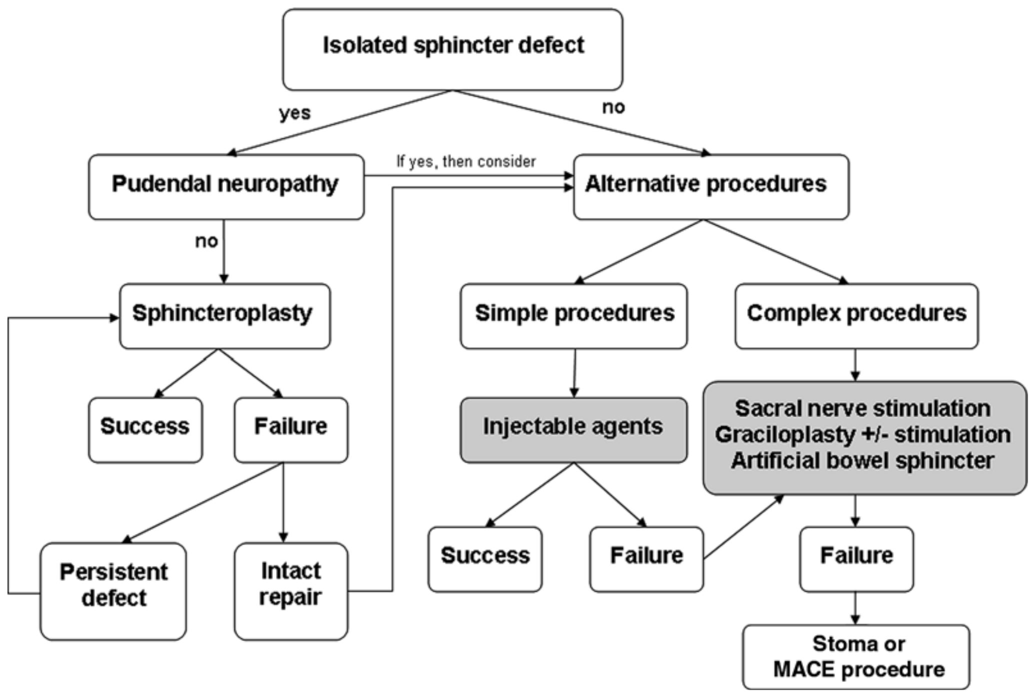

FIGURE 14.8. Algorithm for surgical management of fecal incontinence.

outlined in the tables in this chapter, as well as reviewing each individual patient's respective results of the fecal incontinence score and physiologic testing, an appropriate therapeutic choice can be made.

The number of therapeutic options is testimony to their universal efficacy. In addition, the therapy selected must be tailored not only to the individual patient but also to the individual surgeon. Training and experience in these complex procedures and availability of the resources to undertake them may be limiting steps. Therefore, an additional discussion with each patient may include disclosure that one or more viable options may exist outside of the surgeon's practice. The patient may need to decide between the convenience of a locally performed "simpler" procedure and the expense and inconvenience of a more complex procedure undertaken at a tertiary referral center.

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15

Gastrointestinal Fistulas

Herand Abcarian and Vivek Chaudhry

Reoperative pelvic surgery for fistulas is a complex and challenging problem. Packed within the rigid and tight confines of the bony pelvis are genitourinary, gastrointestinal, reproductive, vascular, and neural structures that are often displaced and fused due to sepsis, radiation, or recurrent tumor. An abdominal approach to these fistulas needs careful planning and special expertise of colorectal surgeons, plastic surgeons, urologists, and urogynecologists working together to minimize the frequent morbidity and occasional mortality. Although an abdominal operation may be necessary, a surgeon should be familiar with the advantages and disadvantages of alternate approaches to the pathology (Table 15.1).

Timing of the operation is critical to success. Repair of fistulas should be undertaken only after an initial period of stabilization, drainage of infection with or without diversion, correction of nutrition, and careful evaluation to delineate the anatomy of the fistula. This approach allows for some fistulas to heal spontaneously while in most others the tissues become less inflamed, increasing the success of the definitive operation.

Several operations have been described for the treatment of complicated gastrointestinal (GI) to genitourinary fistulas. They all have the same basic tenets of success:

- Well-nourished patient without sepsis
- Closure of both sides of the fistula approximating well-vascularized soft pliable tissue whenever possible
- Avoid overlapping suture lines
- Interposition of well-vascularized new tissue to reinforce repair

Rectourinary Fistulas

York Mason Approach to Genitourinary Fistulas

Clinical Scenario

A 66-year-old man underwent radical prostatectomy for prostate cancer. The postoperative period was complicated by small bowel obstruction and rectourethral fistula. An abdominal repair was attempted, but the fistula persisted. He was referred with recurrent urinary tract infections, pneumaturia, fecaluria, as well as passing urine from the rectum for 8 months.

On rectal examination there was anterior induration just above the anorectal ring. Anoscopy and proctoscopy were unable to clearly delineate the rectal opening. The fistula was not visualized on cystoscopy and retrograde urethrogram. A voiding cystourethrogram in the lateral position showed filling of the rectum (Fig. 15.1A). There was narrowing of the urethra with good urinary sphincter. The patient underwent a layered closure of the fistula using the York Mason approach. A repeat retrograde cystourethrogram 3 weeks postoperatively demonstrated a sound repair with no stricture (Fig. 15.1B).

Preparation and Position

Preoperative bowel prep and prophylactic antibiotics are used. The patient is placed in the prone jackknife position under general anesthesia with the greater trochanter placed over the break. Chest and pelvic rolls are used to allow free excursion of the diaphragm. Gluteal folds are retracted cephalad and laterally with tape (Fig. 15.2).

Incision

An oblique parasacral incision is used and deepened to cut the lowest fibers of the gluteus maximus muscle. The levator, puborectalis, and, if needed, the external and internal sphincter muscles are divided. The posterior rectal wall is divided. Care is taken to mark each muscle layer with a different color suture for accurate approximation at the time of closure. A self-retaining retractor maintains optimal exposure (Figs. 15.3 and 15.4).

Fistula Repair

A dilute solution of epinephrine is injected around the fistula. An incision is made sharply around the fistula and deepened through the posterior wall of the prostatic urethra. The scar is excised. The incision is then extended transversely in the anterior rectal wall, and full-thickness flaps of the rectal wall are mobilized both proximally and distally. The urethral opening is freshened and closed transversely with interrupted 3-0 absorbable suture. The rectal flaps are then repaired using the *vest-over-pants technique* (Figs. 15.5 and 15.6). This allows adjacent suture lines to be staggered at different levels avoiding overlying suture lines. The incision is then closed in layers using absorbable sutures facilitated by the color-coded identifying sutures: mucosa, rectal wall, internal sphincter, external sphincter, puborectalis, levator, and gluteus maximus muscle (Fig. 15.7).

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TABLE 15.1. Surgical Approaches for the Repair of Rectourinary Fistulas.

Surgical approach	*Advantages*	*Disadvantages*
Perineal	Familiar to urologists Allows interposition of tissues	Difficult Risk of impotence
Transanal	Minimal pain Reduced wound complications	Limited exposure Suitable for low fistulas in thin patients
Transanorectal	Blood loss minimal Good exposure Allows tissue interposition	Risk of impotence
Kraske	Good exposure of mid-rectal lesions only	Fecal and urinary incontinence due to nerve injury Stricture formation
York Mason	Excellent exposure Dissection in virgin planes Minimal risk of nerve injury	Wound complication Postoperative pain Requires accurate suturing to avoid fistula
Transabdominal	Good exposure Allows tissue interposition Familiar to most surgeons Resection of intestine and treatment of associated abdominal pathology	Reoperation difficult risk of bleeding and iatrogenic injury to organspostoperative pain and ileus

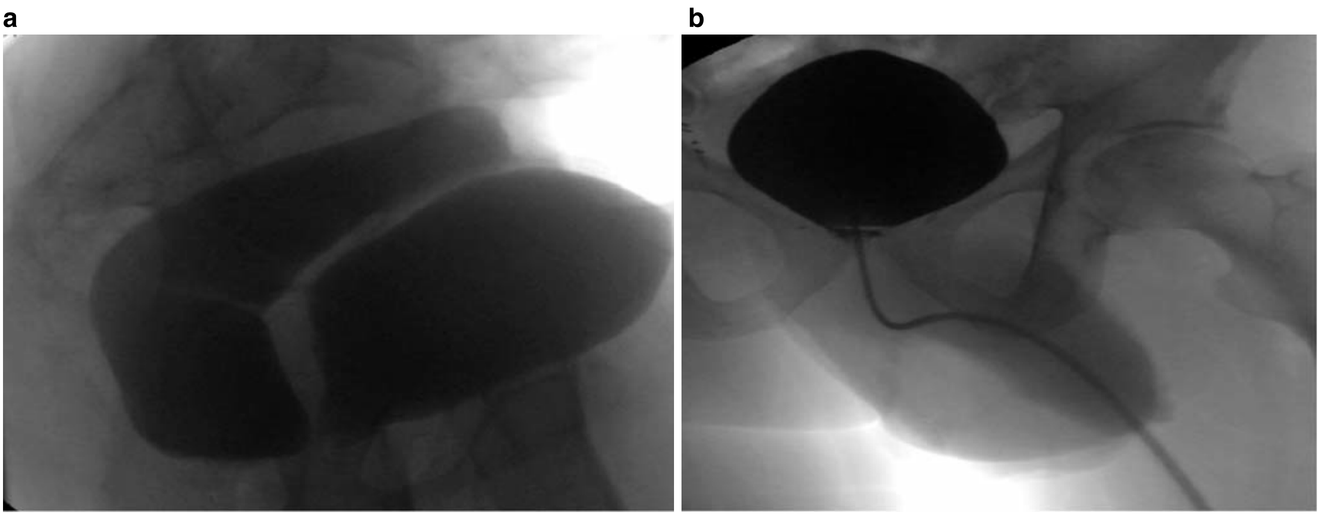

FIGURE 15.1 (**A**) Preoperative retrograde voiding cystourethrogram shows the rectourethral fistula. (**B**) Postoperative cystourethrogram after 3 weeks showing a successful repair using the perineal approach with dartos flap.

Postoperative Care

Diet is advanced as tolerated, with most patients tolerating a general diet and discharged on post-operative day 3 and 4 respectively. Drains and fecal diversion are not used routinely, and the indwelling urinary catheter is removed when a retrograde urethrogram at 2 to 3 weeks shows no fistula or narrowing. If a fecal diversion was used, it can be closed 6 to 8 weeks later.

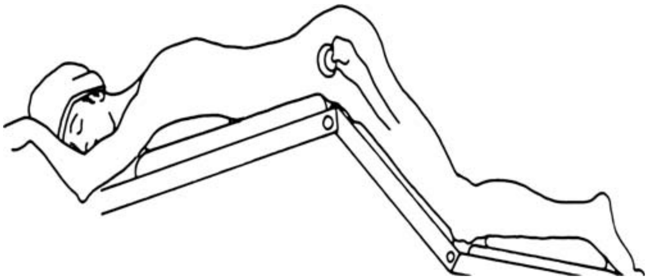

FIGURE 15.2. Position of patient for York Mason approach. (From Prasad et al.,[3] with permission of Springer Science + Business Media.)

A transsphincteric approach to rectal lesions was described originally by Bevan[1] in 1917. A report by Goodwin et al.[2] described spontaneous closure of five and operative closure of 10 of 15 rectourinary fistulas using a wide perineal approach. Kilpatrick and Thomson performed successful closure of six fistulas using the Kraske approach. Kilpatrick and York Mason reported on 17 patients with rectoprostatic fistulas. Thirteen were repaired using the Kraske approach. Complications included recurrence of fistula, persistent anal incontinence (two patients), and urethral stricture (two patients). The remaining four were repaired using the York Mason approach with no complications. We initially reported the York Mason approach to treat rectoprostatic fistulas in 1983, with three patients healing their fistulas without recurrence, stricture, or incontinence.[3] Fengler and Abcarian[4] reported successful fistula

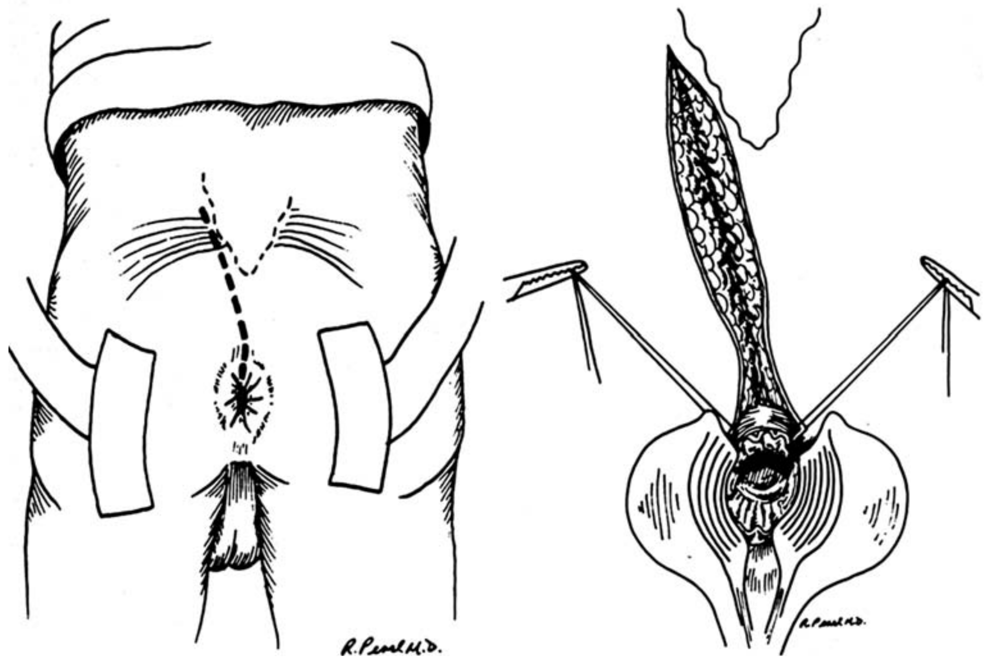

FIGURE 15.3. Incision for York Mason approach. (From Prasad et al.,[3] with permission of Springer Science + Business Media.)

closure without incontinence in eight patients, three of whom had received radiation and two had prior radiation and prostate surgery. Boushey et al.,[5] in a report of two cases, advocate a three-stage approach: proximal urinary and fecal diversion; followed by waiting period of 3 to 6 months to allow for a decrease in the inflammatory response surrounding the involved area and possible spontaneous closure; and definitive surgical repair using a York Mason approach,

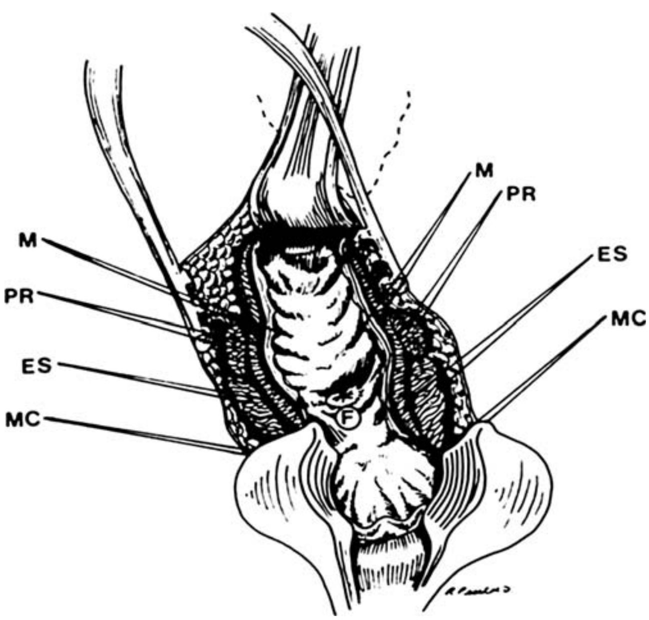

FIGURE 15.4. Sphincter mechanism and posterior rectal wall divided exposing the fistula (F). Each sphincter muscle is tagged with color-coded sutures. M, mucosa; PR, puborectalis; ES, external sphincter; MC, mucocutaneous junction. (From Prasad et al.,[3] with permission of Springer Science + Business Media.)

followed by eventual closure of the stoma. More recently Renscler and Middleton[6] reported healing without incontinence or stenosis of 23 of 24 rectourinary fistulas. Eighteen of these were secondary to prostate surgery. Eleven involved the bladder and 13 involved the urethra. Eleven of these were one-stage procedures without proximal urinary diversion. Two patients had a recurrence; one was treated with a second York Mason and the other with a perineal approach. Dal Maro et al.[7] reported successful healing of the fistula in seven cases with one recurrence after 11 years in a patient with Crohn's disease. Five of seven had a proximal diversion. There was no stenosis or incontinence.

In summary, the posterior sagittal transsphincteric and transrectal approach to treat rectourinary fistulas provides excellent exposure and is highly successful. There is only a rare report of incontinence. The repair can be done as a one-stage procedure, though a staged approach may be more suitable if the tissues are inflamed. The complications described with this approach are wound infection, fecal fistula, chronic coccygeal pain, and pelvic floor herniation.[8] Incontinence is rare. Wound complications can be reduced by accurate suturing and attention to hemostasis, especially in a branch of the inferior gluteal artery at the lower border of the gluteus maximus.

Perineal Approach to Rectoprostatic Fistulas

Clinical Scenario

A 71-year-old man was treated with brachytherapy with seeds for prostate cancer and developed a rectourethral fistula initially treated with ileostomy and suprapubic drainage. The ulcer was 4 cm above the dentate line and 2 cm in size. There was no evidence of recurrent cancer. The fistula was repaired using a York Mason approach.

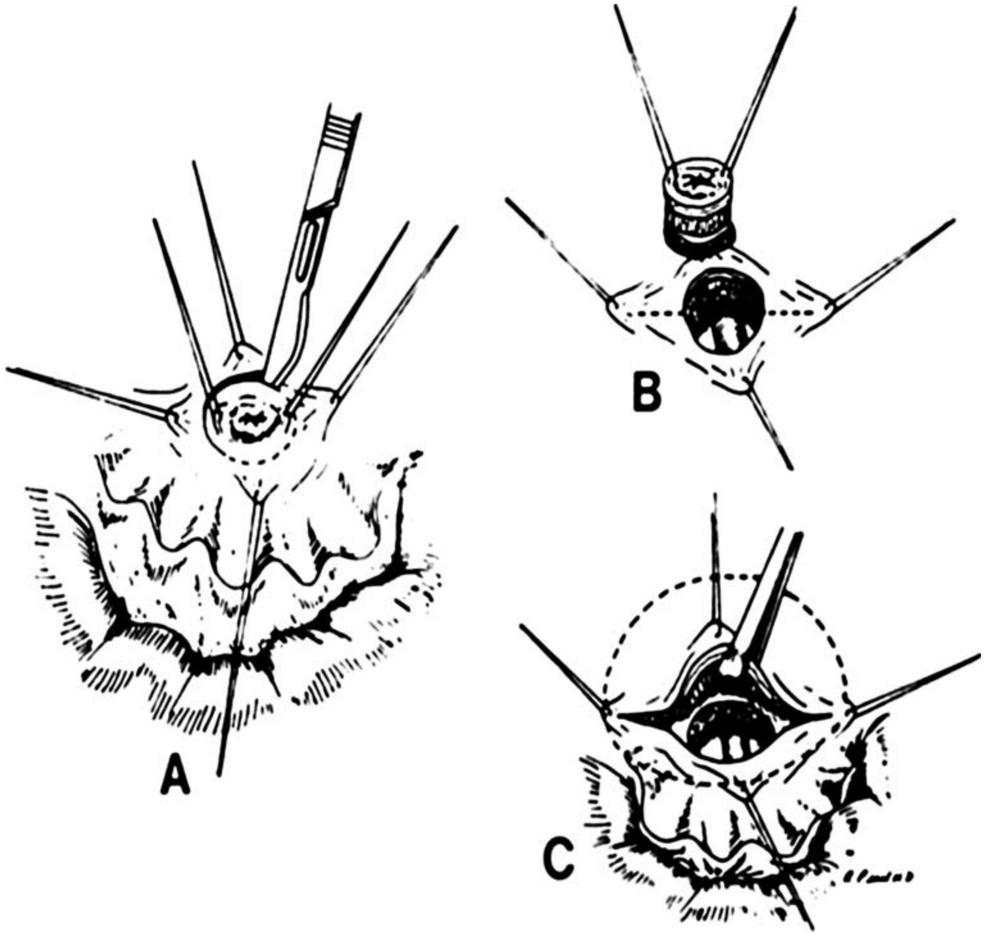

FIGURE 15.5. Incision around fistula (**A**). Excised fistulous tract exposing catheter in prostatic urethra (**B**). Undermining of rectal wall. *Dotted line* represents the extent of rectal wall mobilization (**C**). (From Prasad et al.,[3] with permission of Springer Science + Business Media.)

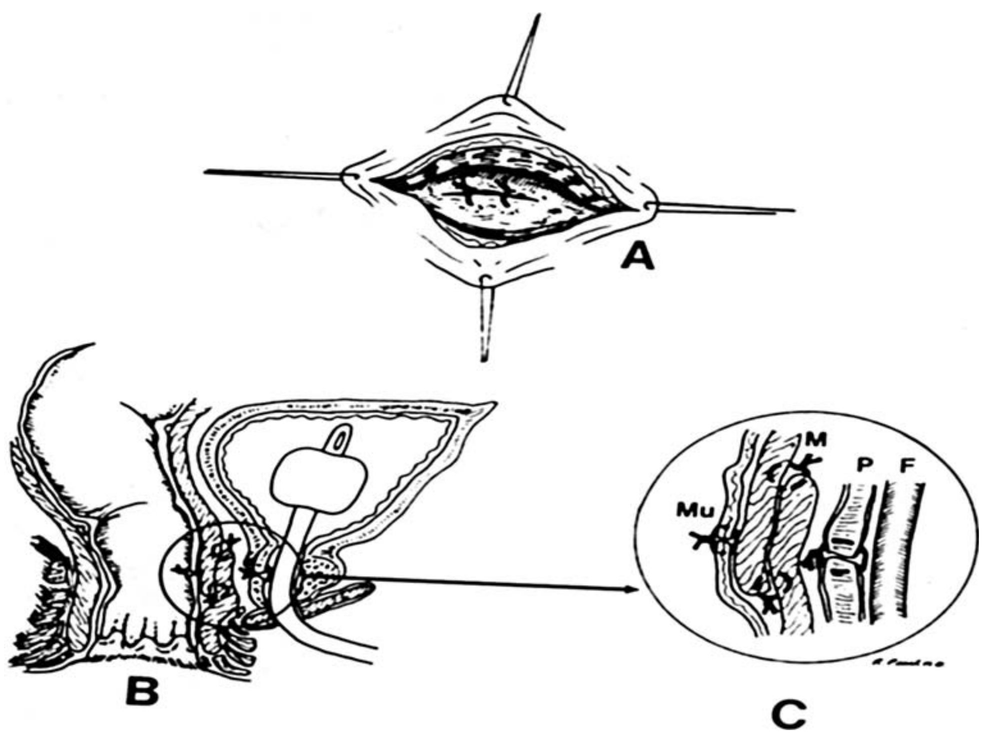

FIGURE 15.6. Closure of prostatic urethra (**A**). Sagittal section showing suture line after repair of fistula (**B**). Magnified view of suture lines. F, Foley catheter; P, prostatic urethra; M, full-thickness rectal wall flaps sutured in a "vest-over-pants" technique. Note that the suture lines do not overlie each other (**C**). (From Prasad et al.,[3] with permission of Springer Science + Business Media.)

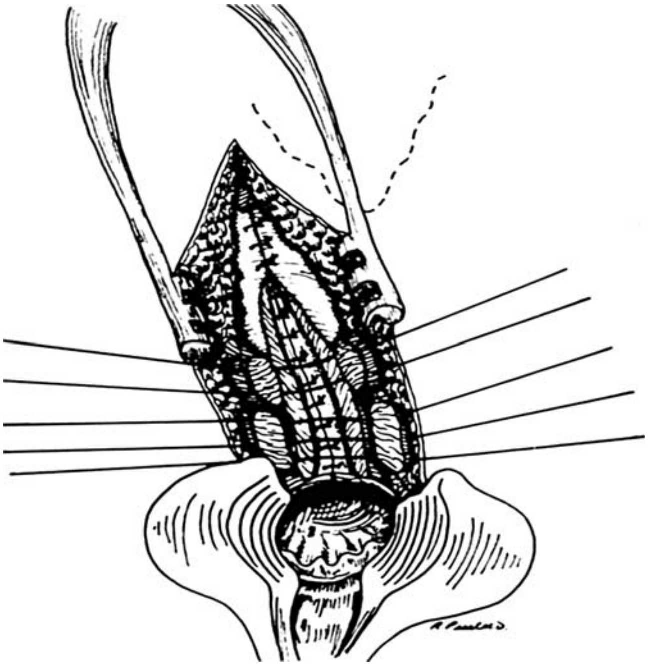

FIGURE 15.7. Suture of rectal wall completed. Sphincter muscle being approximated. (From Prasad et al.,[3] with permission of Springer Science + Business Media.)

The fistula persisted after uneventful recovery from surgery. He then underwent laparoscopy-assisted coloanal anastomosis with omentum interposition. He was diagnosed with persistent fistula after a workup for rectal drainage of blood and pus. A perineal approach to the fistula with Dartos scrotal flap interposition was done 6 months later.

Preparation and Position

Rectourinary fistulas are usually a complication after prostatectomy or radiation implants for prostate cancer. Patients are often referred after fecal diversion, which helps reduce inflammation. The patients receive full mechanical and antibiotic preparation. The patient is placed in an exaggerated lithotomy position (Figs. 15.8 and 15.9).

Incision

A curvilinear incision is made just medial to one ischial tuberosity to the other. The ischiorectal space is entered on both sides (Fig. 15.10).

Dissection

The central perineal tendon is divided. Dissection then proceeds to the rectourethralis muscle, which is divided. The external sphincter muscle is identified and preserved. The prostatic urethral fistula is identified and dissected (Fig. 15.11). A catheter in the urethra helps in identification of the urethra in a scarred field. The use of a Lowsley retractor (Fig. 15.12) is helpful in bringing the prostate into the operative field.

Fistula Repair

The fistula is transected. The defect in the rectum is closed with interrupted absorbable sutures in two layers. The defect in the prostatic urethra is then closed with the help of the Dartos scrotal flap (Fig. 15.13). This flap is well

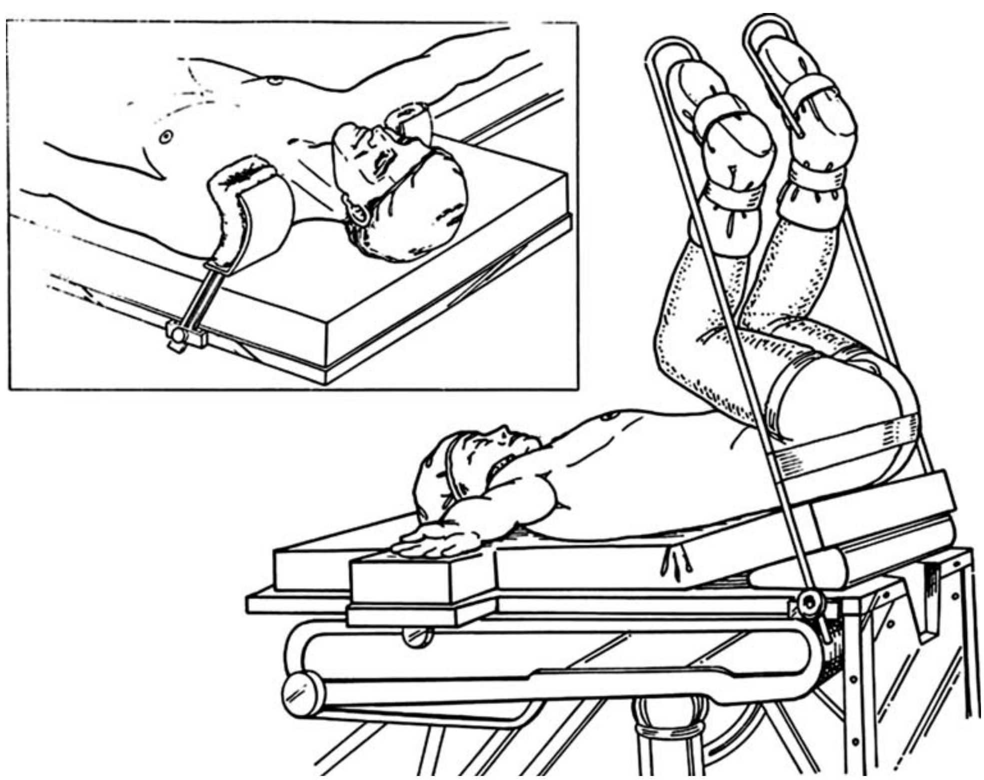

FIGURE 15.8. Extreme lithotomy position for perineal approach to rectoprostatorectal fistulas. (From Campbell and Retik,[87] with permission of Elsevier.)

FIGURE 15.9. Scrotal skin based on the dartos flap will be tunneled through the perineum. This flap will bring in fresh well-vascularized tissue to repair the prostatic urethra.

FIGURE 15.10. Incision for repair of rectoprostatic fistula using the perineal approach.

vascularized and easily reaches the prostate without tension. The incision is closed in layers.

Postoperative Care

The patient is usually in the hospital for 2 to 4 days. The bladder is drained until there is radiologic confirmation of healing after 3 weeks with a retrograde cystourethrogram. A proximal fecal diversion can then be taken down in 6 to 8 weeks.

In patients with a low fistula, without anal stenosis and without heavy gluteal musculature, a transanal approach is feasible. In a fistula that is higher, especially with anal stenosis, scarring may be appropriate for a posterior approach—York Mason or Kraske. The decision to divide the sphincter muscle complex in the posterior approach depends on the exposure obtained, which is limited in a Kraske approach especially in a man with heavy gluteal musculature. It is imperative that an experienced surgeon be available and be confident with accurately repairing the sphincter complex.

Rectovaginal Fistulas

Clinical Scenario

The patient is a 45-year-old woman who developed a low rectovaginal fistula in 1998 after the normal delivery. She underwent four previous unsuccessful repairs prior to being seen in the clinic. In 2001 the rectovaginal fistula was repaired with endorectal advancement flap and sphincteroplasty. The fistula recurred. She subsequently was treated with a laparoscopic colostomy, and three more attempts to heal the fistula in Germany without success. The tenth procedure involved

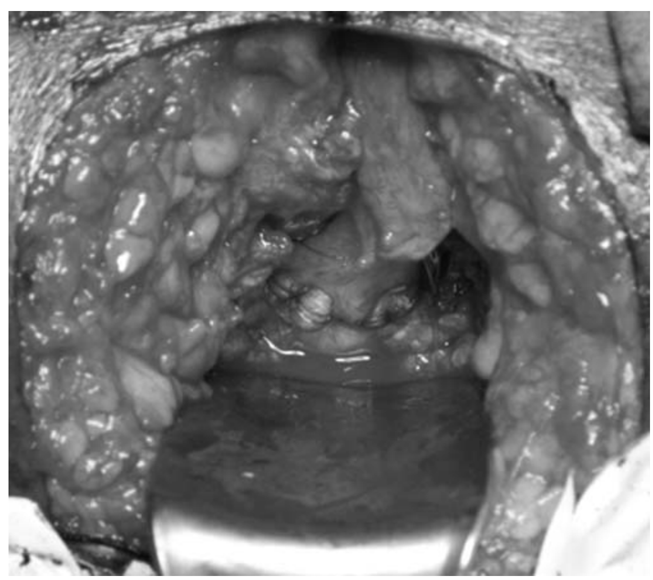

FIGURE 15.11 The perineal approach transects the perineal ligament and dissects between the prostate and the external sphincter. The rectoprostatic fistula dissected and the rectal side repaired in two layers with absorbable suture. To prevent stricture of the prostatic urethra and enhance healing, a dartos flap of scrotal skin will be used.

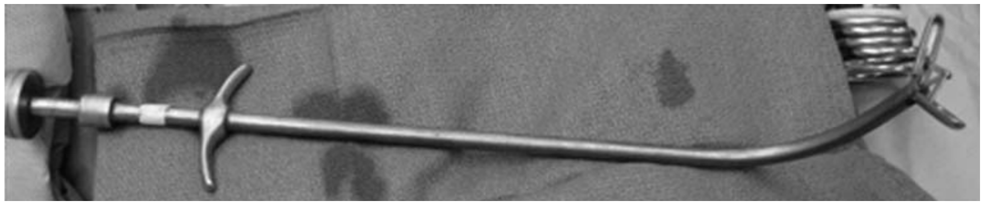

FIGURE 15.12. Lowsley retractor.

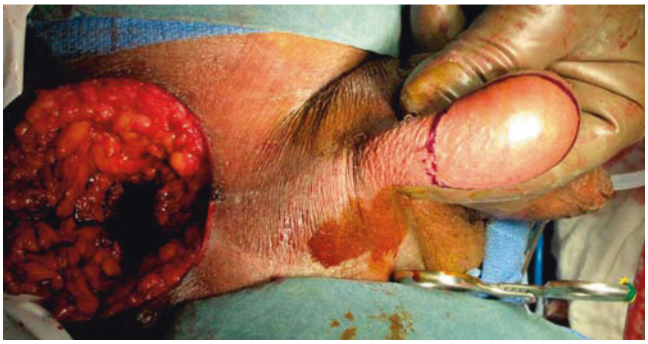

FIGURE 15.13. Scrotal skin incision marked for dartos flap repair of rectoprostatic fistula using the perineal approach.

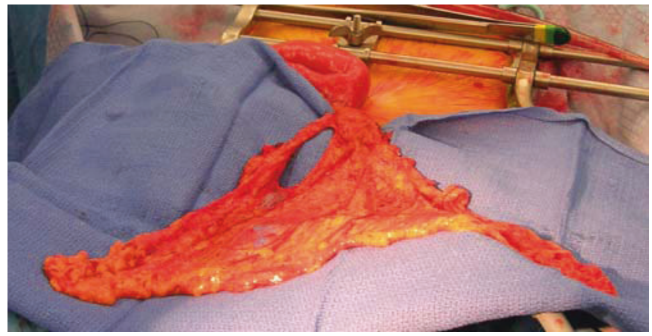

FIGURE 15.14. The greater omentum mobilized based on the left epiploic artery, which will easily reach the perineum.

fistulectomy, removal of mucocele of the rectovaginal septum, levatoroplasty, and rectal advancement flap. The fistula persisted. The patient then underwent a laparotomy with complete takedown of the rectovaginal septum and omental flap interposition and closure of the rectal and vaginal sides of the fistula (Figs. 15.14 and 15.15). The fistula healed and the colostomy has been taken down successfully.

Definition

A rectovaginal fistula is an epithelial or granulation tissue–lined abnormal communication between the vagina and anorectum. It is classified by size, location, and etiology, which are helpful in determining treatment (Table 15.2). Fistulas may also be classified as low, middle, or high. Low fistulas are essentially anovaginal fistulas with an opening from the dentate line to the lower vagina; high fistulas open near the cervix; and middle fistulas open in between high and low.

Additionally, fistulas may be classified as simple or complex; fistulas with a midseptal location, <2.5 cm in diameter, and traumatic or infectious in etiology, are designated simple fistulas.[9] Complex fistulas are large (>2.5 cm), high, and secondary to radiation, inflammatory bowel disease, or cancer. Multiple failed repairs of a simple fistula may also be classified in this category. High complex fistulas often require an abdominal approach with tissue interposition and proximal diversion, while simple fistulas are amenable to transvaginal, transanal, or perineal approaches for repair without proximal diversion.

Obstetrical Trauma

Injury to the rectovaginal septum is the most common cause of rectovaginal fistula. Pressure necrosis of the rectovaginal septum from prolonged labor is rare in the developed world. More commonly, misrecognition or breakdown of a repair of a fourth-degree perineal laceration results in the fistula. Traumatic cloaca occurs in 3% of deliveries. Primigravida, heavy babies, use of forceps, and midline episiotomy are risk factors.[10] Venkatesh et al.,[11] in a study of 20,500 patients,

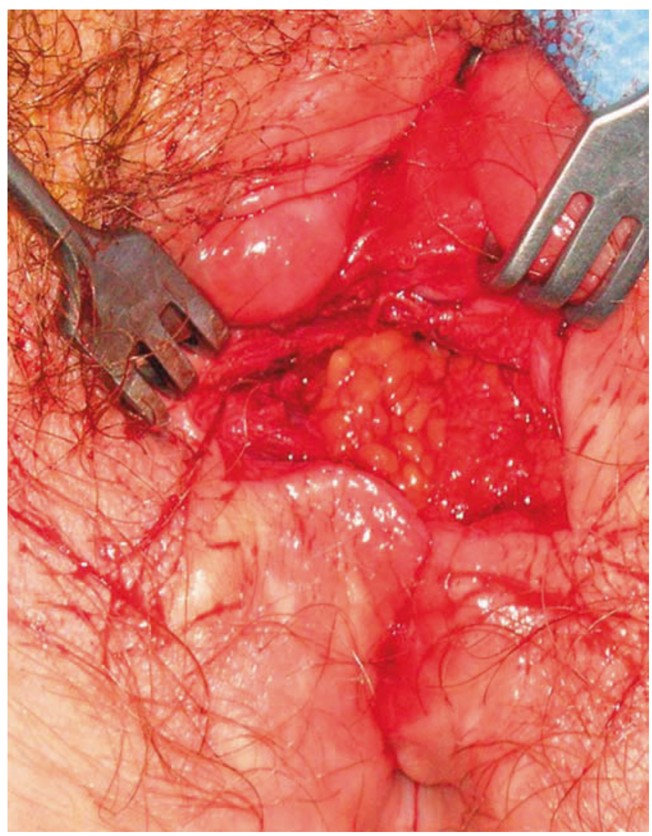

FIGURE 15.15. Perineal view showing the omentum placed as a buttress between dissected and repaired rectovaginal septum.

TABLE 15.2. Etiology of Rectovaginal Fistulas.

Congenital
Acquired
Trauma
Surgical
Obstetric
Trauma
Inflammation
Acute: cryptoglandular
Chronic: Inflammatory bowel disease
Radiation
Neoplastic: carcinoma of the rectum, anal canal, vagina
Location
Low
Middle
High
Complexity
Simple
Complex

reported that 5% resulted in episiotomy with third- or fourth-degree extension or fourth-degree perineal tear; 10% of these developed wound disruption, two thirds of which needed surgical repair. One third had spontaneous resolutions of their wound hematomas, abscesses, and a few fistulas; 25 patients (0.1%) developed rectovaginal fistula.

Crohn's Disease

Crohn's disease is the second most common cause of rectovaginal fistula. It is treated with surgery only after the rectal disease is quiescent with medical management of Crohn's disease. Until that time, seton placement, antibiotics, and thickening the fecal stream will reduce the risk of infection and control sepsis.

Operative Trauma

These fistulas occur after operative trauma, such as vaginal hysterectomy, rectocele repair, hemorrhoidectomy, hemorrhoidopexy, anterior rectal tumors, low anterior resection and restorative proctocolectomy.

Radiation and Cancer

Cancer or radiation used to treat it may cause a rectovaginal fistula. The treatment depends on the stage of the disease and condition of the patient.

Evaluation

Signs and symptoms depend on the etiology, size, and location of the fistula. Patients often present with stool or flatus from the vagina. They may have repeated episodes of vaginitis with associated foul-smelling discharge. Intestinal complaints of rectal bleeding, tenesmus, abdominal pain, diarrhea, and incontinence may be present.

A thorough history and physical examination are essential. Digital rectal examination (DRE), pelvic examination, anoscopy, vaginoscopy, proctosigmoidoscopy, and endoanal and endorectal ultrasound can often be accomplished in the office and help define the location of the fistula, the pliability of surrounding tissues, sphincter defects, and the etiology of the fistula. Occasionally the opening is microscopic and not easily identified. A careful inspection of the vaginal or rectal mucosa may reveal a small puckered dimple that is usually a clue to its presence. Gentle and careful probing via the rectum will identify the tract. Staining of a vaginal tampon with methylene blue or charcoal enema instilled in the rectum may be useful in diagnosis in a rare instance.

It is critical to evaluate for sphincter defects and function in all patients. This is accomplished by a good history, DRE, bimanual examination, and ultrasound. On occasion anorectal manometry may be used. Colonoscopy may be indicated to rule out malignancy and irritable bowel disease (IBD). Contrast studies (lower GI, small bowel follow through, and vaginography) may be indicated for enterovaginal and complex fistulas. A patient with pelvic cancer and radiation may present with multiple fistulas to multiple organs. Computed tomography (CT) of the abdomen and pelvis with contrast is useful for delineating masses, pelvic sepsis, and pelvic anatomy.

It is important to obtain tissue diagnosis in patients who present with fistulas after treatment of cancer. Approximately half the patients will have recurrent cancer in fistulas arising after radiation.[12,13] There are a variety of repairs for rectovaginal fistulas (Table 15.3).

Transanal Flap Repair

This procedure was popularized by Rothenberger et al.[9] After mechanical bowel prep and prophylactic intravenous (IV) antibiotics are used, the procedure is performed with the patient placed in the prone jackknife position under spinal or general anesthesia, with the gluteal folds retracted laterally with tape. The anterior rectal wall is infiltrated with dilute epinephrine. A 4-cm flap of rectal mucosa and circular muscle is raised starting distal to the fistula. The base is twice as broad as the tip to ensure good blood supply to the tip. The most distal portion of the flap with the fistulous opening is excised. The tract is excised into the rectovaginal septum. The internal sphincter is mobilized and closed over the fistula, over which a tension-free partial-thickness rectal flap is sutured to the anal mucosa. The vaginal side is left open for drainage (Fig. 15.16). Postoperative care includes avoiding constipation and vaginal intercourse, and using tampons for 6 weeks.

A concomitant sphincteroplasty to buttress the repair and interpose muscle between the rectal closure and the vaginal repair increases the success rate of the procedure from 29% to 100% to over 95%.[14,15] For rectovaginal fistulas greater than 0.5 cm with associated sphincter defect, as well as for patients with cloacal abnormality, anoperineorraphy or conversion to perineal laceration with layered closure may be used with an equally good success rate.[16]

Traumatic Cloaca Repair

Preparation

The patient receives a bowel prep, preoperative antibiotics, and indwelling urinary catheter. The procedure is performed with the patient placed in the prone jackknife position. The

TABLE 15.3. Techniques of Repair for Rectovaginal Fistulas.

Simple
Rectal flap advancement
Sphincteroplasty
Layered closure transanal or transrectal repair
Inversion of fistula
Conversion to complete perineal laceration and layered closure
Tissue interposition
Gracilis
Martius
Omentum
Gluteus
Rectus abdominus
Sartorius
Abdominal procedures
Proximal diversion
Low anterior resection
Coloanal anastomosis
Onlay patch
Abdominoperineal resection

rectovaginal septum is infiltrated with a dilute 1:200,000 solution of epinephrine to aid with hemostasis.

Incision

An incision is begun at the rectovaginal septum and extended 4 to 5 cm laterally, and cephalad (Fig. 15.16).

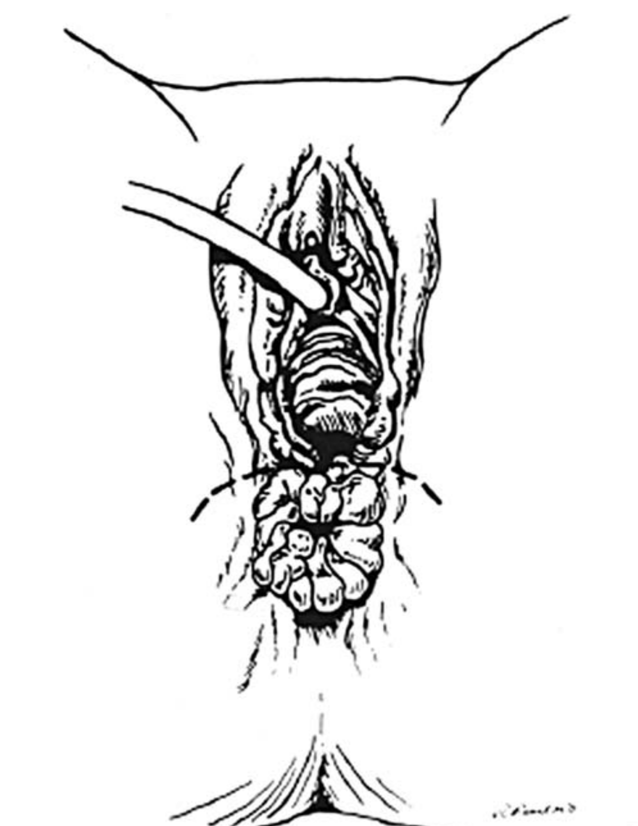

FIGURE 15.16. The incision is made in the rectovaginal septum and extends to the ischioanal skin bilaterally. (From Abcarian et al.,[17] with permission of Springer Science + Business Media.)

Repair

The posterior vaginal wall and anterior anorectal wall are then separated, and the rectovaginal septum is entered. Dissection is performed to approximately 5 to 6 cm cephalad and laterally until the puborectalis muscle can be palpated medial to the ischium. The lateral skin incisions are deepened into the subcutaneous tissue and developed into flaps that are retracted with silk sutures. The cut edges of the external sphincter, retracted laterally, are next identified. The two ends of the external sphincter are then mobilized sufficiently to allow a 2-cm overlap (Fig. 15.17). No attempt is made to debride the scar tissue at the two ends because it can hold a suture better than freshly debrided muscle tissue. Hemostasis is again secured carefully. *Perineoplasty* is then undertaken by approximating the puborectalis muscle in the midline with three to four nonabsorbable sutures (2-0 polypropylene). This interposes a layer of muscle between the vagina and rectum and constructs a new perineal body (Fig. 15.18). Care is taken not to carry the puborectalis sutures too far cephalad in order to avoid excessive narrowing of the introitus. Also, one must be careful not to place sutures in a shallow plane, that is, in the constrictor vaginae muscle, which is at the same tissue plane as the cut edges of the external sphincter. This will narrow the introitus and would not serve as an interposing layer between the rectum and vagina. The two edges of the external sphincter are then approximated and sutured together in an overlapping (vest-over-pants) method using 2-0 polyglactin sutures. If the cut edges of the muscle are overlapped about 2 cm, the anus will assume an O-shape and will allow insertion of the index finger. If the anal caliber is too large, the muscle edges may be overlapped farther to tighten the *sphincteroplasty* (Fig. 15.19). The wound is then irrigated with saline solution, and, after completion of the hemostasis, the skin is closed with 3-0 polyglactin sutures. Cosmetic closure is not only unnecessary but also difficult because of the vertical nature of the perineoplasty separating the anus from the vagina. The skin is closed loosely and the center of the incision is left open to facilitate drainage; no drains are used (Fig. 15.20). A diverting colostomy is not necessary.

Postoperative Care

The patient is ambulated the day after surgery and started on a clear liquid diet. The wound is inspected on a daily basis. The Foley catheter is discontinued after 48 hours and the patient is carefully observed for any voiding difficulty. The patient is allowed to walk around or lie in bed, but is not allowed to sit for a week. After the Foley catheter is removed, the patient is started on showers instead of sitz baths, three times daily. Bowels are not confined, and when diet is advanced to soft or regular, the patient is started on psyllium products and dioctyl-calcium-sulfosuccinate to soften the stool and facilitate bowel movements. Antibiotics or topical anesthetics are not prescribed. The wound is kept dry with application of a 4 × 4 gauze over the perineum; the gauze is changed as needed. Skin sutures are allowed to dissolve spontaneously.

The wound is inspected biweekly in the office until complete healing is achieved. Long-term follow-up beyond

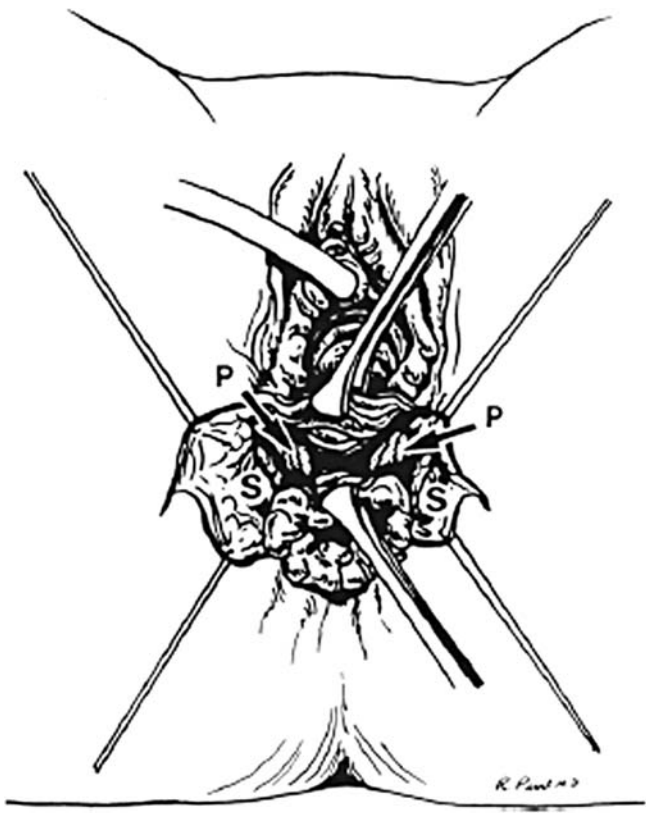

FIGURE 15.17. The puborectalis muscle (P) is identified medial to the ischium. The divided and retracted edges of the external sphincter are identified in the subcutaneous plane. (From Abcarian et al.,[17] with permission of Springer Science + Business Media.)

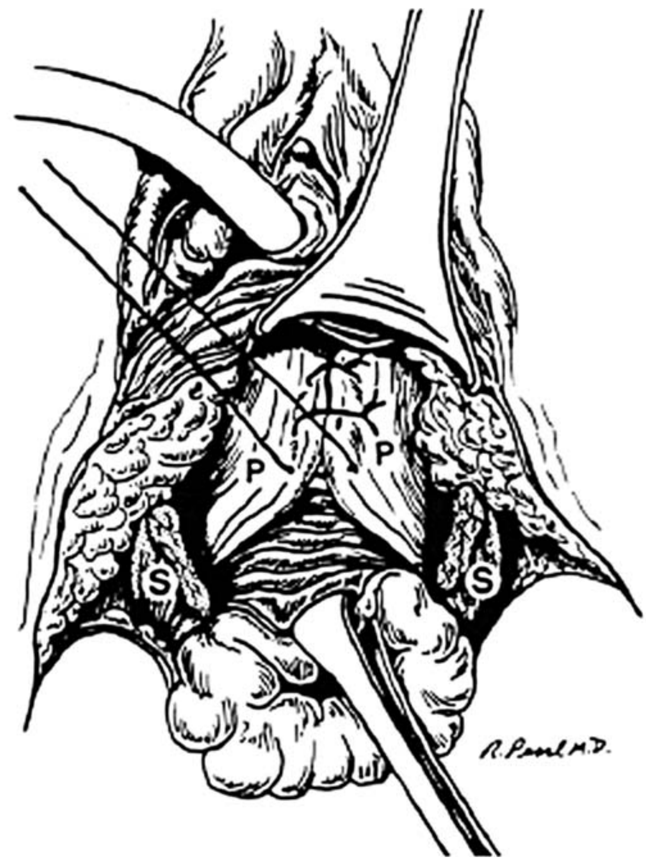

FIGURE 15.18. Perineoplasty is complete by interpositioning the puborectalis muscle to the midline. (From Abcarian et al.,[17] with permission of Springer Science + Business Media.)

3 to 6 months is usually unnecessary. The patient is advised to abstain from intercourse for 6 weeks. If the patient becomes pregnant after the wound is completely healed, cesarean section is recommended to avoid a recurrent injury to the reconstructed, somewhat rigid, perineum.[17]

Other Techniques Used for Complex Rectovaginal Fistulas

Complex recurrent fistulas with a thin fibrotic perineal body and septum due to Crohn's disease, multiple procedures, chronic sepsis, or radiation need fresh tissue with independent blood supply to heal. Coloanal sleeve resection has been reported. Muscle flaps like the rectus, gracilis, sartorius, gluteus, and bulbocavernosus are frequently used, and omental transposition have been described.

The greater omentum is a syncytium of blood and lymphatic channels that can improve healing, fill dead space, and help fight infections in the abdomen, chest, head and neck, and lower extremities. Free flap with microsurgical anastomosis has extended its versatility. The omentum is supplied by the left and right gastroepiploic vessels, which usually give rise to the three main epiploic arteries: right, left, and middle omental arteries. The pedicled graft can be based on any of them, though the right vessel is bigger in caliber. Attention has to be paid to the variants in blood supply, which will alter the design of the incisions if extra length is needed. The disadvantages are the need for a laparotomy; the risk of injury to the stomach, spleen, and colon; hernia; and bowel obstruction.

The gracilis muscle flap has been used successfully for the treatment of complex rectovaginal fistulas; unhealed perineal wounds after proctectomy, vesicovaginal, pouch-vaginal, urethroperineal, and rectoprostatic procedures; and fistulas in the pediatric patients. The success rates range from 60% to 100%.[18–25] The typical patient has had one or more unsuccessful attempts at local repair. The muscle brings in fresh blood supply with nonradiated tissue to fill the dead space and buttress and separate suture lines.

The superior border of the muscle lies at a line drawn from the pubic tubercle to the medial tibial condyle. The muscle is prominent when the hips are abducted and flexed at 45 and 15 degrees, respectively, with the knees slightly flexed. The flap is based on the proximal vascular pedicle, which is a branch of the profunda femoris artery. The muscle is detached from the medial tibia using a longitudinal medial thigh incision and tunneled posteriorly to the perineum to lie between the rectum and vagina or prostate. The overlying skin is supplied by the pedicle and can be mobilized as a myocutaneous flap, if necessary.

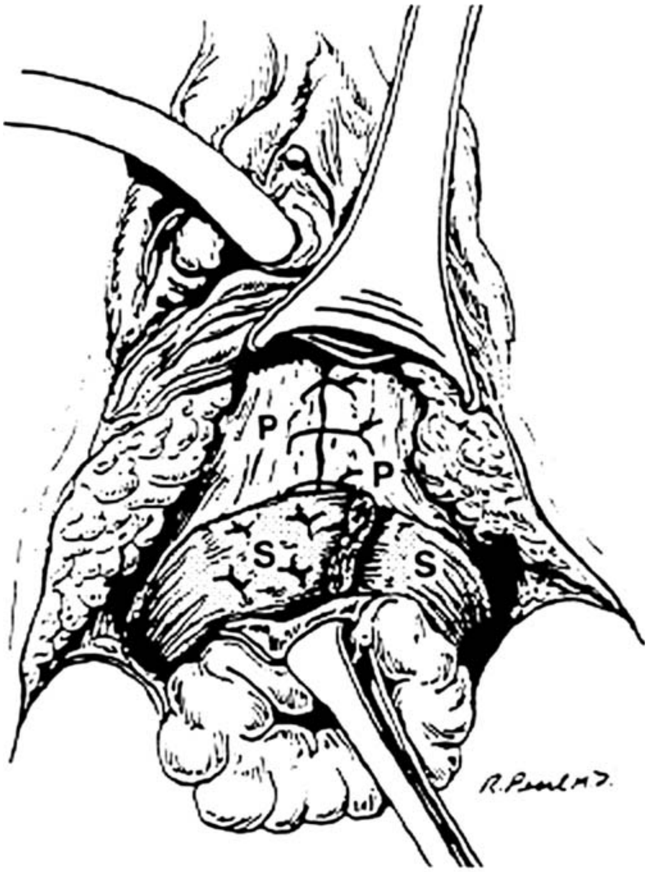

FIGURE 15.19. The overlapping external sphincteroplasty is complete. The anus assumes a normal O shape. (From Abcarian et al.,[17] with permission of Springer Science + Business Media.)

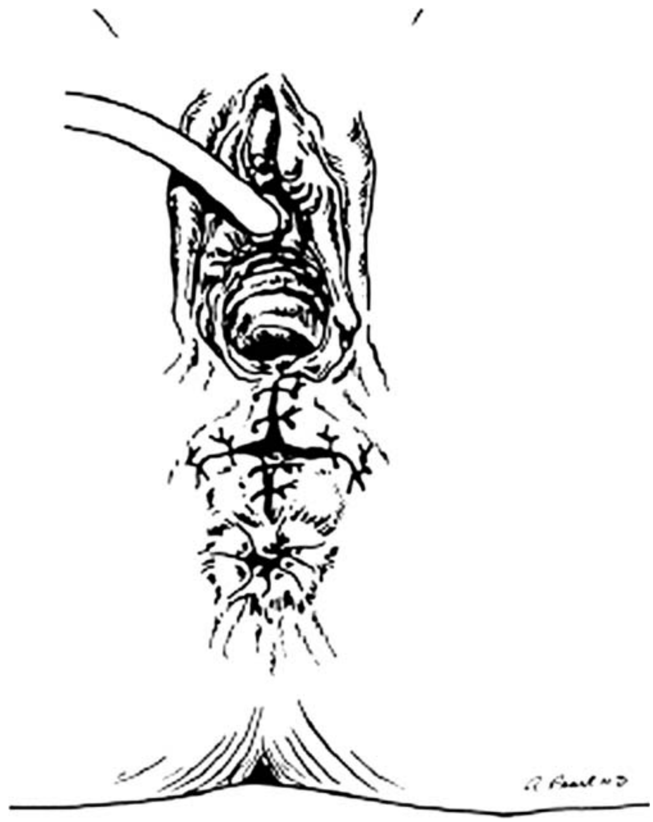

FIGURE 15.20. Partial closure of the incision. The long perineum separating the anus from the introitus. (From Abcarian et al.,[17] with permission of Springer Science + Business Media.)

Vesicoenteric Fistulas

Colovesical

Vesicoenteric fistulas arise most often from bowel disease, with diverticulitis being the most common etiology (66–75%) followed by colorectal malignancy (10–15%) and Crohn's disease (5%). Complications of radiation therapy, infection, and iatrogenic or penetrating trauma account for less than 5% of the cases.[26–28]

Pneumaturia is the most common presenting symptom, and is present in two thirds of the patients. Fecaluria, refractory and recurrent urinary tract infections, fever, abdominal pain, and hematuria can be present in various combinations (suprapubic pain, urinary frequency, dysuria, and tenesmus have been described as Grouverneur's syndrome).[28–31]

A CT scan is the most sensitive and specific diagnostic modality, with a reported accuracy of 90% to 100% due to the extreme sensitivity in diagnosing intravesical air. False positives are due to urinary tract instrumentation and infections caused by gas-forming organisms. A triad of bladder and adjacent bowel wall thickening, the presence of air in the bladder, and colonic diverticula is most often used to diagnose the most common cause of colovesical fistula.[32,33]

Cystoscopy usually shows some abnormality (erythema, edema, stool in the bladder) in more than 90% of the patients, though diagnosis of the fistula is less common (30–40%). Colonoscopy is indicated to help diagnose the etiology.[27,30]

The sensitivity of barium enema can be enhanced by using the Bourne test.[34] The first voided urine sample after a nondiagnostic barium enema can be centrifuged and examined for radiographically dense particles. Alternatively, the presence of charcoal particles in the urine after oral ingestion of charcoal tablets may help diagnose the fistula.[35,36] The use of vital dyes is discouraged as they may be absorbed into the circulation and subsequently excreted, resulting in a false-positive test.

Nonoperative treatment for patients with minimal symptoms, nonmalignant or Crohn's etiology, and high operative risk is occasionally warranted.[37,38] Suppressive antibiotic or a urinary antiseptic agent may be used to prevent recurrent urinary tract infections.

Diverticular Colovesical Fistula

In most patients with acute perforated diverticulitis without fecal peritonitis, a one-stage resection and anastomosis with or without a proximal stoma is possible, with morbidity and mortality comparable to the traditional two-stage procedure.[39–41] We have found the need to mobilize the splenic flexure for a tension-free anastomosis especially if the sigmoid is not redundant. It is imperative to resect all thickened bowel and place the anastomosis at the upper rectum below the level of the sacral promontory. The opening in the bladder should be repaired in two layers if it is large. Often the opening is microscopic in diverticular disease and cannot be identified. It is safe to leave a urinary catheter and drain the pelvis. If possible omentum can be placed between the bladder and bowel.

Judicious use of on-table lavage with primary anastomosis with or without a covering end loop ileostomy is an option in stable patients with a localized inflammation and a small abscess or obstruction. A Hartmann's resection may be needed in the presence of severe pelvic sepsis and inflammation, though the subsequent need for laparotomy for reversal adds to the morbidity, and in up to 20% the stoma is never reversed.

A proximal stoma alone is insufficient to treat the sepsis or close the fistula, and a three-stage approach has been abandoned by most surgeons except in the most extreme cases of instability.[42,43] Compared to general surgeons, colorectal surgeons have been found to use a lower rate of stoma creation, showing the advantage of specialization in treating these patients. Laparoscopy-assisted resection and repair is now well established in the literature and has been shown to have a decreased cost, shorter hospital stay, lower incidence of ileus, and better cosmesis.[44–51] Conversion rates of 20% or less have been reported. The key is to convert early to prevent an increase in morbidity or mortality. Factors causing conversion are somewhat predictable.[52] These operations are technically demanding and should be performed by surgeons with a large experience in laparoscopic colectomy.

Malignant Enterovesical Fistula

Malignant colovesical fistulas are usually due to carcinoma of the sigmoid colon, and, if completely resected, carry a good prognosis. The goal is en-bloc resection with negative margins. Adhesions to other loops of bowel need to be considered malignant and be removed with the specimen. The bladder may need to be opened in an uninvolved area to determine if the trigone and ureters can be saved. Augmentation cystoplasty or rarely total cystectomy may be required. In very large primary rectosigmoid tumors in the pelvis, preliminary diversion may be used to control sepsis and allow for staging and neoadjuvant chemoradiation followed by surgery.

Malignant fistulas after radiation or recurrence usually arise from tumors of the cervix, ovary, bladder, prostate, or rectum. Operative strategy depends on the extent of disease and the condition of the patient. Recurrent tumor needs to be ruled out and the disease staged. Surgery may involve pelvic exenteration with omental or muscle flaps, anterior resection, or coloanal anastomosis with reservoir. Often the disease is advanced and treatment options are limited to palliative stool and urinary diversion with or without bypass.

Rectovesical Fistulas

Malignancy is by far the most common cause of rectovesical fistulas. The tumor itself or radiation and surgery used for the treatment of the primary tumor is responsible. Other causes are traumatic, congenital, and IBD. Due to the tough fascia of Denonvilliers, cancers of the middle rectum only occasionally erode into the bladder, often just above the trigone. In contrast, colovesical fistulas from the sigmoid to the dome are more common and carry a better prognosis. Patients with a history of hysterectomy who are treated for cervical cancer may develop a radiation- or tumor-related fistula, which is frequently complex and involves the vagina, rectum, and bladder. Small bowel may also be involved.

Postoperative rectovesical fistulas are most often seen if there is breakdown of adjacent bowel and bladder suture lines. Unrecognized visceral injury, recurrent tumor, and radiation can also be causative.

Management of postoperative rectovesical fistula is challenging. Initial control of sepsis with CT-guided drainage of abscess and urinary and fecal diversion should be done. We prefer loop ileostomy to colostomy. Access to the fistula can be obtained through an anterior cystotomy. This allows identification of the fistula and preservation of the trigone and ureters. A case demonstrating this is presented below.

Rectovesical Fistula in a Hostile Pelvis: Repaired Using a Transcystic Approach

The patient is a 63-year-old man who presented with pelvic pain, mass, and weight loss after takedown of Hartmann's procedure for diverticulitis. He underwent an open biopsy and drainage of the pelvic mass, which was an encapsulated abscess on the pelvic sidewall. He developed pneumaturia. A workup was done with voiding cystourethrography and water-soluble contrast enema. A CT scan of the abdomen revealed air in the bladder. Cystoscopy revealed hyperemia above the interureteric ridge on the left side, but contrast infection did not reveal a fistulous communication.

Laparotomy was performed, which encountered very dense adhesions, and access into the pelvis could not be obtained. The bladder was opened at the dome with a controlled cystotomy. The ureters were identified, cannulated, and protected. A small infant feeding tube was used to probe the area of hyperemia just above the trigone and easily fell into the fistulous tract. A small Foley was used, and the balloon palpated in the rectum, confirming the presence and site of the fistula. The fistula was cored out. The cystotomy was extended and the rectum was repaired with interrupted 2-0 absorbable sutures. A piece of biologic mesh was used to buttress the suture line. The bladder was repaired with absorbable sutures, and the cystotomy closed over a urinary catheter. A cystogram after 3 weeks showed no abnormalities and the catheter was removed.

Enterocutaneous Fistulas

Etiology

Enterocutaneous fistulas develop most often after abdominal surgery. A breakdown of anastomosis or intestinal repair, unrecognized injury, erosion against suture mesh, drain, an abscess eroding through bowel, and fistulization of exposed bowel in an open abdomen are the most common scenarios. Age, nutritional status, fecal contamination, and site of anastomosis influence the incidence. A classification of enterocutaneous fistulas is presented in Table 15.4. Spontaneous fistulization may be seen in patients with Crohn's disease, cancer, or severe radiation injury. Factors contributing to fistula formation are as follows:

- Malnutrition
- Peritonitis
- Immunocompromised state
- Cirrhosis/renal failure
- Previous abdominal surgery
- Low hospital volume
- Surgeon inexperience

Management of Enterocutaneous Fistulas

Resuscitation

Patients with enterocutaneous fistulas can present with massive fluid loss and sepsis. Crystalloid fluid resuscitation and correction of life-threatening electrolyte imbalances should be the goal within the first 24 hours of the diagnosis. Concurrent measures to protect the skin and measure the output with the use of large wound drainage bags with or without suction drainage should be instituted. Broad-spectrum antibiotics in septic patients are indicated. The common organisms implicated are coliforms, bacteriodes, enterococcus, and staphylococcus. Patients presenting with generalized peritonitis will need an urgent exploration.

Nutritional support, with the use of total parenteral nutrition (TPN) and enteral nutrition if possible, is helpful in maintaining a positive nitrogen balance and decreasing mortality. Calorie requirements are usually 1.3 to 1.5 times the basal energy expenditure (BEE), and protein needs are 0.8 to 2.0 g/kg per day management. Water-soluble vitamins, especially vitamin C, and trace elements such as copper zinc magnesium supplementation are routinely given. Vitamin K is administered weekly. Octreotide has been shown to reduce the output, making the management easier and perhaps reducing the time to spontaneous closure, although it probably has no effect on overall closure or mortality rate. The dose is 50 to 200 μg t.i.d. A depot preparation is also available. Fistulas have been shown to close with enteral nutrition, and we routinely use oral feedings especially for controlled colocutaneous fistulas.

Investigation

Once the patient stabilizes, a CT scan, preferably with oral and IV contrast, is invaluable for diagnosing and treating intraabdominal abscess. It is also useful to show recurrent cancer and bowel obstruction. CT is less useful in the initial phase of enterocutaneous fistula in a nonseptic patient. Information on factors reducing the likelihood of spontaneous closure of the fistula is gained from radiologic investigations, of which a fistulogram performed with water-soluble contrast and fluoroscopy is most useful (Table 15.5). A lower GI, small bowel follow through, and colonoscopy may be indicated.

Surgical Management

Fistulas that persist for more than 6 weeks of conservative management require surgical intervention. The principles of fistula repair are as follows:

1. Operate electively on a stable patient free of infection with good nutritional and functional status.
2. Resect the fistula with the diseased bowel to healthy proximal and distal ends.
3. Anastomosis (with or without proximal diversion) may be needed between healthy bowel ends. Bypass or proximal diversion is done if the fistula cannot be removed.
4. Closure of the abdominal wall defect is performed. Primary closure, separation of components, myocutaneous flaps, or occasionally bioprosthetic materials may be needed.

We prefer constructing an ileostomy in an anastomosis created after pelvic radiation or J-pouch construction, or in cases of enteroanal anastomosis.

TABLE 15.4. Classification of Enterocutaneous Fistulas.

Specific cause	Radiation, irritable bowel disease (IBD), malignant
Simple	
Complex	Associated abscess, multiple organs, radiation, distal obstruction, major abdominal wall defects
High output	>500 mL/day
Intermediate	200–500 mL/day
Low output	<200 mL/day
Small bowel	
Large bowel	
Internal	
External	

TABLE 15.5. Factors Reducing the Likelihood of Spontaneous Closure of Fistulas.

Site—e.g., lateral duodenal, ileal, gastric
Nutrition—albumin <3 g/dL and transferrin <200 mg/dL
Sepsis—intervening abscess
Anatomy—tract >2 cm and defect greater than 50%, ischemia
Foreign body
Radiation
Inflammatory bowel disease
Epithelialization of tract
Neoplasia
Distal obstruction

Fistula in Ano

Clinical Scenario

The patient is a 38-year-old man with a history of "ulcerative proctitis" and had previously been treated with Asacol and metronidazole. Small-bowel follow-through was normal. Colonoscopic biopsies had revealed mild proctitis with pseudopolyp and crypt abscesses. He also gave a history of perianal abscess, which occurred twice. He developed a posterior midline transsphincteric perirectal fistula several months after drainage of an abscess. The internal opening was at the dentate line in the posterior midline. He was treated unsuccessfully with multiple procedures approximately 2 to 5 months apart: fistula plug, fibrin glue, as well as dermal advancement flap. He developed a fair amount of scarring in the perianal tissues. He was then treated with a rectal advancement flap, with complete healing of the fistula at 1-year follow-up.

Definition

The word *fistula* is Latin for *pipe* or *flute*. It is an abnormal communication lined with granulation tissue or epithelium between the anal canal or rectum and the skin.

History

Patients usually present with intermittent perianal pain, discharge, bleeding, or swelling. There may be a history of a perianal abscess, which was drained spontaneously or surgically. A thorough history to rule out specific disorders like Crohn's disease, anal or rectal carcinoma, HIV, radiation, tuberculosis, actinomycosis, and leukemia should be sought. Occasionally, patients present with pruritus ani or incontinence.[53]

Inspection

The external opening is usually easily visualized as an opening on the top of a small nodule of granulation tissue. Multiple external openings may be seen in horseshoe fistulas with secondary openings or in patients with Crohn's disease. There may be evidence of erythema and induration of skin irritated with chronic discharge. A note should be made of the position of old surgical scars and their relationship to the sphincter mechanism. Openings that are a considerable distance from the anal verge may be secondary to pilonidal disease or hidradenitis suppurativa.

Palpation

The fistulous tract can usually be palpated as a firm cord tracking toward the anal canal. Gentle palpation will often express a bead of pus from the tract. The direction of the tract provides clues to the internal opening. In addition, tenderness due to a partially drained abscess cavity may be elicited. This can be especially useful in diagnosing deep post–anal space abscesses, which may present with a normal-appearing perineal area without any swelling. During the office visit, a careful and gentle attempt at probing the fistula with a palpating finger in the anal canal can make the diagnosis and provides information about the internal opening (Table 15.6). The internal opening may be palpable as an indurated nodule. Care should be taken to avoid causing pain or creating false passages.

TABLE 15.6. Incidence of Fistula in Various Types of Anorectal Abscess.

Type	*No. (%)*	*Fistula (%)*
Perianal	437 (43)	35
Ischiorectal	233 (23)	25
Intersphincteric	219 (21)	47
Supralevator	75 (7)	43
Intermuscular	59 (6)	15
Total	1023	

Source: From Ramanujam et al.,[88] with permission.

Anoscopy and Proctosigmoidoscopy

These investigations identify the internal opening and the anorectal mucosa to rule out inflammation or carcinoma. The internal opening is usually seen at the level of the dentate line, and may be behind a hypertrophied anal papilla. A bead of pus can sometimes be expressed by palpating the tract externally. Goodsall's rule is more accurate in predicting the internal opening in posterior fistulas. A small amount of hydrogen peroxide injected into the external opening will confirm the internal opening.

Natural History of Fistula-in-Ano

Spontaneous healing of fistula-in-ano is exceedingly rare, though it has been seen with some low fistulas, which epithelialized to form skin bridges. Persistent fistulas of many years' duration have been reported to develop carcinoma, most commonly a colloid cancer. In addition, untreated fistulas frequently develop repeated abscesses when the external opening closes off. For these reasons, a diagnosis of fistula-in-ano is an indication for surgical therapy with the following goals:

1. Identify clearly the anatomy of the fistula, the relationship to the sphincter muscles, and all primary and secondary openings without creating false passages.
2. Identify underlying diseases when present.
3. Cure the fistula with minimal disturbance to continence.

Imaging

Radiography is indicated when treating recurrent, complex, or atypical fistulas. The accuracy rates of fistulography vary between 16% and 48%, with a 10% false-positive rate. Images are obtained after cannulation of the external opening and injection of small quantity of contrast, in the anteroposterior (AP), oblique, and lateral positions. In complex fistulas, fistulography may change the management in 48% of the cases.[54] Routine use is not required.[55]

In anorectal ultrasound, we use a 10-MHz crystal with a 360-degree rotating probe and hydrogen peroxide injection through the external opening. The fistula tract or scar is seen as a hypoechoic area. It can be differentiated when peroxide is injected through the tract.[56,57]

With magnetic resonance imaging (MRI), it is possible to delineate the fistula, abscess cavity, and secondary tracts with a greater than 95% sensitivity and specificity and has been found to be more accurate than anorectal ultrasound and surgical exploration in some studies.[58] We have used MRI for the most complicated fistulas where it may be a useful adjunct to other radiologic studies.

Management

Practice parameters for the management of abscess and fistula have been established by the American Society of Colon and Rectal Surgeons.[59] Table 15.7 shows commonly used treatment options for fistula-in-ano and Table 15.8 shows the results of surgery.[60,61]

Fistulotomy

Compared to fistulotomy, fistulectomy results in three times higher incontinence to flatus and prolonged healing time with equivalent recurrence rates. If the base is fibrotic the wound should be marsupialized with absorbable suture. We use fistulotomy in the treatment of intersphincteric fistulas and some low posterior transsphincteric fistulas. Minor incontinence rates of up to 73% has been reported, which usually resolve with healing of the wound.[62] The recurrence rate should be under 10%. Anterior fistulas in females and fistula tracts that traverse significant proportions of the sphincter mechanism in patients with marginal preoperative sphincter function are best treated with non–muscle-cutting procedures such as fibrin glue injection or advancement flaps.

Fibrin Glue Injection

Commercially produced fibrin sealant is under scrutiny for the treatment of fistula-in-ano. The fistula tract is accurately identified and curetted with gauze, curette, or a cytology brush (Fig. 15.21). Virally inactivated pooled fibrinogen and human thrombin are injected into the tract using a dual-lumen catheter (Fig. 15.22). A fibrin plug is formed within the tract, which stimulates macrophages and angiogenesis (Fig. 15.23). This technique is attractive as it can be performed under local anesthesia, is practically pain free, and can be repeated, and there is no disturbance of continence. The healing rate at 1 year is 64%.[63,64] Success rates are low in rectovaginal fistulas, Crohn's disease, and fistulas with short (<3 cm) tracts. Most of the recurrences are clinically obvious within 3 months, though late recurrences have been seen with longer follow-up. A randomized trail failed to show the benefit of adding antibiotics to the glue or closure of the internal sphincter.[65] Lower success rates have been reported especially with long-term follow-up and in patients with complex fistulas.[66] Elimination of granulation tissue has been suggested to improve the healing rate in an animal model.[67]

TABLE 15.7. Options Used in the Treatment of Anorectal Fistulas.

1. Fistulotomy
2. Fistulectomy
3. Cutting seton or draining seton
4. Staged fistulotomy with seton
5. Fibrin glue injection
6. Rectal advancement flap
7. Dermal advancement flap
8. Anal fistula plug
9. Fistulotomy with sphincter repair
10. Closure of the internal opening and drainage of the extrasphincteric tract
11. Proctectomy, low anterior resection
12. Medical treatment—remicade (Crohn's fistulas)
13. Posterior transsphincteric approach (York Mason)
14. Expectant management

TABLE 15.8. Results of Anorectal Fistula Surgery.

Author/institution	*Year*	*Recurrence (%)*	*Incontinence (%)*
Fistulotomy			
Ramanujam	1983	1/45 (2)	1/45 (2)
Pearl	1993	3/116 (3)	5/116 (5)
Garcia—Aguilar	1996	6/63 (9)	39/61 (64)
Hasegawa	2000	8/32 (25)	15/32 (4.8)
Long-term results of fibrin glue			
Cintron	2000	32/79 (41)	None
Sentovitch	2003	15/33 (31)	None
Buchanan	2003	19/22 (86)	None
Long term results of anorectal advancement flap			
Garcia Aguilar	1984	2/151 (1.5)	10%
Kodner	1993	8/107 (7)	Improved 18%*
Ozuner	1996	29/101(29)	
Sonoda	2002	36/105 (36)	
Mizrahi	2002	38/94 (40)	9%

*continence unchanged in 80%, 2% with stomas

The Role of Setons

The word *seton* is derived from the Greek word *seta,* meaning *bristle*. Sushruta, an Indian surgeon, used a medicated thread, called a Kshaarasootra, in the treatment of fistulas in 600 B.C. Hippocrates (460–377 B.C.) used horsehair wrapped about a lint thread as a cutting seton for the treatment of fistula-in-ano.

Cutting Setons

Cutting setons are used for definitive treatment of fistulas by gradually transecting the encircled sphincter. This involves periodic tightening of the seton in the office or under anesthesia until it cuts through the involved sphincter muscle, usually over a period of 6 to 12 weeks. A wide variety of materials have been used, such as silk, nylon, rubber band, and even stainless steel wire, with slight variations in technique to accomplish the same goal. We rarely use this technique in our practice due to the frequent follow-up visits required, severe pain, and an incontinence rate of up to 62%.

Drainage Setons

Long-Term Drainage Setons

These setons are used as a method to keep the tract open, thus preventing recurrent abscesses. This method is very

FIGURE 15.21. Fibrin glue treatment for fistula in ano (step 1): clear identification of the tract. This is a transsphincteric fistula with the tract 4 cm long. The tract is probed and then gently curetted with a fine brush or gauze.

useful in patients with active Crohn's disease or in patients with complex fistulas. It is preferable to use soft Silastic vessel loops, the limbs of which are secured loosely around the tract with fine silk suture. They may be removed if definitive repair is attempted once the disease is quiescent.

Short-Term Drainage Setons

After drainage of a perirectal abscess with a high fistula, a seton may be left in place until the abscess heals. Upon subsequent removal of the seton, primary healing of the fistula has been reported in up to 78% of cases.

Marking Setons

Setons may be placed in fistulas to identify the tract at a future operation, as in a two-stage fistulotomy. We divide the proximal portion of the tract and the enclosed muscle and return the patient to the operating room after 6 to 8 weeks for the second-stage fistulotomy. The seton stimulates fibrosis and prevents retraction of the cut edges of the muscle at the subsequent operation. A two-stage fistulotomy has been reported to have a recurrence rate of 0% to 9% and incontinence rates of 0% to 64%.[25,60] We have reported a recurrence rate of 3% and a major incontinence rate of 5% using this technique.[68–70]

Dermal Advancement Flaps

Nelson et al.[71,72] have modified the island flap anoplasty previously described for the treatment of anal strictures for the treatment of transsphincteric fistulas. A pear-shaped incision, which includes the internal opening, is made in the anoderm and perianal skin. The opening in the internal sphincter is debrided of granulation and fibrotic tissue. The internal opening is closed, and after adequate mobilization of the flap the proximal portion is sutured to the anal mucosa and the internal sphincter with interrupted absorbable sutures (Fig. 15.24). The external tract is curetted and left to open drainage. The perianal skin is left open to heal by secondary intention, which is usually complete by 6 weeks. The success rate is 80%, with the majority of recurrences treated with a repeat dermal advancement flap. This procedure has been used for fistulas at all locations and etiologies, though it is ideally suited for fistulas with internal openings at the dentate line.

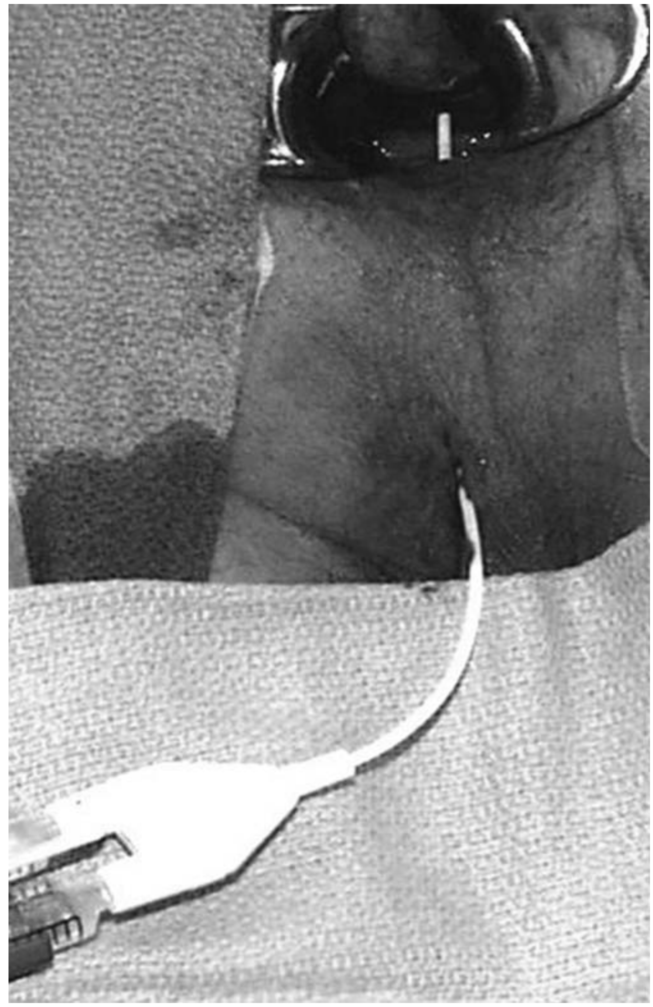

FIGURE 15.22. Fibrin glue treatment for fistula in ano (step 2): position the dual-lumen catheter. The dual-lumen catheter is guided into the tract. Tying a suture to the catheter and probe and pulling it through may facilitate this.

Transanal Anorectal Advancement Flap

Transsphincteric fistulas passing through the upper part of the anal sphincter and rectovaginal fistulas can be repaired using a partial-thickness flap of the anorectal wall. We recommend preoperative bowel prep and prophylactic antibiotics. The internal opening is debrided and excised down to the sphincter defect, which may be closed with one or two interrupted absorbable sutures. The tract should be debrided using curettes or gauze. The partial-thickness flap should be at least twice as broad at the base to ensure

FIGURE 15.23. Fibrin glue treatment for fistula in ano (step 3): final appearance. Well-formed fibrin plug at the internal and external opening. Nonadherent dressing is then placed and the patient discharged with instructions to avoid Sitz baths, vigorous rubbing, and constipation to prevent dislodging the plug.

adequate blood supply at the apex, which is sutured to the freshened lower edge of the internal opening with interrupted absorbable sutures. The long external tract can be drained with a Malecot or small Penrose drain.

Recurrence rates vary from 0% to 32% and minor incontinence rates of up to 35% have been reported. Although the flap procedure may be repeated, the success rate is significantly less in patients with two or more previous repairs.[73–78]

Fistulectomy and Primary Closure

A few reports using this technique have reported low recurrence and incontinence rates. However, this technique has not been widely accepted.

Anal Fistula Plug

A recent addition to the armamentarium of continence-preserving procedures for anal fistula is placement of collagen plug in the fistula tract. This bioprosthetic plug (Surgisis) is commercially available from Cook Surgical Inc. (Bloomington, IN). It is manufactured from dried porcine intestinal submucosa. After rehydration, a suture is tied to the thinner end of the conical plug and is pulled into the tract from the primary opening. The plug is trimmed at the primary opening and sutured with a figure-of-eight absorbable suture. The suture should incorporate internal sphincter to anchor the plug securely and prevent plug extrusion. Excess plug at the secondary opening is trimmed off. The patient is advised to avoid strenuous activity for 2 weeks to prevent dislodgment. In comparison with fibrin glue the success rate was 40% vs. 87% in favor of the plug. In this study Crohn's and superficial fistulas were excluded.[79] A similar experience was recently reported.[80] Long-term follow-up is needed. Several studies are being conducted, and it is to be seen whether these initial good results can be reproduced and stand the test of time to justify the high cost of the plug.

Fistula and Carcinoma

Carcinoma can develop in a chronic fistula, especially in the elderly. Operative biopsies of all abscesses and fistulas are essential. The presence of pain, mass, and mucus discharge should alert the physician, and the patient should be taken to surgery for examination and biopsy. The criteria for this diagnosis include the following: (1) The fistula should be diagnosed several years before the malignancy is detected. (2) There should be no proximal colorectal carcinoma. (3) The internal opening should not be into the malignancy.[81]

Fistula in Crohn's Disease

The overall incidence of fistula is 22%; it is 52% in patients with colonic inflammation, and 14% in patients with small bowel involvement. Proximal colon and small bowel should be evaluated usually with colonoscopy, small bowel series, and white blood cell (WBC) scans. The internal opening may be at the dentate line or higher. Occasionally the fistula is asymptomatic and requires no treatment. In the presence of active Crohn's disease, the fistula is best managed by medical treatment (steroid and 5-acetylsalicylic acid enemas, oral steroids, immunosuppressants, metronidazole, and ciprofloxacin) and seton drainage of the fistula. Definitive fistula surgery (fistulotomy, dermal and rectal advancement flap, fibrin glue, fistula plug) is appropriate in patients with the Crohn's disease in remission.[72] Finally, a proctectomy may be the definitive treatment for complex fistulas for extensive and recalcitrant Crohn's disease. In a randomized double-blind placebo-controlled trial, early reports show a fistula-healing rate of 46% with the use of anti–tumor necrosis factor-α (TNF-α) antibodies when compared to 13% with a placebo.[82]

Fistula in Infants

This rare disease affects mostly males (85%) and usually presents in the neonatal period. Most of the tracts are simple, with an internal opening at the dentate line, and are successfully treated by fistulotomy.

Recurrent Anal Fistula

Failure to identify the tract or internal opening or to unroof an associated abscess cavity may cause fistula recurrence. In addition, a lateral position of the internal opening, complex or horseshoe type fistulas, prior fistula surgery, and the lack of experience of the surgeon have been shown to

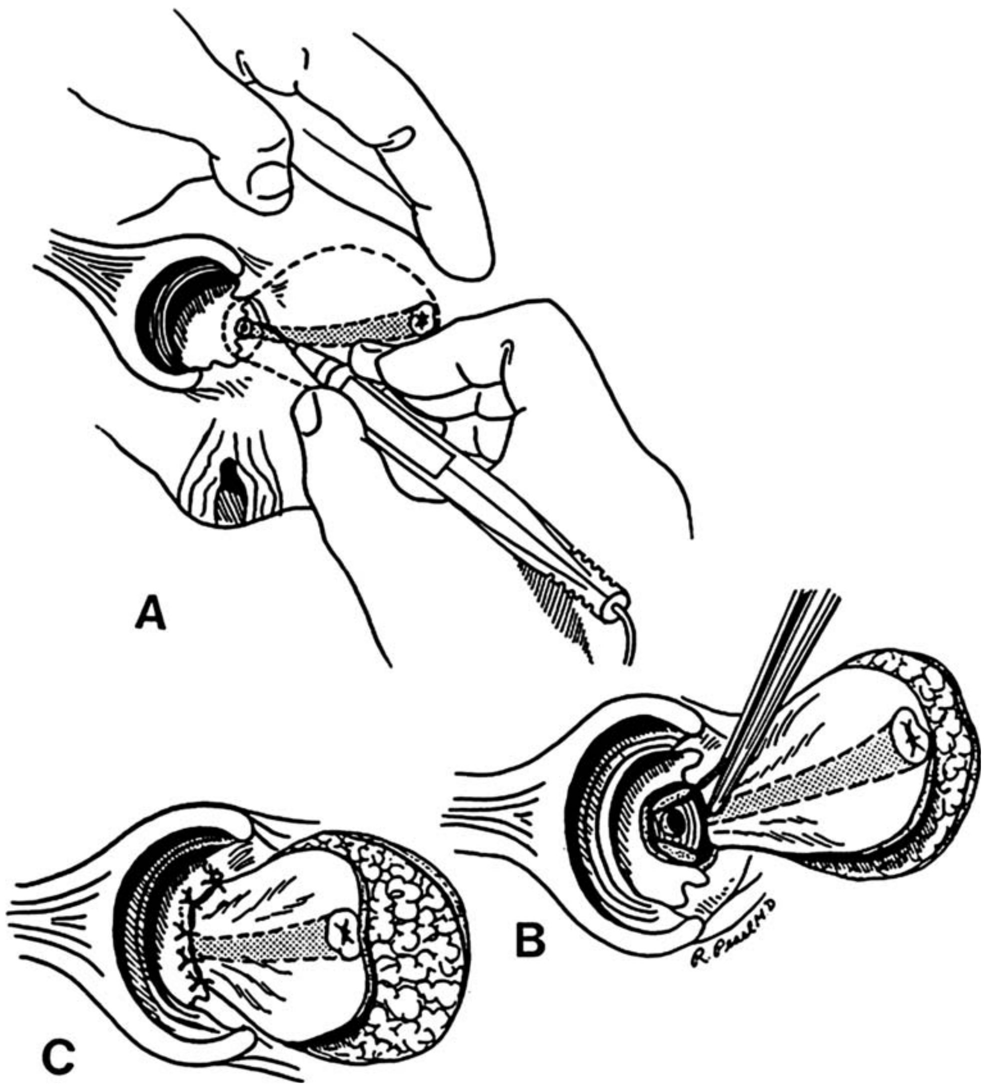

FIGURE 15.24. Dermal island flap anoplasty. (From Del Pino et al.,[71] with permission of Springer Science + Business Media.)

be associated with recurrence. Patient satisfaction is related to the degree of incontinence as well as fistula recurrence.[83,84] Even seemingly simple fistulas may have a recurrence rate of 6.5% after fistulotomy. Recurrence may be due to the inability to identify the primary opening (50%), missed secondary tracts (20%), or premature closure of the external wound. Creation of an external wound that is twice as big as the internal opening may obviate this problem.[85]

Recurrence after primary or staged fistulotomy is usually between 3% and 7%, though reports of recurrence rates of up to 18% to 29%[68,85] have been reported. Recurrence after endorectal advancement flap may be as high as 40% with long-term follow-up. Although many fistulas recur at a median of 2 months after repair, delayed recurrences after 3 years have been reported. Perioperative bowel confinement, presence of a diverting stoma, antibiotic use, type of fistula, and steroid use did not affect recurrence in

TABLE 15.9. Surgical Strategy for Recurrent Anorectal Fistulas.

1. Complete history & physical examination especially IBD, HIV, cancer, previous radiation, incontinence, operative details of previous operations.
2. Careful examination to assess for abscess, drainage palpable fistula tract, previous incisions, external or external opening, degree of induration, stenosis, continence and body habitus.
3. Occasional use of imaging studies – MRI scan - size and position of tracts, rule out presacral cyst and undrained abscess cavity.
4. control sepsis with drainage and setons.
5. In the OR probe the scar prior to opening it as it is easier to fall into the tract
6. Use peroxide to help find the internal opening
7. Open suspected anal valves,
8. Use of lacrimal probes may help finding an elusive internal opening
9. If the fistula traverses the deep post anal space – open it widely by cutting away from the sphincter.
10. Drain secondary tracts rather than laying them open –
11. Glue, plug and flaps can be redone with some success.

one large study. Crohn's disease, female gender, more than two previous repairs, and a rectovaginal location have been correlated with poorer outcomes.[86]

Failures of dermal advancement flap have been associated with male patients, large fistulas, combining rectal and dermal flaps, multiple previous procedures, and not closing the internal opening. As with endorectal advancement flaps, no factor is sufficiently associated with failure as to exclude the patient from sphincter saving surgery.[72] In addition, repeat procedures have been associated with success in many patients (Table 15.9).

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16

Urogenital Fistulas

David E. Rapp and Kathleen C. Kobashi

The urogenital fistula is a devastating condition due to an abnormal connection between the urinary and genital tracts. Urogenital fistulas are known to have occurred since prehistoric times, although documented surgical repair was not attempted until the mid-17th century.[1,2] Subsequent to this description, many refinements in surgical technique have been reported. Consequently, urogenital fistulas are associated with a minimal risk of mortality. Despite this fact, they continue to be associated with related morbidity and, more importantly, effect a huge patient and societal burden as a result of impact on quality of life and medical costs.

The complete discussion of urogenital fistulas is extensive. This chapter provides a general overview of the different types of urogenital fistulas, and describes the principles of fistula diagnosis and management. Moreover, specific focus is placed on surgical fistulas and, further, operative principles germane to the prevention, development, and treatment of urogenital fistulas. Additional focus is placed on vesicovaginal fistula owing to its prevalence.

Etiology and Epidemiology of Urogenital Fistulas

Vesicovaginal Fistula

Vesicovaginal fistula (VVF) is the most common fistula of the urinary tract (Fig. 16.1).[2] The etiology of VVF varies throughout the world. Throughout industrialized nations, VVF is a rare entity and usually results from iatrogenic injury or treatment with pelvic radiation. In contrast, VVF is a common sequela to childbirth and prolonged labor in developing nations. Irrespective of etiology, VVF represents a debilitating complication.

Surgical VVF

Iatrogenic injury to the bladder stands as the most common cause of VVF in the industrialized world. Gynecologic procedures are the most common surgical cases implicated in VVF formation, accounting for approximately 75% of VVF.[3] Abdominal hysterectomy is the most common surgical procedure associated with VVF, carrying a risk of fistula formation in approximately 1/1300 cases.[4] Other abdominal surgery associated with VVF formation include urologic and gastrointestinal surgery. Overall, the reported incidence of VVF following pelvic surgery is 0.5% to 2.0%.[3]

Surgical fistulas generally result from isolated injury to the bladder. As a result, the area of involvement is usually discrete, and surrounding tissue generally remains healthy. This is especially true of cases involving inadvertent cystotomy during sharp dissection. Injury secondary to blunt dissection, surgical clamps, or suture ligature may involve larger defects. When occurring following hysterectomy, fistula formation generally occurs at the vaginal vault.[5]

Obstetric VVF

In developing nations, prolonged and obstructed labor most frequently underlies VVF formation. The World Health Organization (WHO) reports suggest that obstructed labor is seen in 7 million women yearly, with the great majority of these women living in the developing world.[6] The estimated incidence of fistula related to obstetric complications in developing countries is 0.3% to 0.4% of deliveries.[2] Data from 1993 suggest that approximately 2 million women in developing nations worldwide had unrepaired obstetric fistula.[7] In contrast, fistula formation resultant from labor complications has been virtually eradicated in the developed world due to adequate systems of obstetric care.[6]

The development of VVF secondary to obstructed labor results from a local injury to pelvic structures when the size of the fetus exceeds that of the female pelvis during delivery.[6] With progression of obstructed labor, the vagina, bladder, rectum, and other pelvic structures become tightly compressed, resulting in loss of tissue perfusion. With time, these organs undergo a widespread ischemic insult and subsequent tissue necrosis leading to fistula formation. This mechanism leads to a large area of injury, in contrast to most surgical fistulas. As a result, tissue surrounding the central fistulous tract is often scarred and attenuated, thereby making surgical intervention difficult.[6] In contrast to surgical fistulas, obstetric fistulas are commonly located at the bladder neck.[3]

Radiation VVF

Vesicovaginal fistula is significantly associated with pelvic radiation. Certainly, the dose and type of radiotherapy affects the risk of fistula development. A retrospective review of 1456 patients undergoing combination external

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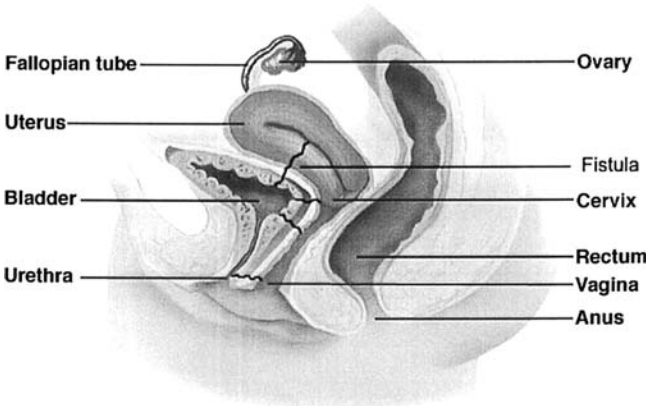

FIGURE 16.1. Common urogenital fistulas (urethrovaginal, vesicovaginal, vesicoureterine). (From Porcaro et al.,[19] with permission from Kluwer Academic Publishers.)

beam and interstitial radiotherapy revealed a 0.6% to 2.0% incidence of VVF for stage I to III cervical cancer.[8] Further, dosimetric parameters were found to correlate with morbidity. A previous report by the same group demonstrated a higher rate of VVF in cervical carcinoma patients undergoing combination radiotherapy and surgery versus surgery alone (1.6% vs. 0.9%, respectively).[9] Despite these risks, refinements in the delivery of pelvic radiotherapy continue to improve the associated morbidity.[10]

The use of adjuvant radiotherapy increases tissue attenuation and impedes healing following surgical intervention. In addition, radiation monotherapy causes a progressive endoarteritis, which may lead to fistula formation. VVF subsequent to radiation therapy (RT) may often be found at a high location within the vaginal vault.[4] Of note, the development of VVF following RT may occur many years following therapy administration.[11] When occurring following the treatment of malignancy, the possibility of disease recurrence must always be anticipated. In this setting, tissue biopsy should be performed.

Other VVF

Vesicovaginal fistula is also reported in a variety of other settings, including pessary insertion,[12] foreign body,[13] infection,[14] malignancy,[2] trauma,[2] sexual abuse or intercourse,[15] and sterilization.[16]

Urethrovaginal Fistula

Urethrovaginal fistulas (UVFs) are a rare entity. Like VVF, in the developed world, the majority of such fistulas are postsurgical. However, in contrast to VVF, a significant portion of such fistulas also occur in the setting of childbirth. In developing nations, the majority of urethrovaginal fistulas occur as a result of prolonged labor.

Surgical UVF may result following a variety of nonobstetric surgical cases. A retrospective review comprising a 34-year surgical experience for UVF found periurethral cyst surgery to most frequently underlie fistula formation.[17] Other etiologies included anterior colphorrhaphy, urethral sling placement, and periurethral bulking agent injection.[17,18]

Vesicouterine Fistula

Vesicouterine fistulas (VUFs) represent less than 5% of all urogenital fistulas.[19] Owing to the number of cesarean sections performed worldwide, however, this prevalence is increasing.[19] VUFs are usually located in a posterior, supratrigonal bladder and anterior lower uterine location.[19] The majority of VUFs occur in the setting of cesarean section. Such fistulas may result from direct iatrogenic bladder injury. Alternatively, postoperative adhesions between the bladder and uterus may develop, creating the setting for fistula formation due to local pressure in the setting of subsequent vaginal delivery. Other causes of VUF include forceps delivery, gynecologic injury, infection, and IUD placement.

Ureterouterine Fistula

Ureterouterine fistulas (UUFs) comprise 1% to 5% of fistulas involving the urinary tract and remain a rare entity.[20] Such fistulas were first reported approximately 30 years ago, with fewer than 30 cases being found in the literature to date.[21] UUFs occur most commonly in the setting of cesarean section.[22] UUF is proposed to result from prolonged compression of the distal ureter and cervix against the pelvic brim, which can lead to local ischemia. In the setting of cesarean section, uterine enlargement and rotation due to fetal growth can result in positioning of the distal ureter in close proximity to the prospective incision site. As such, iatrogenic injury is possible.[21,23] UUF may also occur in the setting of ureteral calculi and medical termination of pregnancy.[24,25]

Ureterovaginal Fistula

Ureterovaginal fistulas (UrVFs) are also uncommon. One retrospective review comprising a 10-year experience with urogenital fistulas found UrVF to represent 21% of all fistulas.[26] UrVF occurs most commonly subsequent to hysterectomy, with such surgery accounting for approximately 80% of UrVF.[26,27] UrVF is reported more commonly in the setting of total versus subtotal hysterectomy.[26] Other causes of UrVF include cesarean section injury, radiotherapy, and trauma.[26]

Evaluation and Diagnosis of Urogenital Fistulas

Presentation

The presentation of urogenital fistulas is dependent on fistula type. Vaginal drainage of urine is characteristic of all fistula types. However, whereas patients with VVF, UUF, and UrVF may exhibit continuous urinary drainage, those with UVF may report minimal or intermittent leakage due to a fistula location beyond the sphincter mechanism. Of note, patients may not associate vaginal drainage with urine, believing that the fluid leakage is of vaginal origin. VUF presentation is dependent on fistula location. Total vaginal urinary leakage may occur when the fistula opening is located beyond the internal cervical os, whereas the isthmic sphincter may prevent vaginal leakage for more proximal fistulas.[19] Passage of menstrual blood into the bladder may also characterize VUF. In addition to urinary leakage, irritative complaints due to urine contamination are common and include skin irritation, pain, and fungal infection.

Physical Examination

A thorough pelvic examination with speculum is essential to fistula diagnosis. Visualization of fistula location may be possible with VVF or UrVF, whereas UVF is commonly visualized on examination. When visible, attention should be placed on fistula characteristics, including size, location, associated infection/inflammation, and vault size. Combined, these features may help the surgeon to plan the timing and approach of surgical repair. A careful manual exam is necessary and care should be taken to exclude the presence of a foreign body or pelvic mass.

Further investigation may be performed using a tampon test or a described variation. Accordingly, a tampon or multiple swabs are placed in the vagina, and diluted methylene blue instilled per urethra. Dye presence at the top, middle, and lower portions of the tampon suggests VUF, VVF, and UVF, respectively. Conversely, dye instillation may be performed in accordance with a speculum exam. Dye passage from the cervical os is suggestive of VUF, whereas direct visualization of dye from the fistula site may be seen with VVF or UVF. Finally, a double dye test using oral phenazopyridine may aid in the diagnosis of UUF and UrVF and produces an orange discoloration corresponding to the fistula location. A complete investigation is mandatory as the presence of multiple fistulas is not uncommon.[2]

Cystoscopy

Cystoscopy should be performed in the investigation of urogenital fistulas. Cystoscopic exam may reveal a mature ostium and fistula tract. When a discrete fistula opening is not visible, periostial inflammation, erythema, and edema may identify the fistula location. A guidewire may be used to aid in fistula identification. Alternatively, a guidewire may be placed vaginally to facilitate visualization of the bladder ostium. A history of pelvic malignancy must always raise suspicion for recurrence, and fistula biopsy is warranted in these cases. If previous upper tract imaging with intravenous pyelography (IVP) has not been previously performed, retrograde pyelography is done in this setting.

Imaging

Upper tract imaging is necessary irrespective of fistula type to rule of the presence of multiple fistulas. As previously discussed, this may be performed in the same setting of cystoscopy with retrograde pyelography. Alternatively, IVP may be obtained preoperatively in patients with high suspicion for ureteral involvement. Voiding cystourethrography and cystography are additional imaging modalities that may be used for diagnostic information. Finally, computed tomography (CT) and magnetic resonance imaging (MRI) are reported in the diagnosis of urogenital fistulas.[28,29] With these imaging modalities, intravenous contrast may be visualized within the genital tract. Finally, CT and MRI may be used to rule out the presence of a foreign body or pelvic mass. We believe that a thorough physical examination, tampon test, cystoscopy and upper tract imaging are adequate for evaluation of urogenital fistulas. In general, additional imaging modalities add little sensitivity and identifying information to the diagnostic evaluation.

Urodynamics

Urodynamic evaluation is not routinely performed in the diagnostic evaluation of urogenital fistulas. Despite this practice, the data suggest that a high incidence of storage and voiding abnormalities are associated with urogenital fistulas. A urodynamic investigation of 30 women with urogenital fistulas found that only 17% had normal urodynamic findings.[30] In contrast, voiding dysfunction, stress incontinence, and detrusor instability were seen in 50%, 47%, and 40% of patients, respectively. Fifty percent of these patients had more than one abnormality. Following surgical repair, isolated urinary complaints remained in almost 30% of the patients, although significant symptom improvement or resolution was seen in the vast majority. Based on these data, the importance of documenting preoperative voiding dysfunction has been highlighted to discriminate urinary pathology resultant from surgical repair.[4] Other authors report the use of urodynamic evaluation only in the setting of urgency.[17] While we do not routinely perform urodynamic evaluation for the urogenital fistula evaluation, we feel that it may be helpful if additional voiding dysfunction is suspected. Further, a careful discussion with each patient describing the possibility of lower urinary tract abnormalities is mandatory prior to surgical intervention.

Surgical Principles of Fistula Prevention

Certainly, fistula prevention through the avoidance of iatrogenic lower urinary tract injury during pelvic surgery is critical to pelvic surgeons. A variety of risk factors for subsequent VVF development may help the surgeon identify the patient population at greatest risk for VVF. Such risk factors include prior uterine surgery, prior radiation therapy, recent cold-knife cervical conization, sepsis, endometriosis, pelvic inflammatory disease, and malignancy.[2,4,31] Despite the identification of such risk factors, a retrospective review of VVF by Tancer[31] found that nearly 70% of fistulas occurred in the absence of definable risk factors.

Given the significant association between hysterectomy and VVF, specific operative techniques should be utilized to minimize the risk of fistula formation irrespective of the presence of risk factors. Bladder injury is most common during mobilization of the bladder from the cervix.[4] Accordingly, sharp dissection during this portion of hysterectomy is recommended as blunt mobilization increases the risk of iatrogenic bladder injury.[4] Bladder mobilization is recommended prior to ureterosacral ligament ligation in order to avoid bladder injury. Bladder injury during the initial abdominal incision is also reported, comprising 15% of bladder injuries in one investigation.[32] In general, the avoidance of cautery and suture tension is advised. In the advent of pelvic bleeding during hysterectomy, adequate visualization is necessary to avoid bladder injury during placement of hemostatic sutures.[2] In the advent of iatrogenic urinary tract injury, intraoperative recognition and management are crucial to the avoidance of long-term sequelae. Graber and colleagues[33] reported a 2% injury rate to the bladder in a case series of 819 hysterectomies. One of 11 patients suffering a recognized intraoperative injury with subsequent repair had a resultant fistula development. In contrast, all five patients with undiagnosed bladder injury developed subsequent VVF. These findings are corroborated in other investigation.[32] Intraoperative bladder injury is easily managed through a standard single- or two-layer closure. Repair integrity is assessed via intraoperative bladder distention. More recently, the use of fibrin glue is reported as a bolster to standard suture repair of intraoperative bladder injury.[34]

Injury involving the trigone must raise suspicion for concurrent ureteral injury. In this circumstance, the bladder should be opened and the ureteral orifices cannulated with a standard guide wire. Methylene blue can be used to aid in orifice identification. The inability to pass a guide wire without resistance is a sign of ureteral injury, which must be repaired intraoperatively. Standard ureteroureterostomy is generally possible, though ureteroneocystostomy may be necessary in cases of significant injury. Following bladder repair, prolonged bladder drainage is instituted, and the repair is monitored using a standard perivesical drain. In uncomplicated cases, cystography is not routinely performed prior to catheter removal in the absence of significant perivesical drain output.

Management of the Vesicovaginal Fistula

The management of urogenital fistulas is often complex and may be approached using a variety of surgical and nonsurgical treatments. In selecting the appropriate treatment approach, the distinction between simple and complex fistulas is integral.[35] A simple fistula is characterized by normal tissue margins. Accordingly, surgical closure can be accomplished using a standard multilayered closure. In contrast, closure of complex fistulas presents a greater surgical challenge. Classification of complex fistulas include fistulas associated with extensive loss of tissue, involvement of the sphincteric mechanism, or the presence of factors that may inhibit postsurgical healing. Further, the failed primary closure of a simple fistula results in its reclassification as a complex fistula.[35] The additional distinction between underlying fistula etiology (e.g., obstetric, surgical) may also be an important consideration. Other classification systems are proposed and are predominantly based on fistula location, size, and type.[36] Nonetheless, no classification system has been shown to correlate with surgical outcomes.[6]

Conservative Management

Conservative management is initially recommended for most cases of VVF. Nonetheless, the vast majority of VVFs will require surgical intervention to achieve resolution.[3] Conservative intervention using prolonged catheter drainage and anticholinergic pharmacotherapy is reported by many, with varying success rates. A spontaneous closure rate of 2% was reported in one large series including 151 VVFs.[31] Other smaller reviews report variable spontaneous closure rates, ranging from 0% to 100%.[37] The optimal duration of drainage remains unknown; however, surgical intervention has been advocated for fistulas failing to resolve after 4 weeks of conservative therapy.[38] A recent review evaluating use of bladder drainage alone for VVF found that the interval to bladder drainage had the highest correlation with spontaneous closure.[37] Catheter drainage initiation less than 3 weeks from insult was associated with a significantly higher closure rate when compared with an interval greater than 6 weeks. Other assessed criteria included fistula etiology, size, and duration of drainage.

Surgical Repair: General Principles

Timing of Repair

Classic teaching suggests that a delay period of several months should be observed prior to surgical repair to allow for resolution of tissue edema and inflammation.[39,40] More recently, early repair of VVF has been advocated, in particular for surgical VVF.[41–45] Accordingly, Blaivas et al.[44] report no difference in outcome when comparing early versus late repair of VVF. These results are complicated by the use of a variety of surgical approaches (e.g., abdominal, vaginal) and techniques (e.g., tissue interposition). Based on these results and a literature review, the authors conclude that postponing repair after local inflammation has resolved provides no additional benefit and has a significant impact on quality of life. Medicolegal aspects of fistula repair also represent a contemporary concern, with some authors reporting that the high number of legal claims related to fistula development may be compounded by an unnecessary delay in repair.[4]

Preoperative Issues

Preoperative measures are aimed at optimizing tissue health and sterility prior to intervention. Accordingly, minimizing local urine contamination is important and may be accomplished through the use of a urethral catheter. Additional urinary diversion is usually unnecessary. Suprapubic catheter insertion may be beneficial in the setting of a low fistula involving the bladder neck. Broad-spectrum antibiotics are routinely administered in the perioperative setting, though isolated data suggest this may not improve surgical outcomes.[46] No data are presented to suggest that a prolonged course of preoperative antibiotics provides benefit in improving surgical outcomes. Additional standard perioperative measures, such as deep venous thrombosis (DVT) prophylaxis are recommended owing to the increased risk associated with pelvic surgery. Preoperative estrogen supplementation has been advocated due to its ability to improve vascularity and local health of vaginal tissue.[3] Topical estrogen application may also be associated with similar tissue benefits.[47] Despite these benefits, no data are published to suggest that improved outcomes are achieved through topical or oral estrogen supplementation. Finally, the preoperative use of cortisone has been advocated; however, a paucity of data exists to support steroid use in this fashion.[48,49]

Surgical Repair: Minimally Invasive Approaches

Sealants

The use of fibrin glue in the treatment of urogenital fistulas is reported. Fibrin glue acts as both a hemostatic agent and an adhesive that allows for formation of a tissue coagulum at the fistula site. Injection may be performed using an endoscopic or vaginal approach. Early experience using fibrin glue for VVF closure was associated with a 66% success rate.[50] Subsequent small series have achieved similar success using fibrin glue in the treatment of select VVF.[51–53] These reports describe injection of fibrin glue alone or in combination with concurrent interventions (e.g., percutaneous diversion) or additional injectable agents. Morita and Tokue[54] report the successful use of fibrin glue and bovine collagen to treat a radiation-induced VVF. In this approach, injection of fibrin glue and bovine collagen was performed in conjunction with electrofulguration using a combined endoscopic and vaginal approach (Fig. 16.2).

More recently, experience using synthetic injectables is described. Most notably, Muto et al.[55] report a 66% closure rate using cyanoacrylic glue for VVF. Cyanoacrylic glue is a synthetic sealant with excellent adhesive, hemostatic, and antibacterial properties, supporting its utility in the treatment of fistulas. This synthetic is eliminated gradually via hydrolytic degradation and polymerizes in a wet environment, suggesting advantages over biologic glues such as fibrin. Owing to its adhesive properties and rapid polymerization time, rapid injection and the avoidance of excessive glue injection is recommended.[55]

Irrespective of agent choice, proper patient selection is critical. Muto et al.[55] suggest that treatment efficacy is related to length and inversely related to width of the fistula tract, based on treatment failures in patients with short fistulas and orifice diameters larger than 1 cm. In addition, appropriate fistula location and tract visualization are necessary to optimize injection efficacy. Despite the reported success using tissue sealants, surgical repair remains the gold standard, and such treatment modalities are best reserved for highly complex patients with significant surgical risk.

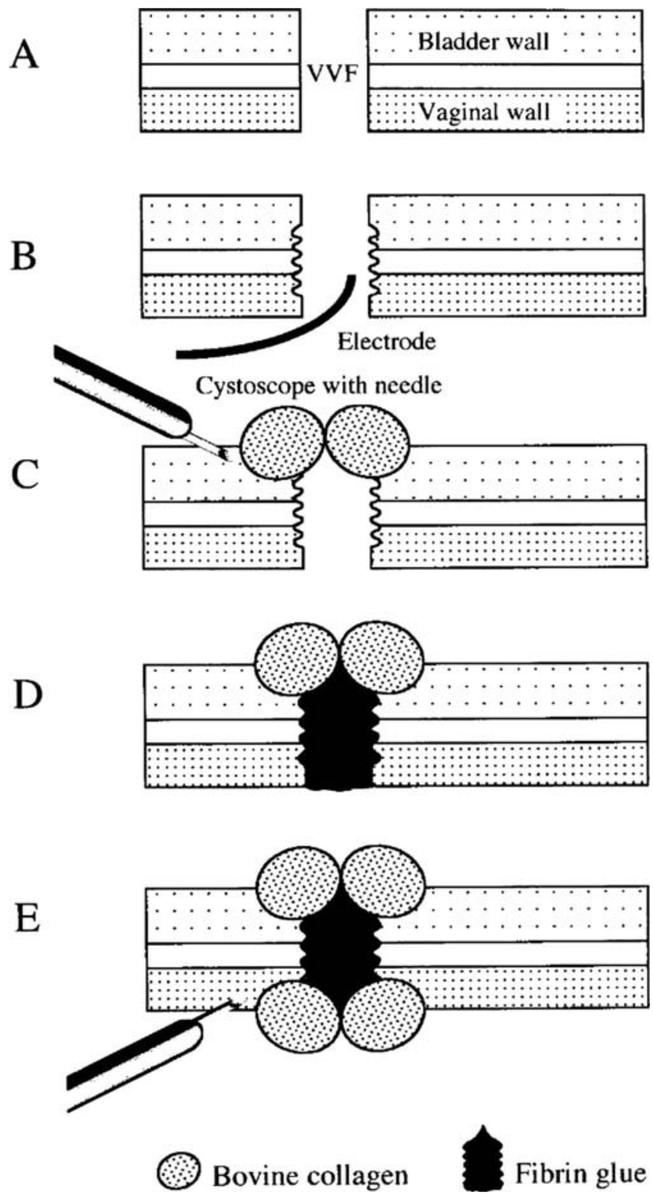

FIGURE 16.2. (**A–E**) Combined transvaginal and transurethral injection of fibrin glue and bovine collagen of vesicovaginal fistula repair. (From Morita and Tokue,[54] with permission from the American Urological Association [AUA], Inc.)

Thermal Ablation

The use of thermal energy for fistula ablation is reported for over 50 years.[2] Stovsky and colleagues[56] report a 75% closure rate using electrocautery for tract ablation of VVF as a primary treatment modality. In addition, a 66% success rate was observed with electrocautery as a secondary treatment following failed open surgical repair. Fistula diameter was less than 3.5 mm in each case. More recently, Dogra and Nabi[57] report success using endoscopic neodymium:yttrium-aluminum-garnet (Nd:YAG) laser fulguration of a small VVF, providing an additional thermal-based option. As with other less invasive options, these interventions are best suited for the treatment of select patients with small diameter fistulas.

Cystoscopic Intervention

McKay[58] described a minimally invasive stepwise approach using a cystoscopic suturing technique. Initially, transvaginal tract ablation using electrocautery is combined with suture closure. A suprapubic cystostomy is performed in the same setting. In the advent of treatment failure following 2 weeks of suprapubic urinary diversion, secondary repair using transurethral cystorrhaphy is undertaken. Accordingly, an arthroscope is passed via the previously developed suprapubic tract, and interrupted suture closure is performed using a laparoscopic needle driver passed per urethra. These authors report success using this technique in a small series of patients with simple fistulas of less than 8 mm.

Surgical Repair: Open Techniques

Surgical Principles

The use of specific surgical principles is important to optimizing repair success, irrespective of the approach chosen. Initially, this involves mobilization of the bladder, the use of sharp dissection, resection of scar and devitalized tissue, removal of foreign bodies, and achieving excellent exposure of the fistula tract. Principles of fistula repair include closure using healthy tissue flaps, achieving a multiple layer and watertight closure, avoidance of flap tension, and the use of nonabsorbable suture, and may include tract excision (discussed below). Following fistula closure, adequate urinary drainage, hemostasis, and avoidance of infection become paramount (Table 16.1).

Classic teaching supports the complete excision of the fistula tract.[2] Accordingly, tract excision and removal of scar tissue may ensure the approximation of healthy, vascularized tissue during fistula closure. Other authors prefer to avoid fistula tract excision under the belief that tract excision is unnecessary and may be deleterious to repair outcome.[59,60] Eilber et al.[59] report that tract excision is avoided, as this technique enlarges fistula size and may potentiate bleeding, thereby requiring cautery and subsequent tissue damage. When performed, a margin of only 1 to 2 mm is required.[61]

TABLE 16.1. Surgical Principles of Fistula Prevention and Repair.

Fistula prevention
- Identification of risk factors (radiation, malignancy, pelvic inflammatory disease, etc.)
- Use of sharp dissection
- Avoidance of cautery
- Avoidance of suture tension
- Excellent visualization during hemostasis
- Intraoperative recognition of iatrogenic injury and appropriate repair

Fistula repair
- Adequate tissue mobilization
- Adequate fistula visualization
- Use of sharp dissection
- Avoidance of cautery
- Removal of foreign bodies, scar tissue
- Fistula tract excision*
- Use of healthy tissue flaps
- Two-layer, watertight, tensionless closure
- Use of tissue interposition
- Adequate postoperative urinary drainage

*Controversial.

Abdominal Versus Vaginal Approach

Fistula repair may be undertaken via a vaginal or abdominal approach. Arguably the most important factor is surgeon comfort and experience, as most fistulas can be approached using either technique. A variety of additional factors merit consideration in this decision. Fistula locations that may be more appropriate for transabdominal approach include those situated high within the vaginal vault, especially when exposure is compromised by small vault size. Conversely, bladder neck fistulas may be more difficult to expose via this approach. Several other advantages are associated with the transabdominal approach. Accordingly, this approach allows for ureteral reimplantation when necessary, provides easy access to a variety of interposition flaps, and generally avoids the risk of vaginal shortening that may be associated with vaginal repairs. In contrast, the transvaginal approach allows for avoidance of the previous operative field, and is associated with minimal blood loss and postoperative pain, decreased hospital stay, and rapid convalescence.[42,62] However, techniques using a limited transabdominal repair are reported to offer comparable success rates, morbidity, and hospital stay when compared to the transvaginal approach.[63] Using a transvaginal approach, midurethral anti-incontinence procedures may also be easily performed. In the advent of repair failure, excellent success may be achieved using subsequent transabdominal repair.[59] While associated closure rate is arguably the most important consideration, direct comparison of outcomes associated with these approaches is complicated by the variability of fistula characteristics, such as size, location, and etiology. Nonetheless, data suggest that excellent outcomes may be achieved using both approaches (discussed below).

Transabdominal Technique for Vesicovaginal Fistula Repair

Multiple transabdominal approaches for repair of VVF are described. A complete description of these surgical options is beyond the scope of this chapter. Briefly, fistula repair may be undertaken in a transvesical or supravesical approach (Figs. 16.3 and 16.4). Via either approach, the bladder is opened and incised to the level of the fistula, which is then excised. The bladder is simultaneously mobilized from the vagina to allow for closure. The vagina and bladder are then each closed with two layers, alternating a continuous layer with interrupted sutures. The popularized O'Conor operation is an example of one such technique; using this technique, O'Conor[64] states that he prefers a supravesical approach due to the ability to avoid adherent bowl and mobilize omentum for interposition. Subsequent to its initial description over 50 years ago, success rates of 90% may be generally achieved using this technique.[65]

Transvaginal Technique for Vesicovaginal Fistula Repair

Multiple transvaginal approaches for repair of VVF are also reported. The popular Latzko technique involves patient placement in the dorsal lithotomy position (Fig. 16.5). Alternative positioning in the prone (Kraske) position to

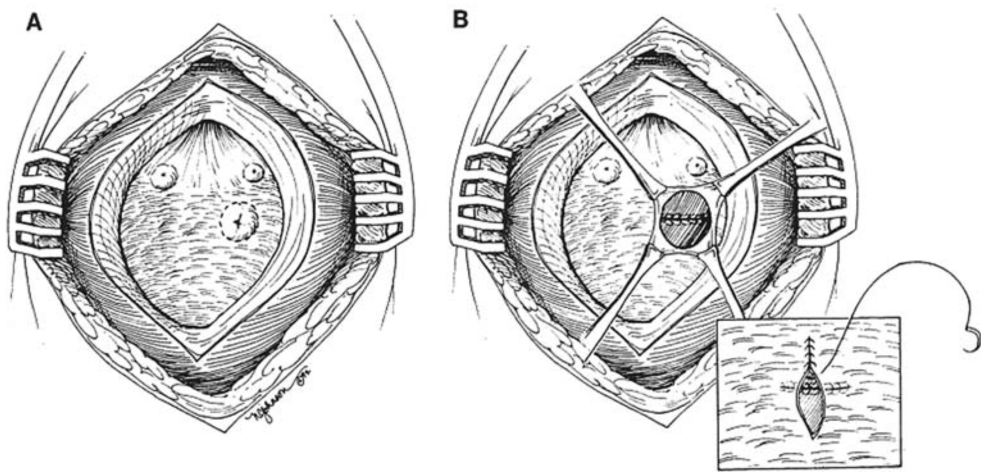

FIGURE 16.3. (**A** and **B**) Abdominal transvesical technique for vesicovaginal fistula repair. (From Gerber and Schoenberg,[38] with permission from AUA, Inc.)

achieve better visualization is also described.[64] This technique is initiated with a generous episiotomy. The vaginal mucosa is then denuded in a circular fashion including both the anterior and posterior vaginal walls. Accordingly, the vaginal mucosa is completely removed over an area beginning approximately 1.5 cm distal to the fistula. The fistula and the remaining vaginal mucosa are then closed in multiple layers, resulting in a shortening of the vaginal vault. As originally described, this repair is performed in conjunction with hysterectomy. Again, success rates of 90% or greater are reported with this approach.[5,66]

Surgical Outcomes Following Open Repair of Vesicovaginal Fistula

Analysis of outcomes data following open VVF repair is complicated by the variety of approaches and surgical repairs, the variability of tissue interposition use, and the wide range of fistula etiologies and complexity. Nonetheless, excellent outcomes are achieved in numerous series, irrespective of approach and technique used. A list of contemporary series of VVF repair is provided in Table 16.2[42,44,45,59,60,62,67–75].

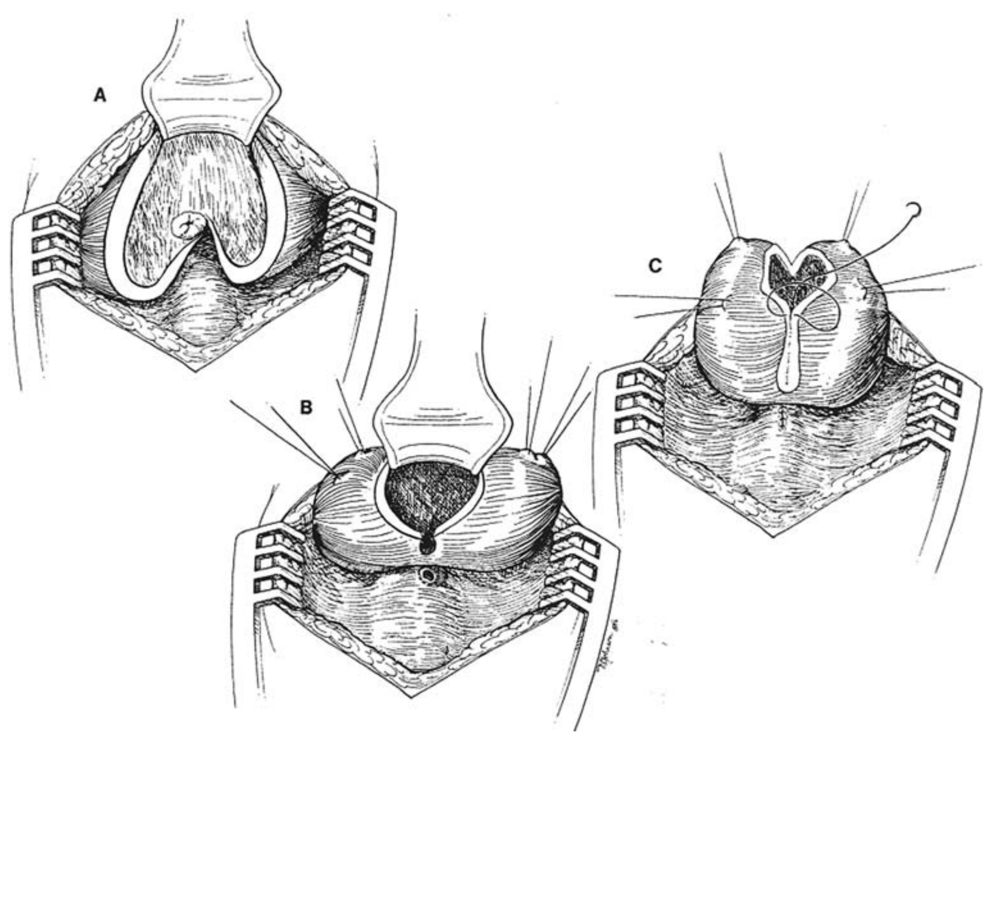

FIGURE 16.4. (**A–C**) Supravesical repair for vesicovaginal fistula. (From Gerber and Schoenberg,[38] with permission from AUA, Inc.)

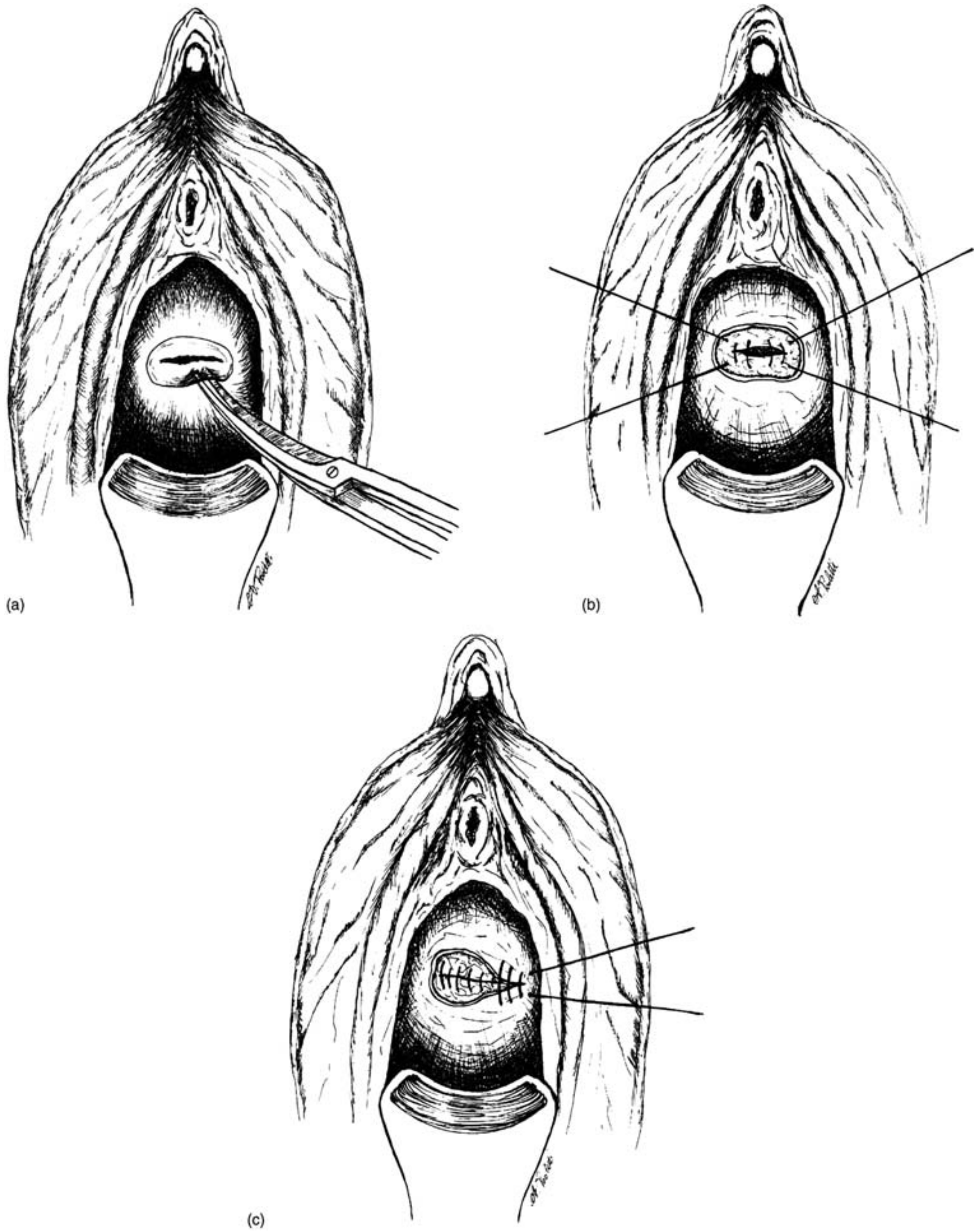

FIGURE 16.5. Latzko technique for transvaginal repair of vesicovaginal fistula. (**A**) Excision of vagina wall. (**B**) Imbrication of bladder wall. (**C**) Closure of vaginal wall. (From Angioli et al.,[109] with permission from Elsevier, Inc.)

Open Versus Laparoscopic Approach

More recent experience has been reported using the laparoscopic approach to VVF repair. Described techniques utilize principles of fistula repair common to the transabdominal approach. In addition, tissue interposition techniques are described via the laparoscopic approach.[76] Sotelo and colleagues[77] report the laparoscopic repair of 15 patients with VVF. At 26-month follow-up, a cure rate of 93% (14/15) was seen. Ou et al.[78] report the comparison of laparoscopic, transabdominal, and transvaginal approaches in small patient series. Success rates of 100%, 100%, and 86% were seen following laparoscopic, transabdominal, and transvaginal repair, respectively. Based on their experience, these authors suggest that the laparoscopic approach is associated with decreased morbidity, shorter hospital stay, and a more rapid recovery, as compared with an open technique. Sundaram and associates[79] describe the successful robot-assisted repair of five cases of VVF with short-term follow-up. Similar to experience with the laparoscopic approach, these authors associated decreased morbidity and convalescence with the robotic approach.

Surgical Repair, Tissue Interposition

Tissue interposition techniques may be advantageous in the setting of complex fistulas. Examples of criteria used for tissue interposition include fistulas larger than 2 cm,

TABLE 16.2. Contemporary Outcomes Following Surgical Repair of Vesicovaginal Fistula.

Repair type *Year*	*Author*	*Patients (n)*	*Success rate (%)*	*Comments (C)/Conclusion (N)*
Transabdominal				
1991	Blandy[45]	25	100	N: no disadv to early repair
1994	Kristensen[67]	18	94	C: complex fistulas
2003	Dalela[68]	26	100	C: O'Conor, omental interposition
Transvaginal				
1990	Wang[42]	16	94	N: 100% success for nondelayed
1998	Iselin[62]	20	100	C: 35% secondary repairs
2006	Roenneburg[69]	65	57	C: 17% failure, 26% lost to fu
2006	Ansquer[70]	11	100	
Transvaginal/transabdominal				
1994	Arrowsmith[71]	98	81,96 (2nd repair)	
1994	Elkins[72]	82	88,95 (2nd repair)	C: complex fistulas
1995	Ayhan[73]	70	93	
*Tissue interposition**				
1993	Raz[60]	11 (all peritoneal)	82	C: TV
1995	Blaivas[44]	24 (16 Martius	96 (overall)	C: TV/TA
		7 omental		C: TV
		1 gracilis)		
2003	Eilber[59]	207 (83 peritoneal	97	
		34 Martius	96	C: TV/TA
		3 full thick lab	33(97 overall)	
2005	Vyas[74]	22 (all bladder muc allograft)	91	
2005	Lentz[75]	6 (all peritoneal)	100	C: TV

*Included series with greater than 50% interposition rate.
fu, follow-up; TV, transvaginal; TA, transabdominal; muc, mucosa.

radiation-induced fistulas, those associated with attenuated tissue or difficult closure, ischemic fistulas, and those recurring following a previous repair attempt.[2,59] Other authors report an improved success rate using flap interposition in not only complex fistulas but also simple fistulas as well.[80] A variety of tissue interposition techniques are described and choice of tissue interposition is based on surgeon comfort and type of repair. Accordingly, omental and rectus muscle flaps are commonly used in association with the transabdominal approach, whereas the labial fat pad or peritoneal interpositions are commonly performed via the transvaginal approach.

Martius Flap

The Martius flap takes its name from the first description in 1928 by Heinrich Martius.[81] The Martius flap comprises adipose and connective tissues supplied from the labium majus. The flap blood supply is provided posteriorly, superiorly, and laterally, respectively, by the posterior labial, external pudendal, and obturator vessels. The flap is developed via a vertical incision to the labium majus and tunneled through the vaginal wall. Given the location of the flap pedicle, the Martius interposition is ideally suited to low fistula. Conversely, fistulas located at a high position in the vaginal vault may require tension to achieve flap coverage and result in vascular compromise.[2,61] Disadvantages of the Martius flap technique include the necessity of a second skin incision and the possibility of vault shortening.[59] Nonetheless, the simplicity and effectiveness of this technique have resulted in its common use in fistulas repairs.

Rangnekar and colleagues[82] report the comparison of simple repair for VVF versus repair using the Martius flap. These authors report the Martius flap to be associated with an improved cure rate (100% versus 81%). Although this advantage was pronounced in patients with recurrent or multiple fistulas, it was also seen in the treatment of simple fistulas. Such data may suggest the value of routinely using interposition techniques in the treatment of not only complex fistulas but also simple fistulas as well. Eilber et al.[59] report a comparison of the Martius flap, peritoneal flap, and full-thickness labial flap in the treatment of VVF. The Martius flap was associated with a cure rate of 97% and was found to be comparable to the peritoneal flap. A modified Martius flap with full-thickness skin island is reported and may be used to repair complex fistulas with large vaginal defects.[83,84] This technique is associated with highly variable cure rates, presumably owing to the complex nature of repair undertaken.

Peritoneal Flap

The peritoneal flap is more commonly used in the transvaginal repair of high-lying VVF. Flap harvest is performed by approaching the peritoneum of the anterior cul-de-sac beyond the bladder wall. Mobilization of the peritoneum allows for fistulas coverage without entering the peritoneal cavity. The flap is then secured using nonabsorbable suture. Advantages of this technique include its simplicity and the avoidance of an extravaginal harvest site and incision.

The VVF repair using peritoneal flap interposition is associated with excellent cure rates. Raz et al.[60] report an 82% cure rate in 11 patients undergoing transvaginal VVF repair with peritoneal interposition. A cure rate of 97% to 100% is reported in additional investigation, with minimal complications.[59,75] Further, excellent success using the peritoneal flap is reported following previous failed VVF repair.[59]

Omental Flap

The greater omentum may be used for tissue interposition during the transabdominal approach. The vascular supply of the greater omentum is supplied from the gastroepiploic arteries, with additional contributions from the gastroduodenal and splenic arteries. Advantages of this technique include its simplicity and the ease of mobilization via a well-vascularized pedicle.

Evans and colleagues[80] report a retrospective review of 37 patients undergoing transabdominal repair of VVF with and without omental flap interposition. A significantly improved cure rate was associated with flap interposition in the treatment of benign fistulas (100% versus 63%, respectively). No significant morbidity and complications were associated with flap repair.

Muscular Flaps

A variety of muscular flaps may be used in the repair of VVF. More commonly reported techniques include rectus muscle interposition via the transabdominal approach and gracilis muscle interposition via the transvaginal approach. Despite the more limited experience reported using these techniques, excellent outcomes have been achieved.[85–88] In general, muscular flaps are a more complex reconstructive adjunct and may be best suited for an interdisciplinary approach involving genitourinary and plastic reconstruction teams. Additional morbidity including nerve neuralgia and donor site defects is a risk of these flap techniques.[87,88]

Postoperative Issues

Specialized postoperative care is essential to optimizing success following VVF repair. Accordingly, adequate urinary drainage is crucial to avoid intravesical pressure and repair stress. As previously described, single urethral catheter drainage or dual-catheter drainage via suprapubic cystostomy may be used. Dual-catheter drainage protects against bladder distention in the advent of single-catheter malfunction. However, additional discomfort due to bladder spasms may be associated with dual-catheter insertion. Bladder spasms may be treated acutely with belladonna and opium suppositories, whereas anticholinergic blockade may be used for longer-term management. An initial period of bed rest may be used, although we prefer to avoid restriction of more than 24 hours. Antimicrobial therapy is used for 24 hours, although no evidence is reported to suggest improved outcomes with postoperative antibiotics. Catheter drainage is generally performed for 2 to 4 weeks, depending on the complexity of the repair. Close monitoring for vaginal leakage is assessed by patient interview. Although leakage is most commonly associated with bladder spasms, the presence of early vaginal leakage may be an ominous sign, and will often dictate a longer period of postoperative catheter drainage. Avoidance of sexual intercourse is generally advised for a period of 8 weeks, and may be extended in more complex reconstructive cases. Cystography is routinely performed in our practice prior to catheter removal.

Management of Additional Urogenital Fistulas

Urethrovaginal Fistula

Surgical repair is generally required for the treatment of UVF. Limited data are available regarding the use of injectable agents for primary or adjunct treatment of UVF. As is common to other fistulas subtypes, there is no consensus regarding the ideal timing of surgical intervention. The transvaginal approach is preferred for UVF repair. Surgical repair is initiated with mobilization of the vaginal and urethral walls. The fistula defect is then visualized by passing a metal sound into the urethra. Fistula tract excision is generally minimized in order to preserve urethral tissue and prevent postoperative urethral stenosis. Accordingly, the use of a proximal urethra or bladder flap may be useful for defect coverage. A standard two-layer closure is performed and the integrity tested to ensure a watertight repair. Finally, the vaginal wall is closed in standard fashion. A urethral catheter is maintained for 7 days.

A limited number of series assess the outcomes following UVF repair.[17,89–92] In these series, cure rates following primary repair range from 70% to 92%. Success rates range from 92% to 100% following a second operation in these limited cases. Significant complications or morbidity are not reported with VUF repair. Given the nature of UVF repair, stress urinary incontinence (discussed below) and urethral stenosis are potential complications. A urethral stenosis rate of approximately 6% is reported in the literature to date.

The use of tissue interposition may have a more limited role in UVF repair.[17] Owing to the minimal space between the vagina and urethra, tissue insertion is difficult, and significant vaginal mobilization may be required. Despite these issues, other authors report the use of labial fat and rectus abdominus flaps in UVF repair.[82,93] Rangnekar et al.[82] reported a retrospective review of 12 patients undergoing UVF repair, of which eight underwent Martius flap interposition. The cure rate was 88% and 25% in the cohorts undergoing Martius interposition versus simple anastomosis, respectively.

Stress urinary incontinence should be anticipated following UVF repair. Pushkar et al.[17] report that 52% of patients developed stress urinary incontinence within a 3-month period following fistula repair. All patients underwent anti-incontinence surgery, with nearly 60% of patients achieving objective cure and an additional 32% achieving subjective satisfaction. A variety of anti-incontinence procedures were used and no subset analysis is reported to compare sling types. Based on their experience, the authors suggest that the procedure of choice is the transobturator synthetic sling as a result of the decreased tissue mobilization required via this approach.

Vesicouterine Fistula

Spontaneous closure of VUF is rare, occurring in approximately 5% of cases.[19] Closure is more likely to occur rapidly following surgery as a result of the process of recovery of uterine tone.[94] Accordingly, an initial trial using bladder catheterization for 1 to 2 months is appropriate. Hormonal therapy is another conservative option in these patients. A combination of levonorgestrel and ethinyl estradiol for 6 months is suggested in order to induce amenorrhea and prospective fistula closure.[19] Jozwik and Jozwik[95] reported spontaneous closure rates of 89% (8/9) and 4% in a comparison of patients receiving versus not receiving hormonal therapy, respectively. A trial of hormonal therapy is specifically recommended in patients presenting with Youssef's syndrome.[19] Irrespective of the decision to use hormonal intervention, a waiting period is recommended prior to surgical repair to allow for uterine involution.[96]

Minimally invasive treatment options for VUF are limited. Molina et al.[97] report the successful closure of a small VUF using cystoscopic fulguration, although there is a paucity of other reports using endoscopic treatment modalities. The open surgical repair of VUF is generally approached via the abdominal route, owing to a more limited exposure available transvaginally. As with other repairs, the bladder is mobilized from the uterus/cervix and the fistula tract is identified. Attenuated tissue is removed and the tract closed in one or two layers. This repair is approached in a transperitoneal fashion. Accordingly, complete mobilization of the bladder and uterus, as well as ureteral identification, is possible.[98] In addition, the approach allows for hysterectomy, although uterine removal is generally not necessary for fistula repair. Alternatively, an extraperitoneal transvesical approach is described.[96,99] Via this approach, the bladder is opened, the fistula tract identified, and the posterior bladder wall sharply dissected from the anterior surface of the uterus. Both the bladder and uterine walls are closed in standard two-layer fashion. As with other abdominal approaches, flap interposition using omentum or peritoneum are advised. Alternative flap coverage unique to VUF repair includes a myouterine flap.[19] Finally, successful laparoscopic repair of VUF is also described.[100] Irrespective of the approach undertaken, good outcomes are reported.[19,96,99–101] Fertility is an important consideration to VUF. Impaired fertility is associated with VUF, and fistula repair is reported to restore fertility potential in a portion of patients.[98,102] Despite this fact, fertility following fistula repair may be limited. The rate of pregnancy and term delivery after VUF repair is 31% and 25%, respectively.[19] Following VUF repair, subsequent delivery should be performed via cesarean section to decrease the risk of VUF recurrence.

Ureterouterine Fistula

There is only limited experience with UUF management, owing to the rarity of this entity. Management of UUF should be approached with the initial goal of renal function preservation and avoidance of infection. Spontaneous healing of UUF is reported, but is found to be independent of a number of proposed predictors such as the number of affected ureters, patient age, and duration of incontinence.[103] Accordingly, more aggressive management with endoscopic ureteral stent placement should be the initial treatment of choice. Dependent on fistula size, retrograde stent passage beyond the fistula site may not be possible, as the stent may preferentially enter the uterus via the fistula tract. In this case, percutaneous drainage may be undertaken. In addition, percutaneous drainage of a perifistulous abscess may be necessary to treat sepsis and decrease local inflammation in anticipation of surgical repair. Fistula resolution following ureteral stent placement and stricture dilation is reported.[104] Despite this success, the overwhelming majority of reported fistulas are approached with open repair.

Definitive surgical repair may be undertaken as a single or staged procedure. The staged procedure entails urinary diversion followed by delayed ureteral repair.[105] This approach allows for resolution of acute infection and inflammation, thereby optimizing repair success. Surgical repair may be approached via ureteroneocystostomy or ureteroureterostomy. The use of ureteroureterostomy is reported and may offer a more simple approach.[106] However, given the local inflammation invariably present, the viability of the distal ureter must be ensured prior to undertaking primary repair. In the advent of significant inflammation, ureteral viability may be difficult to assess and ureteroneocystostomy should be performed. No large series are reported to define outcomes following UUF repair. Isolated case reports demonstrate excellent success rates following surgical repair.[105–107] In addition, successful pregnancy and vaginal delivery following UUF repair is reported.[107]

Ureterovaginal Fistula

Surgical repair of UrVF is most common; however, spontaneous healing of UrVF is reported.[103] Surgical repair is undertaken in a fashion similar to that of other urogenital fistulas involving the ureter. Accordingly, initial management should involve endoscopic ureteral stent placement. Surgical repair using ureteroureterostomy may be more limited owing to the distal location of the fistula tract. Accordingly, ureteroneocystostomy remains the treatment of choice. In contrast to UUF, the distal location of fistula involvement may allow for greater preservation of ureteral length and avoid the need for additional techniques to gain length.

Several larger series demonstrate excellent results using ureteroneocystostomy for repair of UrVF.[26,27,108] Mandal et al.[108] report an 18-year experience comprising 31 patients. A complete cure rate and preservation of renal function was seen in 29 patients undergoing repair with ureteroneocystostomy; two cases of resolution with conservative management were observed. Falandry and colleagues describe a 4-year experience including 17 patient undergoing UrVF repair.[27] With 1-year follow-up, 16 patients were cured and one remaining patient suffered a neoplastic recurrence. The use of adjunct techniques is described, including Boari bladder flap, psoas hitch, and ileoureterocystoplasty. Preservation of renal function was reported in all cases.

Conclusion

The urogenital fistula remains a complex dilemma for the reconstructive urologist. Urogenital fistulas comprise a variety of fistula subtypes. An understanding of the presentation, evaluation, and treatment options is fundamental for urologists. Urogenital fistulas are most frequently complications to surgical injury and obstructed labor; however, there are many other etiologies. Given the strong association between fistula formation and iatrogenic injury, the pelvic surgeon must have a working knowledge of the surgical principles germane to fistula prevention and intraoperative management of iatrogenic injury. Conservative options for treatment are occasionally successful, although the vast majority of urogenital fistulas will require surgical intervention. A variety of surgical approaches and techniques exist for fistula repair. Excellent outcomes are reported with most techniques, and, therefore, surgeon comfort remains a major consideration in choice of repair. Despite these outcomes, a number of patients will fail primary repair and undergo subsequent surgical management. The use of tissue interposition is fundamental to urogenital fistula repair, and may be approached using a variety of described flap techniques.

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17

Complications of Urinary Diversion

Christopher Porter and Greg Hanson

History

The ileal conduit was the first successful and widely adopted technique for urinary diversion. Zaayer is credited with its early inception in the early 20th century,[1] while Bricker popularized its use.[2] As reconstructive surgery has evolved, there have been many modifications to the conduit technique as well as the evolution of continent urinary diversions. While early techniques centered around providing a durable route to divert urine, more contemporary concerns have focused on the protection of the renal units and quality of life issues.

Complications

Complications of urinary diversion have been noted to increase with each successive year of follow up. Overall complication rates have varied from 29.3% to 94%,[3,4] depending on the length of time from diversion as well as the classification system used. More recent series, albeit with shorter follow-up time, detail a perioperative conduit complication rate of 18% and a late complication rate of 12%.[5] This series also showed a 21% late complication rate for neobladder formation as well. While this series may lack long-term follow-up, it also may reflect improved intraoperative and perioperative care compared to earlier series. Nevertheless, the morbidity appears to increase with each year postsurgery, with the majority of these complications observed within the first 10 years after surgery.

Given the relatively high rate of complications seen, the identification and management of these patients necessitates a thorough understanding of the morbidity of this aspect of genitourinary reconstruction.

Metabolic Derangements

One common complication that garners much attention is metabolic consequences after urinary diversion. While electrolyte abnormalities are the most discussed complication, altered reabsorption of medications, nutritional derangements, and osteomalacia all can occur with urinary diversions.

Nutritional Abnormalities

Patients who undergo diversion that employs a large section of ileum or sections that involve the ileocecal valve may manifest a variety of nutritional abnormalities. Approximately 90% of all bile acids and the majority of vitamin B_{12} are absorbed in the ileum. Most surgeons feel that up to 60 cm of ileum can be safely used for reconstruction without any untoward effects on bile salt or vitamin absorption, as long as the ileocecal valve is maintained.[6] If greater than 100 cm of ileum are removed for reconstruction, patients will invariably suffer from malabsorption issues.[7] At this point, the liver is unable to secrete an increased amount of bile salts to compensate for losses, which leads to decreased fat absorption and steatorrhea. In addition, these patients can suffer from a decreased absorption of fat-soluble vitamins, especially A, D, E, and K. The lack of vitamin D can further compound the complications of osteomalacia seen in patients with a diversion.

Patients who lack a terminal ileum are at higher risk of vitamin B_{12} deficiency with the long-term risks of spinal cord degeneration, macrocytic anemia, optic neuritis, and peripheral neuropathy. The human body is unable to synthesize any member of the cobalamin family and is dependent on dietary intake alone. In patients with complete loss of B_{12} absorption capacity, it is estimated to take 3 to 4 years to deplete the total body stores. These patients should be aggressively screened during follow-up and may necessitate monthly intramuscular B_{12} replacement therapy.

A common complaint in patients who have lost their ileocecal valve is that of decreased bowel transit time. Many studies have documented that preservation of the ileocecal valve improves diarrhea and malabsorption complaints.[8,9] Loss of the ileocecal mechanism can also lead to bacterial overgrowth of the small intestine that can compound this issue and exacerbate the symptoms of malabsorption. Certain patients need bulking agents to control their symptoms.

Metabolic Consequences

The use of bowel has been a mainstay in the armamentarium of genitourinary reconstruction. Recognition of the possible metabolic consequences of a given segment of

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TABLE 17.1. Common Metabolic Derangements with Diversion.

Diversion	*Metabolic disorder*	*Incidence*
Ureterosigmoidostomy	Hypokalemia, metabolic acidosis	80%
Ileal conduit	Hyperchloremic metabolic acidosis	70%
Jejunum	Hyperkalemic, hyponatremic, hypochloremic metabolic acidosis	>25%
Stomach	Hypochloremic, hypokalemic metabolic alkalosis	50%
Colon	Hyperchloremic metabolic acidosis	>50%

intestine can lead to proper identification and management of these electrolyte imbalances.

The most common electrolyte abnormalities are outlined in Table 17.1. While these abnormalities remain common, the severity depends on several factors: type of bowel segment used, length of segment, underlying renal and hepatic function, as well as urinary transit time. In addition, the type of urinary diversion employed (continent vs. incontinent) can have a drastic effect on the severity of electrolyte abnormalities. Continent diversions, which employ a longer segment of gut and an increased area exposed to reabsorb urine, are more likely to manifest electrolyte imbalances. Metabolic abnormalities are least likely when the diversion involves ileum and are most severe when the involved diversion incorporates jejunal segments. Patients with normal or slightly decreased renal function often will have no clinical consequences, but those with impaired renal function may manifest more severe imbalances.

Ileum

The ileum is one of the most common segments utilized by urologists for urinary diversion and reconstruction. Physiologically, ileal segments secrete both sodium and bicarbonate but reabsorb ammonium, chloride, and hydrogen ions in the presence of urine. The increased ammonium absorption is thought to be the largest contributor to the development of systemic acidosis.[10]

This loss of sodium and bicarbonate into the urine coupled with the reabsorption of ammonium and hydrogen leads to the classic *hyperchloremic metabolic acidosis* seen in more up to 50% of patients with urinary conduits.[11] This complication, however, is rarely clinically significant, and only approximately 10% of patients with an ileal conduit necessitate medical supplementation to counteract their acidosis.[12]

Jejunum

Complications from jejunal segments are mainly historical in nature, as this segment is less utilized given its high complication rate. However, certain situations may necessitate the use of jejunum in reconstruction, and the urologist should be cognizant of the electrolyte imbalances likely to manifest. The relative indications for the use of jejunum in diversions include a previous history of pelvic radiation, short segments of ureters, or previous extensive pelvic surgery. The most common metabolic abnormality experienced with jejunal diversions is that of *hyponatremic, hypochloremic, hyperkalemic* metabolic acidosis. The more proximal segments of jejunum often manifest with more severe electrolyte abnormalities given the larger villi surface area for secretion and ion exchange. As the jejunum is exposed to urine, sodium and chloride are secreted. Water is lost through this mechanism as well, which produces a physiologic hypovolemic state. Patients with excessive losses of water and sodium chloride often present with malaise, nausea, and weakness. Initial therapy is volume replenishment with sodium chloride solutions and correction of the underlying metabolic acidosis. Once patients have been stabilized, oral sodium chloride supplementation may be indicated. While jejunal segments are not widely used, in certain circumstances this may the only viable option for diversion. Groups that have had success with this diversion with low complications and morbidity have recommended keeping the segment used as short as possible.[13]

Colon

Colonic segments are also associated with electrolyte and metabolic abnormalities, although on a less drastic scale than other segments. These patients typically manifest a mild degree of metabolic acidosis secondary to an increased reabsorption of sodium and chloride from the colonic mucosa.

Patients with a diversion that employs a longer urinary transit time or those who have ileum incorporated into a pouch diversion are at higher risk of developing a clinically significant acidosis and may require oral alkalinization. Metabolic acidosis is seen in upward of half of patients who undergo orthotopic bladder replacement or pouch construction with ileum or colon.[14] In addition, the length of diversion itself is often a factor in the degree of acidosis seen.

Patients who do experience significant acidosis most often present with nausea, fatigue, emesis, or muscle weakness. Acute treatment of symptomatic patients is geared toward correction of electrolyte imbalances with intravenous fluids as well as drainage of the urinary diversion to prevent further imbalances from manifesting. Chronic management may involve intermittent catheterization and drainage of the diversion as well as oral alkalinization.

Oral sodium bicarbonate is often the first-line treatment of a metabolic acidosis secondary to a urinary diversion. The efficacy is often limited by significant gastrointestinal side effects. Potassium citrate solutions may also be an effective treatment, assuming normal renal function. Other pharmacologic interventions include chlorpromazine and nicotinic acid, both of which interfere with chloride transport and limit the development of acidosis. These drugs may have significant side effects and care should be taken in their extended use.

Osteomalacia

The most significant long-term consequence of chronic acidosis is likely osteomalacia.[15] This complication has been clearly established in several series detailing the long-term effects of ureterosigmoidostomy in pediatric patients.[16,17] In addition, patients with underlying renal dysfunction appear to be at higher risk due to impaired renal acid secretion as well as decreased vitamin D synthesis by the kidneys themselves.

While the exact pathophysiology has not been fully elucidated, most investigators suggest that *bone is reabsorbed as a buffer mechanism* in the face of a chronic acidosis. Patients often complain of joint pain and weakness, with serum studies showing increased alkaline phosphatase and low or normal calcium levels. Correction of the acidosis as well as oral vitamin D and calcium is usually sufficient to remineralize the bone.

Drug Reabsorption

The altered reabsorption pattern seen in patients with urinary diversion can also have significant effects on medication. As certain medications are excreted through the urinary system, reabsorption can occur as this urine comes into contact with either conduit diversions or urinary reservoirs. The medications most likely to affect patients with a urinary diversion include Dilantin, certain antibiotics, and theophylline.[18]

The most common agents that are of concern to urologists would likely be chemotherapeutic regimens for bladder cancer, especially methotrexate-based therapy.[19,20] Patients who undergo chemotherapy with methotrexate should be encouraged to maintain a vigorous diuresis of fluids as well as keeping their reservoirs or conduits drained.

Urolithiasis

The development of urinary calculi following urinary diversion can be a troublesome event. Urolithiasis is typically reported as the most common late complication seen in patients with a previous diversion (Table 17.2). In addition, the rate appears to increase over time with the incidence approaching 20% at 10 years and 38% at 15 years or greater follow-up.[3] The development of urolithiasis was usually found as a later complication with a median time of 70 months postsurgery.[3]

In evaluating specific diversions for their rate of stone formation, colon conduits show the lowest incidence of stones at 3% to 5.4% per year.[21,22] The incidence of urolithiasis in patents who have undergone conduit diversion varies from 5% to 20%, with more recent series finding a rate of 9%.[3] Long-term studies of neobladder reservoirs found an incidence approaching 8%,[23] with this being the most common complication seen.

The mechanisms for stone formation in patients with a urinary diversion are multifactorial.[24] Patients who suffer from fat malabsorption issues often will have increased absorption of oxalate, putting them at higher risks for oxalate-based stones.[25] Some patients with urinary diversions also manifest hypocitraturia due to the consumption of buffers in a chronic metabolic acidosis state.[26] In addition, prolonged reabsorption of ammonium from ileum-based diversions results in hypersulfaturia, which can impair renal reabsorption of calcium, leading to hypercalciuria.[27]

Many patients develop a subclinical but perhaps not clinically insignificant metabolic acidosis secondary to loss of bicarbonate through the anion exchange mechanism of the bowel. Prolonged acidosis can lead to breakdown of bone as a buffering mechanism, which can lead to increased urinary calcium, furthering the risk of developing stones.

In addition to these risk factors, underlying colonization of the patient's urinary system by bacteria, in particular urease-splitting species, can further exacerbate the risk of urolithiasis. A process outlined by Dretler[28] outlines risks, which include urinary stasis, underlying bacterial colonization, as well as metabolic changes secondary to the diversion itself. Dretler's series found that the majority of stones evaluated contained *struvite elements*, and that 91% of these patients had *Proteus* species isolated on urinary culture.

Unlike pouch diversions, patients with conduits who develop stones most often do so in their upper tracts. Recent work seemed to suggest that patients who had a nonrefluxing anastomosis were less likely to develop urolithiasis than were patients who had refluxing conduits,[29] possibly suggesting that a freely refluxing diversion may portend a higher risk of urolithiasis.

Calculi have also been observed to arise from foreign bodies within the conduit itself, most notably from staple lines or exposed suture; therefore, most surgeons recommend excluding the staple line from the conduit.

In spite these multifactorial risks, the mere presence of a urinary diversion may be the most important risk factor in patients who suffer from recurrent calculi after surgery.[30]

While calculi in the conduit diversions are usually easily managed with common endourologic techniques, the management of upper tract urolithiasis after conduit diversion is more complicated. The choice of techniques to address these stones depends on stone location, size, and type of diversion employed. Shockwave lithotripsy can be useful, but managing ureteral obstruction of stone fragments often necessitates a percutaneous nephrostomy tube.[31] Percutaneous nephrolithotomy techniques have reported a greater than 80% stone-free rate, and this approach appears well suited for patients with large stone burdens.[32] Retrograde access to the renal system is possible in conduit diversions, but often difficult to obtain.

While the use of endourologic techniques has resulted in high success rates in managing calculi, perhaps most important in management would be the issue of prevention. Given the high levels of urolithiasis seen in patients

TABLE 17.2. Risk Factors for Urolithiasis in Patients with Urinary Diversion.

Hypercalciuria
Chronic colonization
Volume depletion
Enteric hyperoxaluria
Hypersulfaturia
Foreign-body nidus
Urinary stasis

with a diversion and the associated morbidity, clearly it is important to reduce the overall risk factors for stone formation.

Maintenance of a sterile urine and treatment of urease producing bacteria also can contribute to a patient's long-term control of stones. Streem's group[30] described a recurrence rate of 32% in patients who had been treated for stones after diversion and also found the presence of bacteruria in the posttreatment period to be a significant risk factor for recurrence.[30]

All patients should be counseled to maintain a high oral fluid intake to avoid high urinary concentration of lithogenic substances. Thorough counseling on oxalate-containing foods by a nutritionist may be indicated. Oral citrate supplementation may also be appropriate in these patients as well. In addition, the correction of underlying metabolic risk factors and the reduction of urinary stasis are important factors.

Pyelonephritis

Acute pyelonephritis is often an indication of obstruction due to stones, stomal stenosis, ureteroenteric stricture, or malignancy, and all patients who present with febrile urinary tract infections should be evaluated for these conditions. In their series, Madersbacher et al.[3] found that 87% of pyelonephritis was associated with postrenal obstruction.[3]

Patients who present with pyelonephritis following a urinary diversion should be aggressively and promptly treated as the historic mortality for patients under these circumstances approaches 5%.[12]

Stomal Complications

Overall, stomal complications have been reported to occur at an overall rate of 24% to 34% with surgical intervention needed in just under 25% of these patients.[33] In larger series, these stomal complications developed at a median time of 54 months, with 78% developing within the first 5 years after diversion.[3]

Early stomal complications are usually a rare event but can represent a serious cause of morbidity. Clinically significant bleeding is sometimes seen of the exposed bowel mucosa, which can be treated with gentle fulguration or suture ligation. Acute, brisk bleeding has also been seen in patients with cirrhosis and liver dysfunction and may necessitate portal decompression.[34] Actual vascular compromise and necrosis of the conduit almost always necessitates surgical revision. Later complications of the stoma include stomal prolapse, stomal stenosis, skin irritation, and dermatitis around the stoma, as well as parastomal herniation.

The rate of stomal stenosis varies from 2% to 19%,[3,35–37] and can represent a significant cause of morbidity. Stenosis can lead to elongation of the conduit as well as urinary stasis, resulting in pyelonephritis, stone formation, and acute renal insufficiency secondary to obstruction. Most severe cases of stomal stenosis require surgical intervention and correction. The most common factors associated with the development of stomal stenosis include local skin changes, alkaline urine, retraction of the stoma itself, and changes in body habitus. This complication is seen in upward of 20% of patients. Patients who have a urinary appliance that fits poorly around the stoma and leaves skin exposed can develop skin ulceration and irritation, which ultimately can lead to keratinization of the skin and stoma. Aggressive enterstomal care and evaluation is paramount to avoiding and mitigating these complications.

Proper construction of the stoma itself may be the most important factor in the long-term health of a patient's diversion. If possible, a patient should be evaluated and counseled by an enterostomal therapist prior to the planned diversion. All patients should be marked prior to surgery, and should be evaluated in the supine and standing position. All planned stomas should be over the rectus abdominus muscle and should be away from skin creases and the belt line. The fascial incision is usually enlarged to two finger breadths in width and the conduit should be anchored appropriately to the fascia. Great care should be taken to ensure that the conduit and the stoma have an adequate blood supply by avoiding excess tension on the mesentery. In addition, when constructing an everted or nipple stoma, the mature stoma should protrude 1 to 2 inches above the skin.

Parastomal Hernias

Parastomal hernias occur at a rate of 4.5% to 18.3%[33] in patients with an ileal conduit and is typically ascribed to inadequate fixation of the conduit to the rectus fascia. In addition, stomal openings lateral to the rectus fascia can weaken over time. The rate of stomal prolapse was found to be over 20% in patients who had their stomas placed lateral to the rectus musculature vs. 2.8% for those with stomas that came through the rectus abdominus.[38]

This complication is more commonly seen in patients who have undergone a Turnbull stoma. Acute bowel obstruction can be a common presenting sign, and surgical management is indicated in this situation. In other situations, repair is typically reserved for patients who have severe symptoms or who have failed conservative therapy.

Stomal revision, reinforcement, or relocation are all typical outcomes, but repair of parastomal hernias is often fraught with difficulty. Rubin et al.[39] found a 76% incidence of recurrence after repair compared to only a 33% incidence in those who had a stomal relocation. However, patients who underwent stomal relocation had a greater than 50% chance of developing an incisional hernia. Repair of recurrent parastomal hernias with mesh reinforcement lowered the risk of recurrence to 33%. Overall, these authors found the morbidity in these patients to approach 63% and the long-term success of stomal repair to be poor. Other series have found open repair of a parastomal hernia is an effective treatment, with several authors detailing their results.[40,41]

Early attempts at laparoscopic repair of parastomal hernias with mesh showed promising results in a series of 17 patients with short follow-up times.[42] More recent series also with small numbers of patients have not been able to re-create these results, with only a 44% success rate. These patients all failed within 6 months of their repair.[43]

Ureterointestinal Anastomotic Complications

The development of complications from the ureterointestinal anastomosis can be a relatively common cause of late complications and is seen in recent series to have an incidence approaching 7%.[4] These main complications include ureteroileal leak as well as ureterointestinal stricture.

The most common cause of obstruction is ureteroileal anastomotic stricture, which is due to ischemia of the distal portion of the ureter. These complications most often develop within the first 2 years after surgery,[44] and most often do so indolently, underlying the need for close radiographic and serum creatinine monitoring. The incidence of a urinary leak after a urinary diversion and reconstruction is under 5%.[45,46] Patients with long-term urinary leakage, urinoma, or abscess as well as those who have undergone radiation therapy are likely also to be at higher risk of stricture. Patients who undergo a urinary diversion employing an antireflux technique typically have a higher incidence of ureterointestinal stricture.[47]

Most practitioners agree that careful construction of the conduit and anastomosis is integral to avoiding complications. Key elements include preservation of the ureteral blood supply; avoiding angulation while passing the left ureter under the mesocolon; and careful, "no-touch" handling of tissue while performing the ureterointestinal anastomosis.

The surgical technique for constructing the anastomosis is often surgeon dependent (Fig. 17.1). The most common techniques employed are the Bricker end to side[48] and the Wallace conjoined anastomosis.[49] Concerns over the Wallace technique usually entail the possibility of either a stone or a recurrence at the anastomosis, which would theoretically obstruct both renal systems. In addition, a recurrence at the site and the need for a subsequent nephroureterctomy would entail a reimplantation of the contralateral ureter.

The main criticisms of the Bricker technique center around a perceived increased risk of stricture and longer operative time required to perform this step of the operation; however, no published data have shown these to be true. Evangelidis et al.[50] evaluated a large series of cystectomy patients and compared the stricture rates between the Bricker and Wallace techniques. The overall rate of stricture was found to be 2.9%, with no significant difference between the two.

Urinary diversion stents have been evaluated as a means to reduce urinary leakage,[51] with several series reporting high success rates. Most patients who undergo urinary diversion in contemporary series have diversion stents placed at the time of surgery. In combination with the availability of percutaneous drainage procedures and improved surgical technique has contributed to the decline of urinary leakage rates over time.

Most patients who develop a ureterointestinal stricture present with pyelonephritis, sepsis, increased creatinine, or incidentally found unilateral hydronephrosis. On average, these patients present by 11 months after surgery.[52] These patients may often remain asymptomatic for several months prior to diagnosis as the stricture evolves.

In patients who present with systemic infection secondary to obstruction or renal obstruction, percutaneous nephrostomy tube placement is often the first intervention. Once clinically stabilized, further evaluation should then proceed. The diagnosis of ureterointestinal obstruction is most easily confirmed with either computed tomography (CT) scan or intravenous pyelography (IVP). Some instances may also necessitate the use of diuretic renal scans. Looposcopy and loopogram images are useful adjuncts and also help evaluate the character of the stenosis with direct

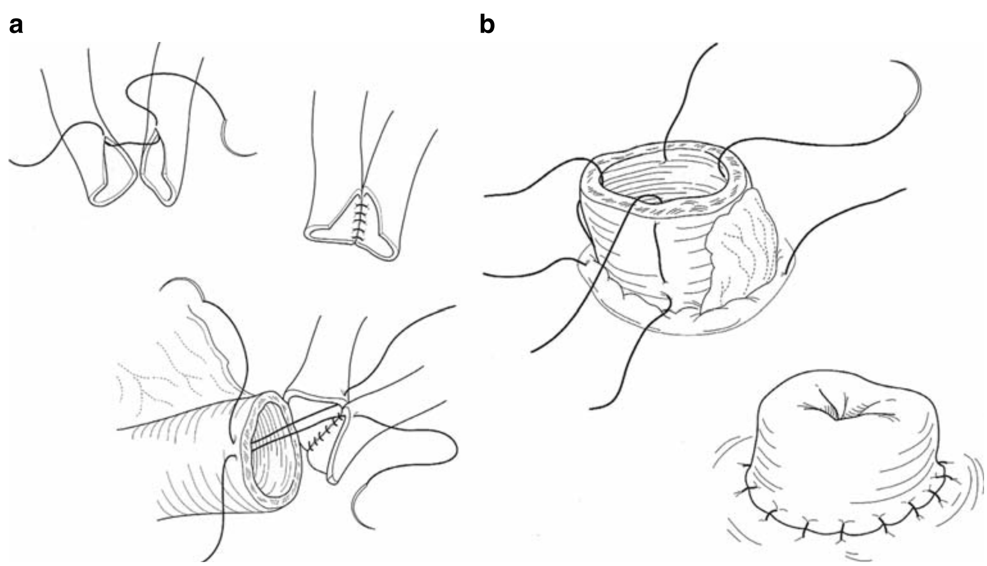

FIGURE 17.1. Ileal conduit. (**A**) The ureters are anastomosed to the proximal end of the isolated ileum. (**B**) The distal end of the conduit is brought through the anterior abdominal wall and formed into a spout. (From Venn and Mundy,[76] with permission of Springer Science + Business Media.)

visualization of the anastomosis. Cytology can also be obtained at the time to help rule out a recurrence in patients with a history of transitional cell carcinoma.

In patients who have been stabilized with percutaneous drainage tubes, antegrade studies can be performed to evaluate the degree of stenosis as well as the length.

Long-term management of this complication centers around either open intervention with revision of the ureterointestinal anastomosis or endourologic attempts to open the stricture. DiMarco et al.[53] evaluated open revision versus balloon dilation and found a 76% 3-year success rate compared to a less than 5% success rate for balloon dilation. Other earlier series have evaluated electroincision or cold knife techniques for ureteroenteric strictures, but success rates have still remained under 68%.[54–56] A more recent series performed by Poulakis et al.[57] showed favorable results of a cold-knife endoureterotomy in patients with good predictive factors, which included length of stricture, degree of hydronephrosis, and underlying renal function.

The use of balloon dilation techniques has been found to have suboptimal results compared with open repair in a series by both Kramolowsky et al.[58] and Shapiro et al.[59] These series had a 0% to 16% success rate at 1 year, with the majority of patients failing within the first 22 to 24 months.

While long-term success rates appear greater in open revision, recent short-term success has been seen with the use of holmium laser incision of the stricture.[60] Watterson et al.[60] evaluated 23 patients who underwent an antegrade treatment of ureteroenteric stricture with a holmium laser fiber. A full-thickness incision was made in stricture under direct visualization followed by balloon dilation and endopyelotomy stent placement. With a mean follow-up of 22 months, a success rate of 71% was achieved. Similar results were seen.

The use of metallic, self-expandable stents has also been investigated in patients with ureteroenteric anastomosis.[61] In select patients, Tal et al.[62] managed a series of patients with ureteroileal strictures with indwelling nephroureteral stents that were changed periodically. While the results of both of these studies appear efficacious, these techniques may be best reserved for patients whose life expectancy or comorbidities preclude more significant intervention.

Overall factors associated with lower success with endourologic techniques include stricture length >1 cm, strictures involving the left ureter as it passes under the mesentery,[63] and patients who present within the first 6 months after diversion.

Bowel Complications

The incidence of bowel complications following urinary diversion is seen in approximately 25% of patients and represents a significant cause of postoperative morbidity and mortality in patients who undergo urinary diversion.[3] Nearly 50% of bowel complications present within the first 48 months after diversion, and these complications can complicate the postoperative course and necessitate reoperation in up to 1%.[64]

In the perioperative period, ileus is a relatively common cause of postoperative morbidity and prolonged hospital stay, with rates varying up to 18%.[65] Bowel obstruction rates requiring treatment vary from 5% to 12% in patients with ileal diversions and colonic diversions.[4] True bowel obstruction is most often caused by postoperative adhesions followed by recurrent malignancy. While internal hernias and obstruction at the bowel anastomosis are causes of postoperative bowel obstruction, they likely represent less of a cause of obstruction than previously believed.[66]

Most patients are treated initially with nasogastric drainage, parenteral nutrition, and correction of electrolyte balances. In spite of these conservative measures, up to 50% of these patients may need exploration.

Renal Function

Upper urinary tract changes are quite common following urinary diversion with recent reports indicating upper tract dilation in 34% of patients at a mean of 5 years' follow-up.[67] Sullivan et al.[35] evaluated greater than 60 patients with more than 5 years' follow-up and found significant changes in patients' levels of renal insufficiency after conduit diversion.[35]

True decline of renal function has been historically difficult to define given the limitations of serum creatinine to accurately reflect renal changes. Recent studies focusing on glomerular filtration rate (GFR) have given a more precise idea of the amount of renal effect. Samuel et al.[68] studied the natural history of ileal conduits using renal scans, and found a 29% rate of worsening GFR at a mean of 8.2 years.

The most commonly discussed mechanisms for these changes have been reflux and chronic infection of the urine. While refluxing systems by themselves may not affect overall GFRs,[69] most surgeons feel that the development of a urinary tract infection in the presence of reflux invariably leads to renal scarring and long-term renal impairment.

Recent studies on the long-term effects of conduits on renal function implicate recurrent urinary tract infections (UTIs), hypertension, and early postoperative renal insufficiency as the major contributors to postdiversion renal deterioration.[68] Early recognition and aggressive treatment of these issues may help ameliorate some of these long-term consequences.

Secondary Neoplasm

While a primary tumor recurrence in a urinary diversion is most common, the de novo development of a secondary malignancy in a segment of bowel is also a recognized risk since the inception of urinary diversion. Historically, most malignancies have been described in ureterosigmoidostomies in pediatric patients. Long-term studies of ureterosigmoidostomies have shown an increased risk of the development of adenocarcinoma, especially at the ureterovesicular junction.[70] In a large series with long follow-up, Husmann and Spence[71] found that up to 70% of these patients developed adenocarcinoma, with up to one third of these patients dying of their disease.

The development of a transitional cell or squamous variant in ureterosigmoidostomies is extremely rare. Studies have shown that malignant tumors developed at a median of 26 years after diversion[72] in this patient population if the diversion was performed for benign disease versus a median of 13 years if performed for a malignancy. The mixing of urine and fecal matter is thought to project a far higher risk of malignancy in these patients than in the general population, and appropriate screening measures should be undertaken in these patients.

In contrast to the risk of patients undergoing ureterosigmoidostomy diversions, the development of secondary malignancies is a less common event in other diversions. Austen and Kalble[72] evaluated the risk of developing a new primary malignancy in all urinary diversions, and found that over 80% of these tumors developed in continent urinary reservoirs in contrast to conduit diversions. The most common histologic subtype of new malignancies was adenocarcinoma, but signet ring cell, leiomyoscarcomas, oat cell carcinomas, and recurrence of previously treated lymphoma have also been reported.[73] The vast majority of adenocarcinomas developed in colonic diversions with only a handful reported in ileal conduits,[74,75] which is in line with the relatively low malignant potential of small intestine in general. De novo development of transitional cell malignancies in urinary diversion has also been observed.

Approximately 11.9% of malignancies that developed in patients who had undergone diversion did so within the first 5 years. Given these considerations as well as the poor outcomes associated with disseminated disease, many have recommended that endoscopic evaluation as well as loopograms, IVP, and cytology be undertaken early in the postoperative stage. More aggressive surveillance should be undertaken in patients with continent reservoirs and those with significant portions of colon as part of their reconstruction, as these patients appear to be at higher risk.

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18

Complications of Transurethral Surgery

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Despite advances in alternate techniques, transurethral surgery has remained the gold standard for treating urologic disorders of the prostate and bladder. Specifically, transurethral access has allowed urologist to perform transurethral resection of the prostate (TURP) and transurethral resection of bladder tumor (TURBT) to treat benign prostatic hyperplasia (BPH) and bladder tumors, respectively. These procedures are familiar to and used by most urologists, and have shifted surgical treatment away from a traditional open approach. TURP and TURBT have complications that are unique to them. However, because both use similar equipment, there is some overlap in the potential complications of these procedures. This chapter discusses the indications, technique, and complications of each procedure.

Transurethral Resection of the Prostate

Current indications for TURP include recurrent urinary tract infection (UTI) caused by bladder outlet obstruction, recurrent episodes of urinary retention, recurrent hematuria caused by bladder outlet obstruction, and renal insufficiency caused by BPH. Although the presence of bladder stones has long been considered an absolute indication for TURP, recent studies have shown only a small recurrence of bladder stones after specific stone therapy.

The management of BPH has undergone substantial change in recent years. Most patients are initially treated with medical therapy. Regardless of treatment, the objectives have remained constant: to decrease bladder outlet obstruction by either medical management or by physically removing obstructing prostatic tissue.[1,2] This entails creating an open channel for voiding, thereby relieving symptoms attributed to the obstruction. Methods of relieving outlet obstruction from BPH have evolved from more invasive (open prostatectomy) to less invasive. TURP is considered a second-generation treatment after open surgery. In fact, it is considered the first available minimally invasive option to open surgery.

Various approaches to TURP have been proposed. In 1943, Nesbit[3] described a procedure that started with resection of the ventral parts of the gland (between the 11 o'clock and 1 o'clock positions), followed by both lateral lobes, the mid-lobe, and finishing with the apex. Other descriptions exist; however, the commonality of these procedures is that prostate adenoma is systematically resected from the bladder neck to the verumontanum. The procedure is typically divided into four steps. The first step involves resection of the median lobe. This is followed by resection of the paracollicular and lateral lobes. It is completed with the apical resection. Improvements in TURP technique were followed by improvements in equipment including suprapubic trocar systems and continuous-flow resectoscopes, both of which provide low irrigation pressure, and video-assisted resection.[4–6] Standard electroresection is performed with a high-power, monopolar current.

The TURP procedure, along with open prostatectomy, is considered the gold standard for treatment of BPH. It has proven to be both efficacious and durable. Long-term data have shown improvements in American Urological Association (AUA) Symptom Index (AUASI), peak flow rate (Q_{max}), and quality of life score (QoL). While effective, however, TURP carries substantial potential morbidity, and the need for anesthesia and possible hospitalization.[7] This has provided the impetus for the development of new, minimally invasive therapies, such as transurethral microwave thermotherapy (TUMT) and transurethral needle ablation of the prostate (TUNA). These minimally invasive therapies seek to offer a cost-effective alternative to TURP while achieving substantial improvement in quality of life with a lower risk of complications. However, most cannot completely replicate the removal of adenomatous tissue from the prostate.

According to the 2003 AUA guidelines on management of BPH, the overall complications for TURP include hemorrhage (6%), urinary retention (5%), UTI (6%), retrograde ejaculation (65%), erectile dysfunction (10%), urinary incontinence (3%), bladder neck contracture or urethral stricture (7%), and transurethral resection (TUR) syndrome (2%).[7,8] Rare complications such as bladder explosion have also been reported.[9,10]

Minor and serious cardiovascular complications, including thromboembolic events such as deep venous thrombosis and pulmonary embolus occur in 5% of cases.[7] Patient positioning remains an important factor in the incidence of these events. Inadequate padding of the legs along with longer resection times predispose to deep venous thrombosis and pulmonary embolus. Leg wrapping with compression stockings or sequential compression devices may lower this risk.[11,12] Also, inadequate padding of the knees while in lithotomy position may cause peroneal nerve injury.

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Lastly, although death is a possibility, overall mortality rate remains low (0.4–2.5%) depending on age and medical comorbidities.[13] Greater than 50% of patients undergoing TURP are over 70 years old, and many have concomitant diseases such as diabetes, hypertension, and cardiac and respiratory ailments that increase their perioperative risk. In these men, perioperative morbidity and mortality approaches 20% and 1%, respectively. Regional anesthesia, specifically spinal anesthesia, offers many advantages over general anesthesia for TURP with some evidence of lower morbidity even though similar mortality rates and overall surgical outcomes are reported for both groups.[14]

Intraoperative Complications

Complications (overall 3%) include bleeding, irrigant absorption, prostatic capsule perforation, bladder perforation, and injury to ureteral orifices or external urethral sphincter.

Bleeding

Bleeding is the main complication of traditional electrocautery TURP. It results from cutting across the prostatic parenchyma and opening prostatic venous sinuses or transecting arteries. The amount of intraoperative bleeding may depend on gland size and resection weight. Venous bleeding generally occurs because of capsular perforation and venous sinusoid openings. Arterial bleeding can be even more pronounced in cases of preoperative infection or urinary retention.[15] Antiandrogens have been shown to decrease intermittent hematuria seen in BPH,[16–18] and as a result, some investigators have given these medications (finasteride) preoperatively to reduce bleeding that may be encountered during surgery.[19,20]

Continuous or heavy bleeding may necessitate transfusion and cause associated problems such as clot retention, premature termination of the procedure, and inadequate relief of obstruction. Bleeding can also result in the need for continuous catheter irrigation and complications such as stricture secondary to traction on the Foley catheter. Rarely, uncontrolled bleeding can even require open packing of the prostatic fossa. Poor visibility because of bleeding is also thought to be a cause of iatrogenic sphincteric injury and incontinence resulting from TURP. The risk of transfusion-requiring hemorrhage ranges from 4% to 8%,[7, 21–23] and increases twofold if the amount of resected tissue exceeds 45 mL or if the resection time is longer than 90 minutes.

There are many techniques to stop venous and arterial bleeding during TURP. Both types of vessels can be coagulated with the electrocautery loop. This often involves using the resectoscope sheath to hold pressure over the bleeding vessel and then applying the loop for cautery. Arterial bleeding sites may be difficult to identify because they are partially covered by clot or prostatic tissue, or they are near the bladder neck and not seen directly. In this case, careful, systematic search will identify the source in most cases. Alternative technologies including electrovaporization and photoselective vaporization of the prostate can decrease the degree of hematuria seen intraoperatively.[24–26]

Venous bleeding is usually dark red and found in areas of capsular perforation. Careful coagulation is necessary to prevent further tear to the capsule. Often, small venous bleeders can be treated with direct pressure from a Foley catheter balloon. If placed in the prostatic fossa, the balloon should be inflated to the approximate volume of tissue removed. This procedure should be done with care because aggressive inflation of the balloon can rupture the capsule. This allows a temporary tamponade effect on the venous bleeders. Also, the Foley catheter balloon can be placed within the bladder and put under traction to compress the prostatic fossa. Lastly, if bleeding persists, digital manipulation via the rectum on the prostate can further allow pressure to tamponade bleeders.[15]

Transurethral Resection Syndrome

The use of irrigating solutions is essential for distention of mucosal surfaces and visualization of the surgical field during transurethral resection. The TUR syndrome is caused by absorption of a hypotonic irrigating solution. Dilutional hyponatremia occurs when serum sodium drops below 125 mEq/L. The absorption of fluid is due to early perforation of capsular veins or sinuses with consecutive influx of hypotonic irrigating fluid.[27] The incidence of TUR syndrome during TURP ranges from 0% to 2%.[7,15]

Hypertension and mental confusion are the predominant symptoms; however, patients experience visual disturbances, nausea, vomiting, and bradycardia.[28] Those who receive spinal anesthesia may also exhibit unrest, cerebral disturbance, or shivering as the first sign of the syndrome. Patients who have general anesthesia cannot communicate signs of fluid absorption. Instead, one may see increasing blood pressure and pulse intraoperatively. The absorption of irrigation fluid during the TURP has been shown to be greater in spontaneously breathing patients with regional/spinal anesthesia in comparison to patients undergoing general anesthesia. It was hypothesized that the positive pressure ventilation necessary for respiration with general anesthesia raises the central venous pressure and thereby impedes the absorption of irrigating solution during TURP.[29]

As with bleeding, fluid absorption increases with larger glands and longer resection times. Also, the absorption of irrigation fluid during TURP is determined primarily by hydrostatic pressure in the bladder and prostatic venous pressure; therefore, the amount of irrigation fluid used, the height of the fluid bag (hydrostatic pressure of the fluid exceeds venous pressure), and the type of anesthesia (spinal vs. general) can increase the volume absorbed.[30] Hahn[31] showed that past and present tobacco smoking increased the risk of large-volume fluid absorption during TURP when compared to nonsmokers. The suspected mechanism was an alteration of the prostatic vascularity in smokers.

The combination of high hydrostatic pressure and hypoosmolality causes fluids to shift from the intravascular space to interstitial and intracellular compartments. If left untreated, TUR syndrome may have severe consequences like bronchial/pulmonary or cerebral edema. Irrigant fluid absorption during electrocautery can also result in glycine-induced ammonia intoxication or the direct toxic effects of glycine.[21]

Preventive measures include better resection training of urologists, resection of smaller glands, reduction in surgical time, lowering the height of the fluid bag, and low-pressure irrigation. Alternative techniques can also decrease dilutional hyponatremia. For example, the use of a bipolar energy source allows the urologist to resect with normal saline as an irrigation fluid. In addition, technologies such as electrovaporization and photoselective vaporization of prostate tissue have a sealing effect that minimizes this complication by preventing fluid absorption.[24,26]

If patients are not symptomatic during surgery, TUR syndrome is often suspected when fluid output does not correlate with irrigating fluid input. Treatment involves correcting the fluid imbalance and the hyponatremia. Patients are hypovolemic due to a natriuresis that follows fluid absorption.[32] The hypertension may be transient, and patients may become hypotensive and hemodynamically unstable. Correction of hyponatremia with hypertonic saline restores the sodium concentration and the fluid volume. It is indicated when several symptoms develop or the serum sodium concentration is <120 mEq/L. Alternatively, if the patient is not hypovolemic, he can be treated with intravenous furosemide. Often furosemide is given after hypertonic saline after fluid volume has been replaced. The primary indication of furosemide is to combat acute pulmonary edema and to induce diuresis when this does not occur spontaneously.

Visual disturbances resolve spontaneously within 24 hours and need no treatment. Mild adverse events are treated by supportive measures, including antiemetics. In addition, hypertension is likely to be transient.

Prostatic Capsule Perforation

Perforation of the prostate capsule occurs during deeper resection of the adenoma or resection near the bladder neck. As the amount of tissue resected increases, the likelihood of perforation also increases. Overall incidence varies from <1% to 10%.[15]

When perforation is unrecognized or occurs early in resection, irrigation fluid can extravasate into the retroperitoneal cavity. Large-volume extravasation can cause pain and discomfort, and even delayed TUR syndrome. In addition, fluid can be absorbed into the peritoneal cavity; however, this is more common with a bladder perforation.

Similar to TUR syndrome, extravasation is often suspected when fluid output does not correlate with irrigating fluid input. Once TUR syndrome has been ruled out, extravasation can be a likely cause of the fluid discrepancy. Physical exam may reveal a distended suprapubic region. A cystogram can be performed to evaluate for extravasation. In addition, the cystogram can differentiate extraperitoneal from intraperitoneal extravasation.

In most cases, extraperitoneal extravasation is treated conservatively with catheter drainage. However, with larger volume extravasation, intravenous furosemide or drainage may be necessary. Morbidity and mortality can be reduced by surgical drainage of the retroperitoneal fluid after massive absorption. Percutaneous drainage can be performed with a cystotomy or nephrostomy tube. Open drainage can also be used. Ultrasound guidance can help with drainage; however, access to the retroperitoneal space is usually from above the symphysis pubis. TURP can be continued with lower pressure irrigation; however, many surgeons would terminate the procedure, place a Foley catheter, and continue resection at another time as a staged procedure. Intraperitoneal fluid is treated with percutaneous drainage.

Injury to the Ureteral Orifices

Ureteral injury typically occurs when a large median lobe is encountered. In these cases, the ureteral orifices are difficult to identify prior to resection. As a result, they can be injured when the loop is placed beyond the median lobe. When resection is near the ureteral orifices, or when injury is identified, a pure cut electrical current should be used to minimize the chance of stricture. If cautery was used, or in cases of severe injury, ureteral stents can be placed in a retrograde fashion. Stents can be left in place for 4 to 6 weeks to allow the orifice to heal without stricture. Upper tracts should be monitored with sonography or intravenous pyelography at 2 weeks and at 3 months after stent removal to monitor for obstruction. Minor injuries can be treated without stenting and followed with upper tract imaging.[15]

Injury to the External Sphincter

Sphincteric injury and stress urinary incontinence are significant concern during TURP. Overall rates are low (from <1% to 3%). It is crucial to limit resection from the bladder neck to the verumontanum. The verumontanum serves as a significant landmark to stop resection because the external urethral sphincter lies just distal to it. Iatrogenic injury typically occurs during resection at the 12 o'clock position when the verumontanum is not seen. As a result, resection can be carried out too far distally. Injury can also occur if the verumontanum was mistakenly resected, or if the patient has distorted urethral anatomy due to previous surgery or radiation therapy (i.e., prostate or bladder cancer).[15]

Patients may also experience varying degrees of urinary urgency and urgency incontinence after TURP. Rather than from injury to the sphincter, this problem exists due to detrusor overactivity or irritability of the prostatic fossa postoperatively. Anticholinergic therapy is usually an effective form of treatment.

Careful inspection of the sphincter should be done repeatedly intraoperatively. If injury has occurred, patients experience varying degrees of incontinence from total incontinence to mild stress incontinence. Patients may have gradual improvements for up to 1 year postoperatively. Those who are bothered by these symptoms and not significantly improved after 1 year should be further evaluated with urodynamics and offered some form of anti-incontinence therapy.

Postoperative Complications

Peri- and postoperative complications include failure to void after catheter removal, persistent hematuria, UTI, epididymitis, and irritative symptoms.

Failure to Void/Urinary Retention

Approximately 3% to 9% of patients will not void spontaneously after TURP when the catheter is removed. Others will have a persistently elevated postvoid residual. Although some cases can be associated with incomplete resection, most cases, by far, are seen in patients with detrusor decompensation after chronic urinary retention or primary impaired detrusor contractility.[33] Other risk factors include long-standing/poorly controlled diabetes mellitus and neurogenic diseases that cause urinary retention. Preoperative evaluation in these patients should include urodynamics to assess etiology and detrusor muscle function.

Hematuria

Varying degrees of hematuria may persist after TURP. Bleeding may be venous or arterial and can sometimes be differentiated by examining the outflow of the catheter. Venous bleeding would be continuous with dark bloody urine, whereas arterial bleeding would be brighter red with intermittent spurts in the catheter. In the immediate postoperative period, patients are catheterized with a three-way catheter to allow continuous irrigation of the bladder to prevent blood pooling and clotting in the bladder and catheter. In most cases, traction may be applied to the catheter to compress venous bleeding from the prostatic fossa.

If severe bleeding is encountered, the catheter can become blocked with clot allowing a further buildup of clots in the bladder (1–5%). This can cause severe discomfort and pain to the patient. The clots must be evacuated with manual irrigation. Cases in which clot cannot be removed manually, or bleeding does not stop require reintervention. Clot evacuation with fulguration of bleeding points or reresection is often necessary.

UTI and Epididymitis

A preoperative urine culture should be obtained and treated with culture-specific antibiotics. A sterile urine culture should be the rule prior to surgery. The incidence of UTI following TURP ranges from 1% to 14%, while that of epididymitis ranges from 0.8% to 1.2%.[21,34] There is also a risk of urosepsis in a patient treated with TURP with a concurrent UTI. Some risk factors for UTI include preoperative bacteriuria, and prolonged duration of the procedure (>70 minutes).[15]

Irritative Voiding Symptoms

Greater than 15% of patients will experience irritative voiding symptoms after surgery. Most of these patients will have urinary urgency and urgency incontinence. Unlike stress urinary incontinence, which is due to injury to the continence mechanism during resection, this problem is caused by detrusor instability due to long-standing BPH, UTI, or irritability of the prostatic fossa postoperatively. As a consequence, patients may continue to have these symptoms until the UTI is treated or the prostatic fossa heals. In most cases, conservative treatment is recommended. If not done preoperatively, urodynamics can be helpful in diagnosing detrusor overactivity from other causes of irritative symptoms. Anticholinergic as well as antiinflammatory therapy are usually effective forms of treatment.

Late Postoperative Complications

Complications include urinary incontinence, bladder neck contracture or urethral stricture, ejaculatory dysfunction, and erectile dysfunction. In addition there remains a 5% retreatment rate with TURP.

Urinary Incontinence

Although early incontinence may occur in up to 30% to 40% of patients, late iatrogenic stress incontinence occurs in less than 1% of patients. If it persists for longer than 6 months, incontinence after BPH surgery requires careful evaluation. A complete workup includes retrograde urethrogram, cystourethroscopy, and urodynamics. There are several causes of incontinence including intrinsic sphincter deficiency (30%), detrusor instability (20%), mixed incontinence (30%), residual adenoma (5%), urethral stricture (5%), and bladder neck contracture (5%).[35,36] Depending on endoscopic and urodynamic findings, conservative treatment for sphincteric deficiency includes pelvic floor exercise, biofeedback, or electrostimulation. In general, patients should be observed for improvement for a period of 1 year. At this time, if there is no improvement with conservative therapy and the patient is still bothered by symptoms, additional therapies including periurethral injections, male sling, or artificial urinary sphincter can be employed. Treatments for urethral stricture and bladder neck contracture are discussed below.

Urethral Stricture and Bladder Neck Contracture

The incidence of urethral stricture after electrocautery TURP ranges from 3% to 5%.[21] Stricture formation is thought to be secondary to trauma induced by the large size of the resectoscope as well as the use of low-intensity, coagulating current, which penetrates deeper into tissue than cutting currents. The most common areas of stricture include the membranous urethra, bulbar urethra, and the fossa navicularis. The etiology is related to location of stricture. For example, fossa navicularis or urethral meatus strictures usually occur due to the introduction of a resectoscope with a larger caliber than the urethral diameter, and bulbar urethral strictures due to insufficient lubricant, which causes the monopolar current to leak and causes electrocautery trauma to this area.

Methods to decrease stricture formation include urethral dilatation prior to passage of the resectoscope, generous lubrication with gentle resectoscope passage, use of smaller instruments, and shorter resection time. When lubricating the resectoscope, the lubricant should be applied carefully in the urethra and along the entire shaft of the resectoscope. The lubricant should be reapplied in cases of longer resection time. In addition, the use of a non–water-soluble lubricant like petroleum jelly may decrease stricture formation because it persists within the urethra for longer time. A high cutting current may cause greater damage to the urethra and should be avoided. If a prior urethral stricture is seen during scope passage, an internal urethrotomy should be performed before TURP.[6,37] In addition, passage of the resectoscope under vision will decrease the incidence of false passage formation. Postoperatively, a smaller drainage catheter may also decrease stricture formation; however, this needs to be balanced with the need to provide adequate drainage and allow for continuous bladder irrigation. Lastly, catheter traction may cause ischemia or pressure-necrosis on the urethral mucosa. If traction is necessary to limit bleeding, it should be released as soon as possible after the procedure.

The overall incidence of bladder neck contracture is 5% (range 0.3–9.2%). This problem is seen more often in men with small (<30 g), fibrotic prostates. In these cases, transurethral incision of the prostate (TUIP) provides an alternative to TURP in patients with BPH if the adenoma weight does not exceed 30 g.[38–40] TUIP lowers the incidence of bladder neck contracture when compared to TURP. In contrast to TURP, TUIP does not remove hypertrophied tissue. Instead, it allows for an easier opening of the bladder neck and widening of the prostatic urethral through the decrease in pressure exerted by the prostate and prostatic fascia. This is accomplished by the destruction of a large part of the adrenergic receptors, which improves emptying of the bladder.[41] TUIP can be done with standard electrocautery or with a laser incision of the bladder neck. Patients who develop contractures have a high risk for development of future contractures. For those who have repeated contracture, open surgical repair or urinary diversion may be necessary.[27]

Ejaculatory Dysfunction

Retrograde ejaculation represents another potential side effect of electrocautery TURP, occurring in 65% to 90% of patients.[7,21] It may be avoided if the apical prostatic tissue near the verumontanum is spared during resection. Although this problem may not be bothersome to many older patients who are not planning to have children, it can be a significant concern to younger men. For younger men who are considering future children, medical therapy with alpha-blockers or 5α-reductase inhibitors may be an optimal choice of treatment due to their reversible nature. Alternatively, a TUIP can be considered in these patients.

Erectile Dysfunction

It is possible that a current generated close to the capsule may damage the neurovascular bundles during resection; however, most studies show a low rate (4–10%) of erectile dysfunction following TURP. The reason for complaints of erectile dysfunction after TURP is thought to be due to unreported erectile dysfunction at baseline (prior to surgery) or patients confusing erectile dysfunction with retrograde ejaculation.[27] In addition, the finding of erectile dysfunction after TURP is related to the patient's age.[42]

In contrast, there are reports of improved erections after TURP.[42,43] In one study, 81% of men had erectile function that remained unchanged or improved after TURP.[44] Clearly there is variability in the diagnosis of erectile dysfunction after surgery. Patients should be screened preoperatively and then reassessed after surgery to determine the true degree of dysfunction after surgery.

Retreatment

The retreatment rate of TURP remains low, ranging from 3% to 14.5% after 5 years.[7,45] Others report even lower retreatment (1.9%) at 10 years.[46] Recurrence of BPH symptoms requiring repeat TURP may be due to regrowth of prostatic tissue or to its persistence after inadequate resection.

Transurethral Resection of Bladder Tumor

Bladder cancer currently accounts for 2% of all malignant neoplasms and is the second most common neoplasm of the genitourinary tract. Most patients (80%) present with superficial disease. The initial diagnosis and staging of a suspected bladder tumor is confirmed by pathologic examination of tissue obtained during transurethral resection.[47]

Although TURBT is a standard urologic procedure, it is not morbidity- or mortality-free.[48] Complications include hemorrhage requiring blood transfusion, bladder perforation, urethral stricture, and rarely TUR syndrome. Many of these complications can be correlated with the surgeon's level of training, and the size, number, and location of bladder tumors. Other complications not directly related to the surgical procedure include deep venous thrombosis, pulmonary embolus, myocardial infarction, and cardiac arrhythmias.[47,49,50]

Many patients who present with bladder cancer are older and have medical comorbidities. In addition, a large percentage of patients who have bladder cancer are tobacco smokers when compared to the general population. These factors alone put this patient base a high risk for complications. In addition, preoperative risk factors for adverse surgical outcomes include the presence of metastatic disease, recent weight loss, low serum albumin, elevated serum creatinine, patient's dependent functional status, and emergent case status.[51]

The transurethral approach to a bladder tumor involves placement of a cystoscope lens with resectoscope sheath and obturator into the bladder. A visual obturator can be used for safe placement with less risk for urethral trauma. Cystoscopy is performed and compared with the previous findings from outpatient workup or previous resection. The resectoscope is then placed through the sheath into the bladder. Various lenses can be used for resection (i.e., 0, 12, or 30 degrees). Depending on tumor size, tumor location, and tumor pedicle, TURBT is started by using a normal or horizontal loop with glycine irrigation. The bladder is partially distended. Resection involves placing the loop on the side opposite the resectoscope and initiating the electrocautery current as the loop is retracted toward the resectoscope. This is continued sequentially until the tumor is resected. Electrocautery is used to coagulate bleeding vessels. For larger tumors, often continuous bladder irrigation is necessary postoperatively to prevent clot formation in the bladder.

Hemorrhage

Most patients experience varying degrees of hematuria after TURBT. However, hemorrhage requiring blood transfusion is seen less often, ranging from 0.9% to 13%.[47–50,52] Severe hemorrhage has also been reported with obturator nerve reflex causing bladder perforation and subsequent obturator artery injury.[53] In most cases, bleeding occurs either intraoperatively or postoperatively on the day of surgery, and is associated with extensive or infiltrating tumors. Intraoperative bleeding is best managed by direct fulguration of the tumor bed or bleeding vessels. However, if bleeding occurs postoperatively, manual bladder irrigation to remove clots followed by continuous bladder irrigation is often necessary. If it persists, repeat cystoscopy with fulguration of bleeding points may be indicated.

Bladder Perforation

Perforation is one of the most feared complications of TURBT and is usually a consequence of inadvertent full-thickness bladder wall resection. Most studies report a perforation rate of 4% to 7%; however, the true incidence of bladder perforation during TURBT is difficult to assess because most perforations may be small and not be clinically significant or recognized intraoperatively. In addition, in some cases, perforations are not considered accidents; instead, they are intentional and are seen after either a full-thickness biopsy or deep tumor resections.[54]

Perforations are usually reported when extravesical tissue (e.g., fatty tissue, small bowel, dark space between muscle fibers) is seen during resection. When postoperative cystogram was performed, 58.3% of cases were shown to have perforation. The incidence was significantly associated with tumor size.[54]

Bladder perforations can be classified as extraperitoneal or intraperitoneal. Extraperitoneal perforations are much more common and constitute up to 80% of all perforations. They are more often associated with posterior and lateral wall tumors. In these cases, fluid may accumulate in the perivesical space; however, fluid extravasation as far as the thorax has been reported.[55] Most cases are treated with prolonged Foley catheterization to provide adequate bladder drainage and allow the bladder to heal. It may be necessary to puncture the perivesical space to drain the collection if it is large.[47]

When intraperitoneal perforation occurs, treatment may be more extensive and involve laparotomy to repair the perforation and associated injuries.[47,53,54] These lesions, unless small, do not heal adequately with simple Foley catheter drainage. However, concurrent drainage of the bladder and peritoneal cavity has been reported with successful treatment.[56,57]

A major concern of bladder perforation during transurethral resection is the possibility of tumor cell dissemination into the peritoneum or perivesical area. In addition to upstaging of the cancer, there is a potential for an increased risk of metastatic disease. Although there are several reports of peritoneal or abdominal wall recurrence after a bladder perforation, dissemination does not necessarily lead to metastasis. Overall incidence of local recurrence and metastatic disease after perforation has been low. However, a higher number of cases of recurrence are in patients who have laparotomy for repair of perforation. A number of factors are involved, including tumor seeding into the target tissue, cell adherence, neovascularization, and the role of the immune system.[58,59]

Following perforation, irrigation fluid extravasation may cause TUR syndrome. It is seen less often after TURBT when compared to TURP. The fluid is absorbed after intraperitoneal or retroperitoneal perforation and extravasation. In contrast to the faster onset after TURP, the fluid and electrolyte imbalance after bladder perforation is typically slower. Serum sodium may not reach its lowest value for up to 6 hours. The rate of decrease of serum sodium is related to the amount of extravasated fluid volume and site of extravasation (intraperitoneal vs. extraperitoneal). Treatment is similar to TUR syndrome from TURP.[60]

Other Concerns

Bladder tumors may grow near or on the ureteral orifice(s). During TURBT, in an attempt to resect these tumors in their entirety, it is often necessary to resect bladder tissue involving the ureteral orifice. In these cases, a pure cut current should be used to prevent cautery damage to the ureteral orifice with subsequent stricture. It may be necessary to place a ureteral stent postoperatively to allow healing of the orifice.

Similar positioning and instruments are used for both TURP and TURBT. As a result, many complications related to prolonged surgery are possible. These include UTI, urethral stricture, and thromboembolic events.

Conclusion

Transurethral resection of the prostate and transurethral resection of bladder tumor are standard procedures in the armamentarium of urologists. Although both minor and major complications are possible with each procedure, both have proven efficacy for treatment of BPH and bladder tumors, and remain gold standards for treatment for their respective disease processes.

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19

Reoperative Management of Fissure and Hemorrhoids

Martin Luchtefeld and Michael Ott

Anal Fissure

Definition and Epidemiology

Anal fissure was first described as a disease entity in 1934. It represents one of the most common benign anorectal problems in Western countries. It is estimated that anal fissure represents up to 10% of all visits to colorectal surgical clinics.[1] Anal fissure represents a linear split or disruption in the distal anal canal anoderm. The vast majority of anal fissures present in the posterior midline of the anal canal, with a minority (10–15%) occurring anteriorly (predominantly in women). Fissures that occur in positions other than the anterior of posterior midline are often secondary fissures caused by such conditions as Crohn's disease, HIV, anal canal neoplasm, and tuberculosis. The presentation of anal fissure is variable with minor to severe complaints of anorectal pain during and following defecation with associated bright red rectal bleeding. Classically, patients describe a tearing sharp pain with defecation.

Anal fissures are divided clinically into acute and chronic. The definition of chronicity is arbitrary, with chronic or recurrent fissures representing those that recur or fail to heal within 6 to 8 weeks. The majority of acute anal fissures heal with simple conservative measures and are often treated by primary care physicians. Chronic anal fissures tend to be refractory to simple conservative measures and require a more aggressive approach to achieve healing. Clinically chronic anal fissure have several easily identified stigmata including hypertrophied anal papilla, indurated edge, internal anal sphincter fibers or granulation tissue at the base, and a sentinel pile. This chapter focuses on chronic or recurrent anal fissures.

Etiology

The exact mechanism of fissure occurrence has been a matter of debate for many decades. Internal anal sphincter hypertonicity and the resultant ischemia has been elucidated as the pathophysiology behind the failure of chronic fissure healing. Although trauma from a hard constipated bowel movement remains an often-cited initiating event, a good proportion of patients do not describe any antecedent constipation.[2] The major breakthrough in understanding the pathophysiology of anal fissure healing failure came with the awareness of increased resting tone of the internal anal sphincter in those with chronic anal fissure and poor healing.[3] Many reports using anorectal manometry have documented elevated resting anal pressures and hypertonicity of the internal anal sphincter in those with failure of acute fissure healing.[4,5] The identification of hypertonicity of the internal anal sphincter lends credence to the initial surgical therapies, which were aimed at decreasing sphincter tone with anal dilation or sphincterotomy.

Further understanding of the pathophysiology of chronic anal fissure came from the identification of local tissue ischemia at the site of the fissure. Gibbons and Read[6] demonstrated through postmortem angiographic studies a paucity of end arterioles in the posterior midline of the anal canal and that anodermal perfusion depends on arterioles that cross the fibers of the internal anal sphincter. More recently, the limited blood flow in the posterior midline of the anal canal has been confirmed using laser Doppler flowmetry by Schouten et al.[7] in both normal individuals as well as those with anal fissure. Flowmetry demonstrated decreased blood flow in the posterior midline compared to other quadrants in the anal canal. Anteriorly there was a corresponding decrease in blow flow as well but not as dramatic as the difference seen in the posterior midline. The authors also noted that fissure patients had dramatically increased internal anal sphincter tone and an equally dramatic decrease in posterior midline anodermal blood flow compared to normal individuals. Together the hypertonicity of the internal anal sphincter and the resultant local ischemia is thought to be the etiology of chronic or recurrent anal fissures. The majority of treatment modalities, both medical and surgical, used for chronic anal fissure focus on

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decreasing sphincter tone, thereby promoting increased perfusion to the anoderm resulting in facilitated healing.

Management

Multiple strategies have been employed to promote the healing of anal fissures. In the setting of acute fissure healing can be expected with conservative management (sitz baths and fiber supplementation) to occur in about half of all patients. However, recurrence rates are high, with several studies reporting recurrence rates of 18% to 27% over long-term follow-up.[8,9] Once fissure recurrence or chronicity develops, several modalities, both medical and surgical, have been employed to promote healing.

Medical Management

Nitrates

Nitric oxide donors were the first topical medical treatment applied to chronic anal fissure in order to promote healing. Nitric oxide is the main chemical neurotransmitter involved in mediating relaxation of the internal anal sphincter (IAS) leading to decreased resting anal pressures.[10] Topical application of nitric oxide donors has been shown to decrease resting anal pressures.[11] Several uncontrolled reports have demonstrated high rates of primary healing with the use of topical nitrates for chronic anal fissure. Healing rates as high as 70% to 80% are demonstrated in several case-controlled trials.[12] Similarly, in a prospective trial Lund and Scholefield[13] demonstrated that a clear advantage was seen for healing of chronic recurrent anal fissures following nitrate therapy. They demonstrated that nitrate therapy also increased anodermal blood flow and significantly reduced maximal resting anal pressures, countering the pathophysiologic mechanisms of chronic anal fissure. Several randomized controlled trials have also been completed that found improved healing of anal fissure with topical nitrate ointments.[14–19] In these studies primary healing rates ranged from 46% to 85%, with recurrence rates ranging from 0% to 43%. Headache, the major side effect of topical nitrates occurred in 8% to 65% of patients undergoing therapy, significantly higher than in placebo controls. Within this group of randomized studies, no episodes of lasting incontinence resulted from nitrate treatment.

Other authors have cast some doubt on the efficacy of topical nitrates for the healing of chronic anal fissure. A systematic review by the Cochrane Database found topical nitrates to be marginally better than placebo for healing of chronic fissures, with late recurrence rates reported as high as 50%.[20] Other recent literature has shown that the severity of side effects may alter compliance of treatment with topical nitrates. In a study by Dorfman et al.,[21] only 67% of patients were compliant with the course of therapy, with side effects being the number one cause for terminating treatment. In this group of patients only 55% had resolution of symptoms. In a similar study in the United Kingdom, 68% had resolution of symptoms but 11% were unable to complete the course of treatment secondary to side effects.[22] Similarly, in a large multicenter trial comparing topical nitrate treatment to sphincterotomy, 84% of nitrate patients developed side effects, a large proportion of which were headache, with severity of side effects leading to 21% of patients being unable to complete therapy.[23] Many authors still consider topical nitrates as the gold standard medical therapy for the management of chronic fissure. The high recurrence rate and severity of side effects that lead to poor compliance, however, have substantial impact on healing rates.

Calcium Channel Blockers

Calcium channel blockers, like nitrates, also show pharmacologic activity of smooth muscle relaxation. By blocking the influx of calcium ions, calcium channel blockers such as nifedipine and diltiazem have been given both orally and topically to promote healing by relaxation of the internal anal sphincter in the treatment of chronic anal fissures. Treatment with oral nifedipine demonstrated a significant drop resting anal pressures, and resulted in healing rates similar to those with topical glycerine trinitrate.[24] Headaches and flushing were common with oral nifedipine and resulted in treatment completion failure rates similar to those seen with nitrates. Oral diltiazem has been used as well, with similar anal resting pressure results and healing rates to those with oral nifedipine, with a less severe side effect profile.[25,26] The use of topical nifedipine has also been evaluated. Antroploi et al.[27] demonstrated in a multicenter trial a 30% reduction in maximal resting anal pressure and a corresponding increased healing rate of chronic anal fissures using nifedipine ointment compared to those using lidocaine/hydrocortisone gel (95% vs. 50%).[27]

Several different investigators have also explored diltiazem as a topical treatment for chronic anal fissure. In evaluating topical diltiazem (2% gel) Carapeti et al.[28] demonstrated healing rates of 75%, with 66% of patients remaining symptom free with long-term follow-up. Of those that recurred after initial treatment with diltiazem ointment, six of seven responded to repeated treatment with healing. In a randomized controlled trial of oral diltiazem compared to topical treatment, healing rates were twice as high in the topical treatment arm (65% vs. 38%), suggesting that local therapy is more efficacious than systemic treatment.[29] Side effects were seen to be less in the oral calcium channel blocker group than previous published results for nitrates, and the topical diltiazem group had the least complaints of detrimental side effects. In two randomized controlled trails directly comparing topical diltiazem gel and nitrates, healing rates were similar with a significant difference in side effect profiles favoring diltiazem.[30,31] Based on the data available, calcium channel blockers, particularly diltiazem, is at least as effective as nitrates in promoting healing of chronic anal fissures with a much more favorable side-effect profile. Most authors conclude that diltiazem should be used either as a second-line treatment for those who have failed topical nitrates or recur following nitrate treatment, or as a first-line treatment of chronic anal fissure.

Botulin Toxin

The first use of botulism toxin in the treatment of chronic anal fissure was reported in 1993.[32] Botulin toxin is produced by *Clostridium botulinum.* The toxin prevents acetylcholine release from presynaptic nerve terminals in a noncompetitive manner, acting at both skeletal and smooth muscle targets. The onset of action is maximal after 7 days, and lasts up to 3 months. Botulin toxin acts to produce a denervation of the internal anal sphincter, leading to relaxation. Espi et al.[33] demonstrated that, at a minimum, 15 units of locally injected botulin toxin are required to result in a significant change in the maximal anal resting pressures. Several other authors have also demonstrated relaxation of the internal anal sphincter with injection into the internal or external sphincter with varying amounts of toxin, either 15 or 20 units.[34] Using 20 units of toxin improved healing rates compared to 15 units in a randomized trial comparing doses.[35] In another randomized controlled double-blinded trial, the site of injection influenced healing rates, with injection in the anterior midline being more effective than in the posterior midline.[36]

In a randomized controlled trial comparing botulin toxin and saline injections, healing occurred in 73% of the treatment arm compared to 13% in the control arm. Those in the control arm who crossed over to the treatment arm after failure to heal had a 70% healing rate.[37] In a direct comparison of botulin toxin injection to topical glyceryl trinitrate for chronic anal fissure, both groups showed decreases in resting anal pressures, but the botulin toxin group had a healing rate of 96%, while nitrates had a corresponding 60% healing rate.[38] Those with nitrates reported significant side effects in 20%, while the botulin toxin group demonstrated no significant side effects. Lysyl prospectively studied patients with chronic anal fissure who had recurrence or failed to heal following nitrate therapy.[39] Groups were treated with a combination of topical nitrates and botulin toxin or botulin toxin alone. The 6-week healing rate was 66% for those with the combination therapy compared to 20% for those treated with botulin toxin alone. Although initial results with botulin toxin have been very effective in healing chronic or recurrent fissures, the long-term efficacy has been debated. Minguez et al.,[40] in a study with 42-month follow-up after botulin toxin injection, reported a recurrence rate of 41%, suggesting that previously reported healing rates do not remain in the long term. Although botulin toxin in most series has been reported as a safe modality to treat fissure, some incontinence has been seen short-term following injection. Incontinence rates range from 0% to 22%, with the majority being transient incontinence to flatus, and very few cases of true incontinence that is long lasting.[34,35,41,42] There is no consensus on the site of injection and the amount of toxin that is required, but the majority of studies report a similar high rate of initial healing for chronic fissures. The majority of authors still advocate this as a second-line therapy or for recurrent fissures.

Surgical

Anal Dilatation

Anal dilatation has been a long-standing therapy for multiple anorectal conditions. The technique was reapplied to anal fissures in 1964.[43] Lord's procedure, or digital dilatation, has a success rate of 87% to 100% in the literature.[43–46] Recurrence rates are highly variable and range from 0% to 56%. There has been a lack of standardization for the procedure within publications, making it impossible to compare across studies. The introduction of Park's retractor using balloon dilatation attempted to make a more uniform and reproducible procedure.[47] While the dilatation may lead to sphincter relaxation and improved blood flow, and thereby healing, there has been a great deal of criticism surrounding uncontrolled sphincter injury. Nielsen et al.[48] examined patients following anal dilatation using endorectal ultrasound and identified sphincter defects in 65% of patients with incontinence of 12.5%.[48] Others have reported unsatisfactory incontinence in up to 51% of individuals.[43–46] Currently few authors would recommend anal dilatation in the treatment of anal fissures given the risks to continence.

Sphincterotomy

Operative intervention is often recommended when fissures fail to heal with conservative management, and is indicated in recurrent or chronic fissures. The most widely applied operative procedure for fissure is internal sphincterotomy. Sphincterotomy was initially described as a posterior midline procedure with splitting of the internal sphincter fibers in the fissure bed.[49] Problems with wound healing led to the lateral internal sphincterotomy with multiple variations in technique. More recent meta-analysis does not demonstrate any difference in posterior compared to lateral sphincterotomy.[50] One unique complication of the posterior midline approach is the development of a keyhole deformity that may lead to incontinence to flatus and liquid stool. The use of lateral internal sphincterotomy removes this risk and is therefore preferred by most colon and rectal surgeons. Multiple variations on lateral internal sphincterotomy have been published in the literature, including open as well as closed procedures and even tailored sphincterotomy. Essentially all involve a similar process of division of the most superficial fibers of the internal sphincter muscle in a position lateral to the fissure. By division, the internal anal sphincter canal hypertonicity is relaxed, and blood flow reestablished to promote healing of the chronic wound.

The use of lateral internal sphincterotomy has been evaluated thoroughly in the literature, with success rates for healing range from 90% to 100%, with recurrence rates quoted in the range of 0% to 20%.[51–58] While efficacy rates and cure rates are uniform in the multiple reports of lateral internal sphincterotomy, there is variability in incontinence rates ranging from 0% to 20%. The extent of sphincter muscle division is closely linked to the final outcome of the procedure in terms of healing and incontinence. Using endoanal ultrasound in patients previously having sphincterotomy documented a high rate of incomplete sphincterotomy in those with symptomatic recurrence.[59] The amount of sphincter division appears to be more tenuous in female than in male patients. In a prospective trial using ultrasound to facilitate decisions about sphincter division, women were found to have a shorter anatomic anal canal.

The shorter anal canal combined with previous obstetrical trauma is postulated to be the etiology of increased continence impairment.[60]

Although there is minimal evidence of the optimal extent of division of the internal anal sphincter, most authors conclude that the proximal extent of sphincter division should be equal to that of the proximal extent of the fissure.[61] This strategy leads to the least amount of sphincter muscle division required to improve blood flow and achieve complete healing, a strategy that should lead to limited incontinence problems. In comparison to nonsurgical or medical sphincterotomy, healing rates with lateral internal sphincterotomy are higher when compared to nitroglycerin.[23] In long-term follow-up over 6 years, lateral internal sphincterotomy had a higher level of patient satisfaction, with no increase in fecal incontinence compared to treatment with nitroglycerin.[62]

Two major standard techniques of lateral internal sphincterotomy are used with some minor variation: open sphincterotomy and closed sphincterotomy. A meta-analysis of surgical trials failed to show any significant differences in the two techniques for healing rates, incontinence, and patient satisfaction.[50] Most authors agree that lateral internal sphincterotomy is the appropriate choice for patients with chronic or relapsing fissures, with good overall success and minimal complications rates. The majority of incontinence that develops is short lived and is primarily incontinence to gas. Tailored sphincterotomy with division of muscle just to the proximal extent of the fissure decreases the already low incontinence rates. The addition of endoanal ultrasound to investigate those with previous sphincter damage may be useful to determine the level of sphincter division and to select out those for whom the procedure should not be recommended, and more importantly those who are contraindicated for sphincterotomy.

Fissurectomy

In the setting of recurrent anal fissures for which maximal medical management has been tried and failure to heal occurs with lateral internal sphincterotomy, two major surgical alternatives remain: fissurectomy and anal advancement flaps. Given the concerns of increased incontinence rates with repeated sphincterotomy,[63] sphincter-preserving alternatives have been investigated. Fissurectomy entails excision of the chronic granulation tissue, hypertrophied papilla, and scar, and is either left open or closed primarily. Engle et al.[63] looked at the combination of fissurectomy with nitrate topical therapy in 17 patients with chronic recurrent fissures. The majority of patients had not undergone previous sphincterotomy. All of the chronic fissures had healing following 10 weeks of follow-up, and no recurrence on a 29-month average follow-up. Similarly, Lindsey et al.[64] looked at the combination of fissurectomy and botulinum toxin injection in those failing medical management. Healing occurred in 93% of patients who had complete healing with median follow-up of 16.4 months. Despite concerns with a keyhole deformity possibly occurring following fissurectomy, in both studies the incontinence rates were only as high as 7%, which was transitory to flatus only. In a similar study looking at the use of botulinum toxin in the setting of fissurectomy with a mean follow-up of 1 year, fissure healing rates were found to be 79%, with only four patients with recurrence identified, but no comments were made on them.[65] No literature exists on fissurectomy alone for the treatment of chronic or recurrent anal fissure. While fissurectomy in combination with either nitrates of botulinum toxin appears to be a viable alternative to lateral internal sphincterotomy, the majority of authors still recommend lateral internal sphincterotomy over fissurectomy. Fissurectomy may be an alternative method for those who have failed following lateral internal sphincterotomy, or where excessive anxiety about division of the internal anal sphincter precludes lateral internal sphincterotomy.

Anal Advancement Flaps

An alternative method for sphincter preservation in the setting of chronic or recurrent anal fissure is advancement flaps. Anal advancement flaps are advantageous in those with an already increased risk of incontinence, such as the elderly, diabetics, multiparous women, and those who have already undergone sphincterotomy unsuccessfully. The goal of advancement flaps is to replace chronic nonhealing granulation tissue with well-vascularized tissue with a better chance to heal. Kenefick et al.,[66] in a group of patients who had undergone multiple surgical attempts at fissure healing, found a high rate of complete healing with advancement anoplasty. Similarly Nyam et al.[67] demonstrated healing of anal fissures in patients who were poor candidates for sphincterotomy given hypotonia of the internal anal sphincter preoperatively. In this group of 21 patients, no significant complications and most importantly no alterations in continence were observed over a follow-up of 18 months. Singh et al.[68] proposed rotational flaps to treat chronic and recurrent anal fissure in an attempt to limit the complications observed at flap donor sites. In this series of 21 patients, 17 had complete resolution of symptoms, with only three patients having recurrence of their fissure.

Summary

Anal fissure is a common and distressing problem. Acute fissures require minimal treatment, and in most instances will heal spontaneously with mild conservative measures. Chronic anal fissure or recurrent anal fissure is treated with various medical and surgical treatments. Although medical management is attractive because of limited side effects and minimal risk of incontinence, healing rates remain moderate. Surgical interventions with a tailored lateral internal sphincterotomy remains the gold standard in promotion of healing for chronic anal fissure. Those with sphincter weakness or who are at increased risk of incontinence have reasonable results with advancement flap techniques that spare the internal sphincter muscle. The optimal management of chronic fissure based on patient satisfaction and cost-effective treatment is still debated in the literature.

Anal Stenosis

Definition and Epidemiology

Anal stenosis results from any process that induces or causes scaring in the anoderm. Stenosis of the anal canal is defined by lack of the normal compliance of the anal canal leading to a tight fibrous stricture. Anal stenosis can be classified anatomically, based on position, as low, middle, or high anal canal lesions, or classified based on severity and symptoms, as mild, moderate, or severe.[69] Mild stenosis allows examination by index finger or medium Hill-Ferguson retraction, but with moderate stenosis forceful dilatation is required to insert the index finger or medium Hill-Ferguson retractor, and with severe stenosis neither the little finger nor a small Hill-Ferguson retractor can be inserted without forceful dilatation. The most common position of stenosis lies in the lower anal canal.[69]

Often there is little correlation of severity of stenosis and patient symptoms.[70] Primarily patients complain of pain, constipation, bleeding, and incontinence.[71,72] Incontinence usually results from overflow diarrhea or failure of the anal os to close secondary to such severe fibrosis. Patients often resort to laxative abuse, enemas, or even digital disimpaction in order to maintain a normal lifestyle. Such practices may cause more injury and subsequent fibrosis. The majority of cases on anal stenosis are caused by trauma to the anal canal, with iatrogenic trauma being the most prevalent case.

Etiology

There is very little published data on the incidence and prevalence of anal stenosis in the literature. The vast majority of studies focus on the incidence following local anorectal procedures. Anal stenosis has been reported to be as high as 10% following radical amputative hemorrhoidectomy and other anorectal surgical procedures.[69,73,74] Other causes include inflammatory diseases, neoplasia, ischemia, chronic diarrhea, functional disorders, and post-radiation. Khubchandani[74] classified anal stenosis based on etiology. Congenital stenotic lesions are the result of imperforate anus and anal atresia. Acquired stenosis may be primary, as is the case with iatrogenic trauma, or secondary, as in inflammatory bowel disease. In the retrospective study by Milsom and Mazier,[69] the most common cause of anal stenosis was posthemorrhoidectomy, representing 88% of 212 patients seen over 5 years at a colon and rectal surgery specialty clinic. The other most common etiologies are Bowen's disease, fistulectomy, ileoanal anastomosis, and Paget's disease. Classically, anal stenosis was linked to the complication of Whitehead hemorrhoidectomy, with the Whitehead deformity resulting in stenosis and ectropion of rectal mucosa. Most surgeons have abandoned the Whitehead hemorrhoidectomy. However, overaggressive excisional hemorrhoidectomy may result in a similar fate.

Management

Nonoperative

Minimal anal stenosis can often be managed with nonoperative conservative therapy. Initially, mild stenosis will respond to alterations in diet, the addition of bulking agents, and stool softeners. Primarily, dilatation should be the result of gentle passage of stool. Patients can also be taught gentle digital dilatation or mechanical dilatation with reasonable results.[69] Patients are taught to bear down and gently dilate the stenosis with bowel movements. A large proportion of patients, however, will find it difficult to comply with daily dilatation. If conservative measures fail, or patients find dilatation unacceptable, then often surgical intervention is required.

Surgical

Patients who have failed conservative management or are found to have moderate to severe stenosis often come to surgery for amelioration of symptoms. Multiple surgical techniques have been described in the literature to improve upon anal stenosis. For mild to moderate anal stenosis of the distal anal canal, simple sphincterotomy has been advocated with good functional results.[75] Multiple sphincterotomies may also be used with favorable results, depending on the degree of stenosis. Milsom and Mazier[69] found that those who had multiple sphincterotomies had improved results compared to individuals with a single sphincterotomy for low moderate anal stenosis, and they advocated this approach. Prior to undertaking bilateral or multiple sphincterotomies, it is essential to ensure that a complete examination and history focusing on patients' current continence status is determined to avoid unacceptable results with uncontrolled incontinence. The results of bilateral or multiple sphincterotomies are poor in the setting of severe stenosis. The primary operative management of severe stenosis is based on bringing in healthy well-vascularized tissue from the anoderm into the anal canal to relieve stenosis. These procedures encompass island tissue transfer or advancement and rotational flaps.

Mucosal Advancement Flaps

Mucosal advancement anoplasty involves removal of the stenotic scar, sphincterotomy, and replacement of tissue with a rectal mucosal advancement. Careful placement of the distal aspect of the flap is required in order to prevent development of ectropion. Kubchandani[74] reported his experience in 53 patients undergoing mucosal advancement flaps, with 82% of patients reporting a good outcome, and 11% reporting a fair improvement in symptoms.

V-Y or Y-V Advancement Flap

The most common anodermal flap used in patients in whom mucosal advancement flaps are not appropriate is V-Y or Y-V advancement flap (Figs. 19.1 and 19.2). The flaps result in the mobilization of anodermal tissue into the anal canal with widening of the original scar, thus relieving the stricture. One major disadvantage of the Y-V flap is that the

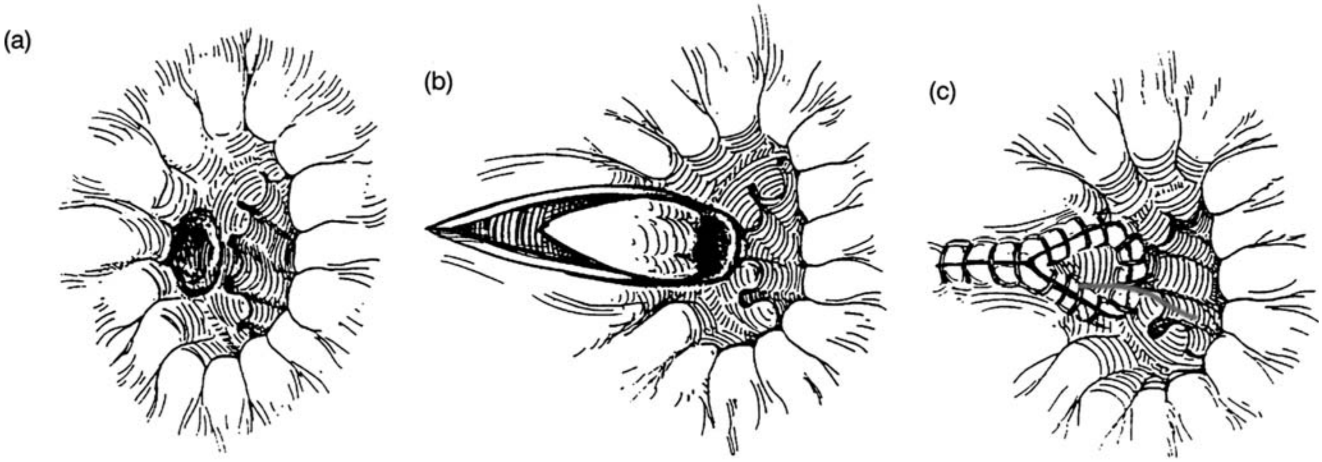

FIGURE 19.1. xxxV-Y advancement. (**A**) A *V-shaped* incision is made at the anal verge. (**B**) The flap is mobilized, taking care to preserve vasculature after first incising the stenosis. (**C**) The flap is advanced into the anal canal and sewn in place. (From Beck and Wexner,[96] with permission of David E. Beck, MD, and Steven D. Wexner, MD.)

most proximal end of the flap is narrow, allowing for little relaxation above the dentate line. A V-Y flap reverses the orientation of the flap, leading to greater expansion more proximally, making this more advantageous to strictures that are middle to high in the anal canal. The use of Y-V advancement flaps has been reported to have excellent results, with a healing rate of approximately 92%.[71,76,77] Although V-Y advancement flaps was initially intended for the correction of ectropion,[78] its adaptation to the treatment of anal stenosis has resulted in favorable outcomes in severe low anal stenosis.[69,79]

Diamond or House Flap

The diamond flap was initially described by Caplin and Kodner[73] (Fig. 19.3). The scar is excised in a diamond shape and a similarly shaped flap of tissue from the anoderm is mobilized into the anal canal. Several authors have reported very favorable outcomes using this technique.[73,76,80] A variation on the diamond flap, the house flap, was described by Christensen et al.[81] (Fig. 19.4). This flap is advantageous because of its broad base and variable length, allowing it to be adapted to varying lengths of stenosis. The flap is placed with the base of the house proximally and the roof distally, allowing for a widening of the excised scar. Sentovich et al.[82] presented a series of 21 patients with 89% reporting improvement in overall condition.

Rotational S-Plasty

Ferguson[83] initially described rotational S-anoplasty for dealing with circumferential ectropion secondary to whitehead hemorrhoidectomy (Fig. 19.5). This flap is created with a large S-curve incision, with the anus in the center of the S. The tip of the flap is then rotated in toward the anus to provide coverage after the mucosa is detached from the perianal skin. The primary advantage of this flap is that it provides a broad base of coverage for large defects, as well as circumferentially relaxing stenosis. When large areas of

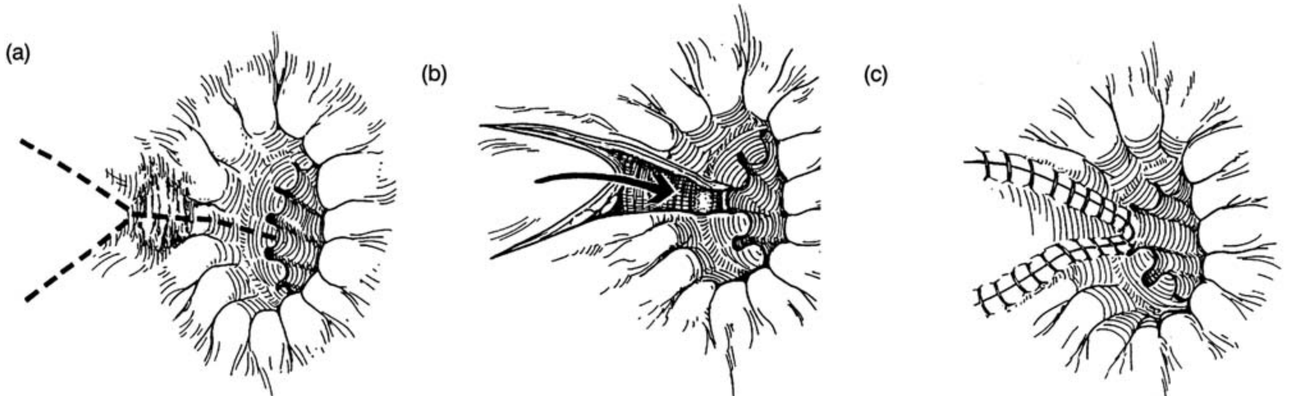

FIGURE 19.2. Y-V advancement. (**A**) *Y-shaped* incision is made starting at the anal verge and carrying it up into anal canal. (**B**) The flap is mobilized. (**C**) The flap is advanced into the anal canal and the resulting V shape is sutured in place. (From Beck and Wexner,[96] with permission of David E. Beck, MD, and Steven D. Wexner, MD.)

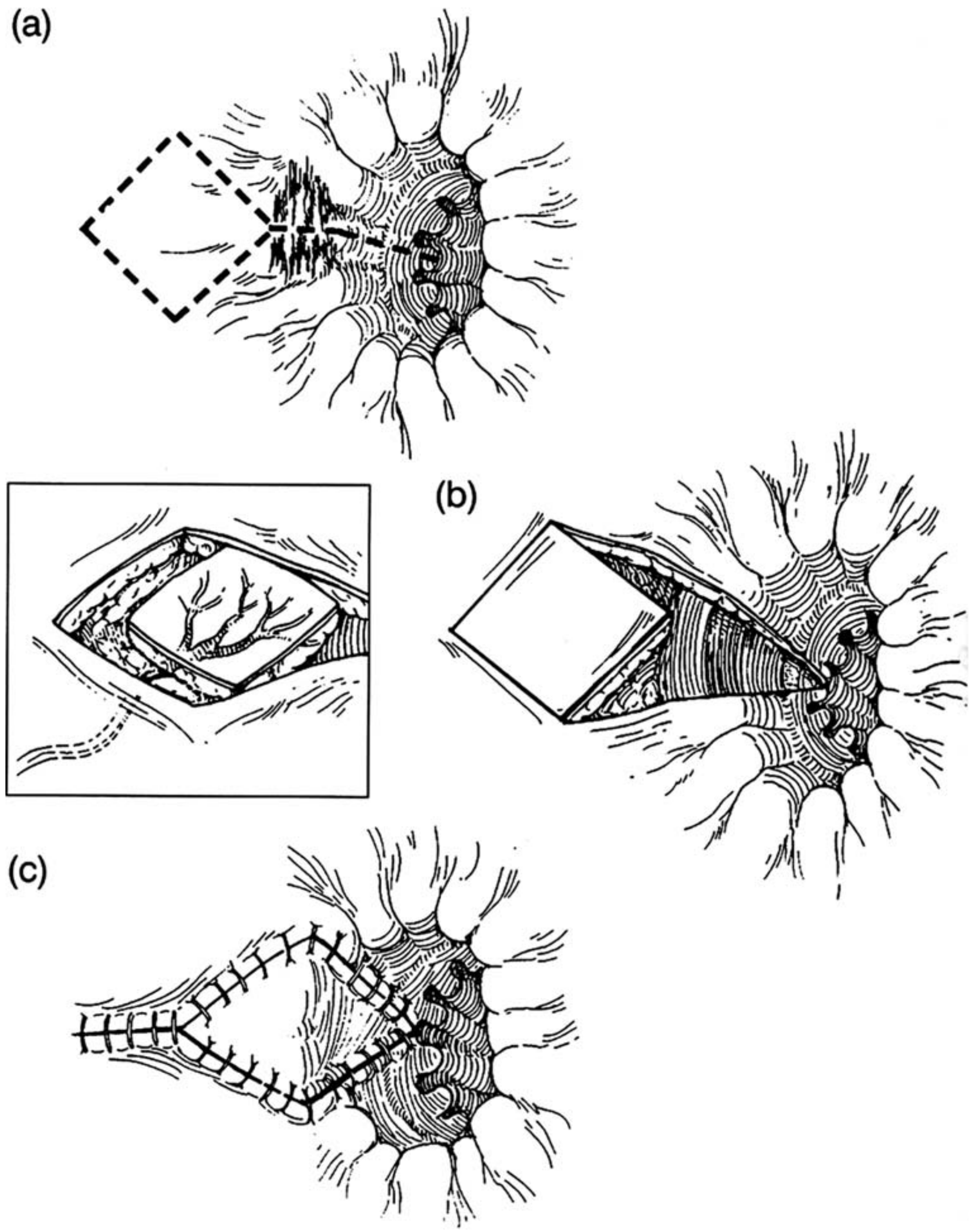

FIGURE 19.3. Diamond advancement. (**A**) A *diamond-shaped* incision is made in the perianal area and the stenosis is incised. (**B**) The flap is mobilized and placed into the anal canal. (**C**) The flap is sutured in place. (From Beck and Wexner,[96] with permission of David E. Beck, MD, and Steven D. Wexner, MD.)

coverage are required, options include multiple diamond/house flaps or a rotational S-plasty flap. Excellent results have been obtained, although this procedure is less commonly reported in the contemporary literature.

Summary

Anal stenosis most often presents following local anorectal trauma that is primarily iatrogenic. The management depends on the location within the anal canal and the severity of the stricture. Minor stenosis may be managed with nonoperative therapies or sphincterotomy. More complex procedures including multiple sphincterotomies and anoplasties are required for more extensive structures. The choice of advancement flap primarily is based on the extent/proximity of the stenosis and the defect left following excision of scar tissue. The best long-term results appear to occur with uncomplicated advancement flaps.

Recurrent Hemorrhoidal Disease

Hemorrhoids are a common benign anorectal problem. The prevalence rate of symptomatic hemorrhoids has been estimated as high as 4% in the United States population in any given year. A large number of management options exist including simple medical management, invasive techniques such as banding and sclerotherapy, and operative treatment including open and closed formal

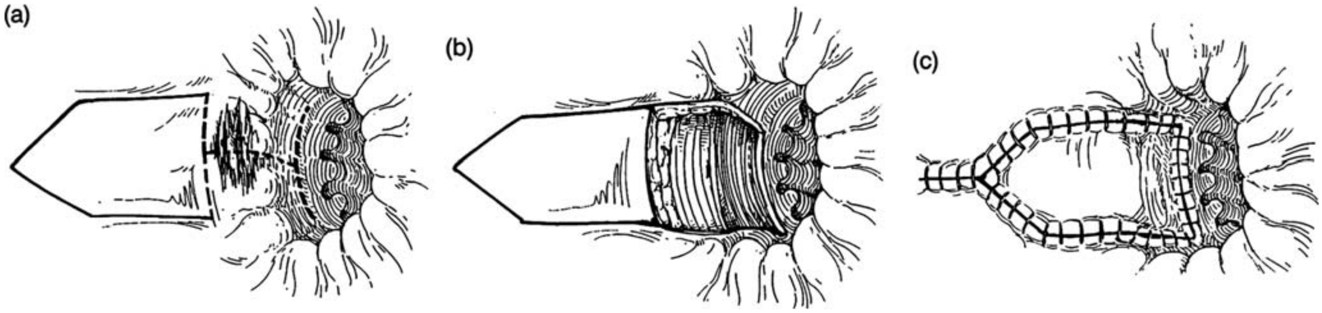

FIGURE 19.4. House advancement. (**A**) A *house-shaped* incision is made at the anal verge and the anal stenosis is incised. (**B**) The flap is mobilized. (**C**) The flap is sutured in place in the anal canal. (From Beck and Wexner,[96] with permission of David E. Beck, MD, and Steven D. Wexner, MD.)

hemorroidectomies. Stapled hemorrhoidopexy has gained popularity as an alternative to formal excision because of favorable patient satisfaction due to less postoperative pain and quicker recovery. Other noninvasive techniques such as infrared coagulation have also been introduced. In reviewing the literature, none of the aforementioned management options is without recurrence. Here we review rates of recurrence and management options.

Rate of Recurrent Hemorrhoidal Disease

Infrared coagulation for the treatment of hemorrhoidal disease is a noninvasive technique entailing coagulation and occlusion of the hemorrhoid vascular pedicle. This treatment involves less pain in comparison to other nonsurgical options of management, but requires multiple treatments for efficacy.[84] This method has a high level of patient satisfaction compared to banding and sclerotherapy, and it controls symptoms in the majority of patients.[85] Recurrence rates are found to range between 20% and 54% in a review of the literature, suggesting that it is not an effective long-term management option.[85,86] Similar to infrared coagulation, rubber band ligation is a simple, well-tolerated office procedure that leads to occlusion of the hemorrhoid vascular pedicle. Rubber band ligation has been reviewed and compared in countless articles and is the gold standard to which all other nonsurgical procedures are compared. In a systematic review of randomized trials comparing hemorrhoidectomy with rubber band ligation, Shanmugam et al.[87] found that patients who had undergone rubber band ligation had up to a 40% retreatment rate compared to excisional hemorrhoidectomy, which has a retreatment rate of 5% to 6%.[87] In the American Gastroenterological Association (AGA)-sponsored review of treatment options

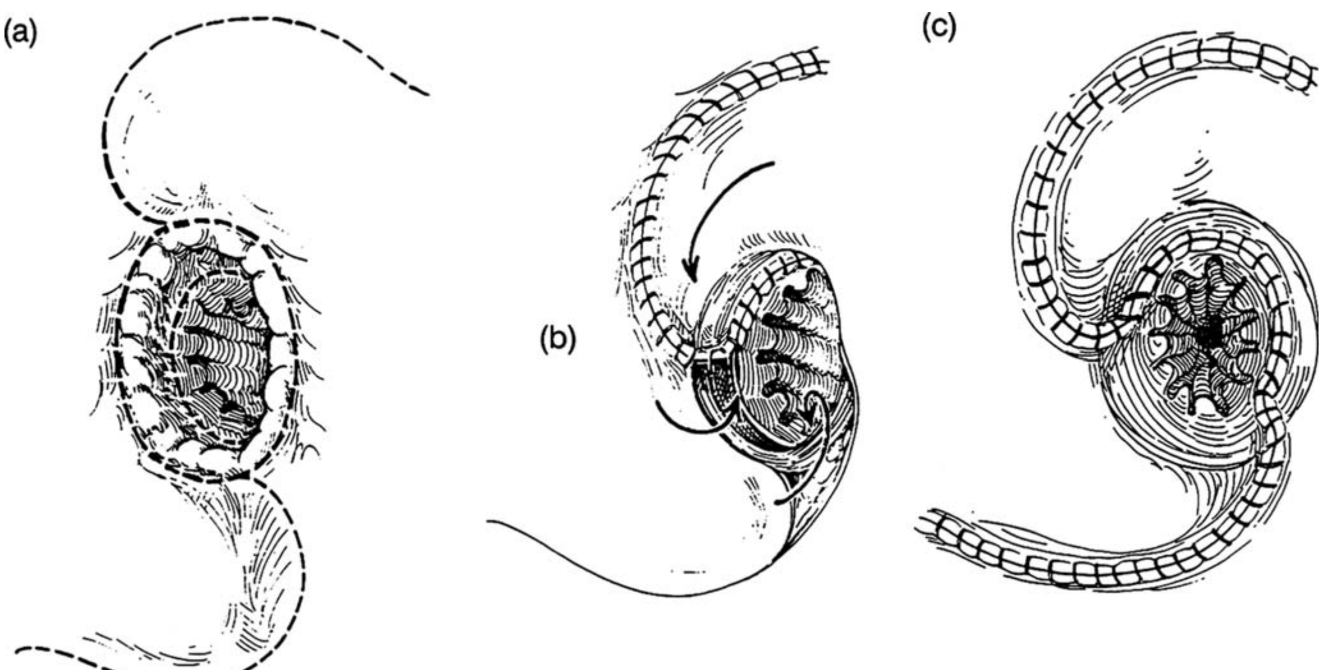

FIGURE 19.5. S-plasty. (**A**) An *S-shaped* incision is made around the anal opening and any excess ectropion is excised. (**B**) The incisions are extended well out onto the buttocks. (**C**) The flaps are rotated into the anal canal and sutured in place. (From Beck and Wexner,[96] with permission of David E. Beck, MD, and Steven D. Wexner, MD.)

of hemorrhoids, recurrence rates following rubber band ligation were found to be as high as 60% to 70%, with adequate long-term follow-up. However, most patients responded to repeat banding, with only 10% coming to formal hemorrhoidectomy.[88]

Sclerotherapy is another nonoperative modality used in the treatment of hemorrhoids with, again, a similar mechanism to banding and photocoagulation. A sclerosing agent is instituted into the vascular pedicle, resulting in resolution of vascular engorgement. Although this is a satisfactory treatment to patients because of minimal pain, it requires multiple treatments. Recurrence rates following sclerotherapy in a long-term follow-up prospective study were found to be 40% to 60%, depending on the grade of hemorrhoids initially present.[89]

Surgical hemorrhoidectomy by far has the lowest recurrence rate of all the modalities; however, this is offset by increased patient discomfort following the procedure. Numerous publications have looked at the long-term outcomes of excisional hemorroidectomy. In the Cochrane systematic review of stapled hemorrhoidopexy compared to excisional hemorrhoidectomy, recurrence rates for excisional hemorrhoidectomy at 1.4% were much lower than for the stapled hemorrhoidopexy.[90] The excisional hemorrhoidectomy remains the gold standard for the management of hemorrhoidal disease. In order to improve on patient postoperative discomfort, the stapled hemorrhoidopexy was introduced; it has increased in use compared to excisional hemorroidectomy for the treatment of hemorrhoidal disease. The recurrence rate is variably published. In the aforementioned Cochrane review, recurrence rates were at 8.5%.[90] A recent series of 3711 stapled hemorrhoidectomy procedures was published with a recurrence rate of 0.3% and an overall complication rate of 12.3%.[91] In the meta-analysis comparing stapled hemorrhoidopexy and excisional hemorroidectomy by Slawik,[92] there was no difference observed in reintervention rates.

Management of Recurrent Disease

Recurrent hemorrhoidal symptoms following nonoperative therapy is common. Universally the reapplication of nonoperative techniques may be employed, and often in the use of banding or sclerotherapy, several treatments are required. Retreatment with hemorrhoidal banding or sclerotherapy is not well evaluated in the literature but is a common practice among surgeons when patients are resistant to a more aggressive approach. In their long-term follow-up of hemorrhoidal banding, Savioz et al.[93] determined that only 55% were symptom-free at 5 years or longer following the procedure, with 23% requiring a further procedure. In the group of patients requiring reintervention, half had further conservative measures while the others had an excisional hemorrhoidectomy. Only a small number of patients who had a retreatment with rubber banding ever came to excisional hemorrhoidectomy. The authors conclude that repeat banding has high patient satisfaction and should be considered for the relapse of symptomatic hemorrhoidal disease. The authors also report that failed attempts at dealing with hemorrhoids through banding will respond to excisional hemorrhoidectomy with a recurrence rate close to zero.

The recurrence rates following stapled hemorrhoidopexy are variable in the literature but are mostly higher than those for excisional hemorrhoidectomy. Brusciano et al.[94] looked at the type of reintervention required in recurrent hemorrhoidal disease following stapled hemorrhoidopexy. In this cohort analysis, 11% of patients required retreatment, with 5% requiring reoperation following stapled hemorrhoidopexy. The most common operative intervention in this study was excisional hemorrhoidectomy, with no evidence of recurrence following the excision. Those who had a reintervention had higher rates of bleeding and soiling compared to those without a second procedure. The authors report that the majority had a good result, and that those who fail stapled hemorrhoidopexy should be treated by a colorectal surgical specialist, and most will require excisional therapy to remain symptom free.

In a second cohort review focusing on complication and reoperations following stapled hemorrhoidopexy, a recurrent prolapsed hemorrhoid rate of 1.3% was found; a majority of these patients underwent excisional hemorrhoidectomy, with good results.[95] The authors warn that any external component does not seem to be altered by the hemorrhoidopexy, and that patients should be warned of this. They also advocated excision of the external tags at the time of the original stapling procedure to limit reintervention. More recently, some authors have advocated reapplication of a second staple hemorroidopexy.[92,96] Slawik et al.,[92] in their review of outcomes following stapled hemorroidopexy, had three patients undergo a second stapling procedure for recurrent symptoms, with no adverse outcome recorded. Although reapplication of a second stapling procedure seems feasible and without complication in the small subsets reported, excisional hemorrhoidectomy remains the standard of care for recurrent symptoms.

Summary

Although less invasive techniques like banding and sclerotherapy have less pain associated with them, the recurrence rate of hemorrhoidal disease is high. A large proportion of patients will require another intervention to completely abolish symptoms. While stapled hemorroidopexy has advantages to patient comfort, long-term recurrence is higher than with excisional hemorrhoidectomy. The gold standard for minimizing recurrence remains excisional hemorrhoidectomy. Most recurrences from other treatments can be managed easily with excisional hemorrhoidectomy. Often if an excisional hemorrhoidectomy is initially performed, recurrences are minor and may be treated with minor anorectal procedures. Whenever operating on hemorrhoidal recurrence, caution should be used to prevent the creation of an anal stenosis.

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20

Reoperative Surgery for Inflammatory Bowel Disease

Stephen R. Gorfine

Inflammatory bowel disease, specifically Crohn's disease (CD) and chronic ulcerative colitis (CUC), are often managed surgically. Reoperations, especially in the setting of Crohn's disease are common.

Crohn's Disease

It is probable that CD existed as a clinical entity long before its first description in 1932.[1,2] Crohn's disease is an inflammatory condition that can affect any portion of the gastrointestinal tract from the mouth to the anus. Most commonly, the small bowel, colon, or both are involved. Segmental disease is the rule with normal-appearing bowel intervening between involved areas. The inflammatory process involves all layers of the bowel wall. Mucosal ulcerations, which can be small aphthous ulcers to linear "rake" ulcerations along the mesenteric aspect of the mucosa, are characteristic (Fig. 20.1). Ulcerated mucosa may be surrounded by normal-appearing mucosa. Confluence of ulcers can lead to a *cobblestone* mucosal appearance. The histologic appearance of involved bowel shows infiltration of all layers of the bowel primarily by lymphocytes. Noncaseating epithelioid granulomas, found in about 50% of pathologic specimens, are considered pathognomonic.

The cause of CD is unknown, and there is no cure. The course of illness is generally characterized by exacerbations and remissions, but the disease tends to be slowly progressive. Surgical intervention is not curative; rather it is used to treat complications. More than 70% of patients with CD undergo surgery at some point in the course of their disease. Fistulizing (Fig. 20.2) and cicatrizing disease (Fig. 20.3) are the most frequent pathologic findings associated with CD. Crohn's disease most commonly involves the terminal ileum and cecum.[3,4] Isolated colonic disease, usually with rectal sparing, occurs in about 25% of cases.[4] Crohn's disease involving the colon and small bowel generally has the worst prognosis. Failure of medical therapy is the most frequent indication for elective surgical intervention. Intraabdominal abscess, fistula to the skin or adjacent organs, fulminant colitis, bleeding, free perforation, and cancer prevention (or treatment) are also less frequent indications for surgery. Amelioration of extraintestinal manifestations alone is rarely a cause for operative management. International guidelines concerning when surgery is appropriate for patients with CD have recently been published.[5,6]

Reoperative surgery is the rule rather than the exception in the setting of CD. One third to more than half of CD patients have had at least one more surgery within 10 years of the initial intervention.[7,8] Ileocolonic involvement is associated with the highest reoperation rate.[8]

Small Bowel Disease

Surgery for CD, whether primary or reoperative, should adhere to a number of common principles. Foremost among these, the surgeon must remember that CD is not cured by surgery. Consideration of the possibility of future surgical intervention must be borne in mind when planning operative strategy. Surgery is performed for complications of CD. More significant complications will require more complex and technically demanding surgery. Mortality and intestinal failure from CD is often related to operative misadventures.[9] Resections should be limited in an effort to preserve intestinal function. Numerous studies have shown that resection to macroscopically disease-free margins is sufficient.[10–13] Stricturoplasty offers a durable, nonresectional solution when disease is quiescent and obstruction is the surgical indication.[14] Surgery may have to be staged. Preoperative optimization of the patient is imperative. Optimization of nutritional status, including parenteral nutrition, when indicated, is mandatory. Percutaneous drainage of preoperatively identified collections is desirable, and every effort should be made to accomplish this.[15] The possibility of intestinal diversion, whether temporary or permanent, must be discussed with the patient preoperatively.

Surgery

The most commonly performed surgery for CD involves resection of the terminal ileum and cecum with an

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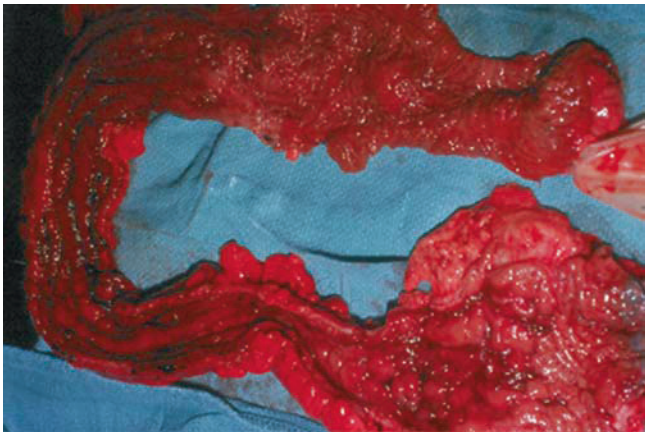

FIGURE 20.1. Total proctocolectomy specimen from a patient with Crohn's colitis. Note the linear *rake* ulcerations.

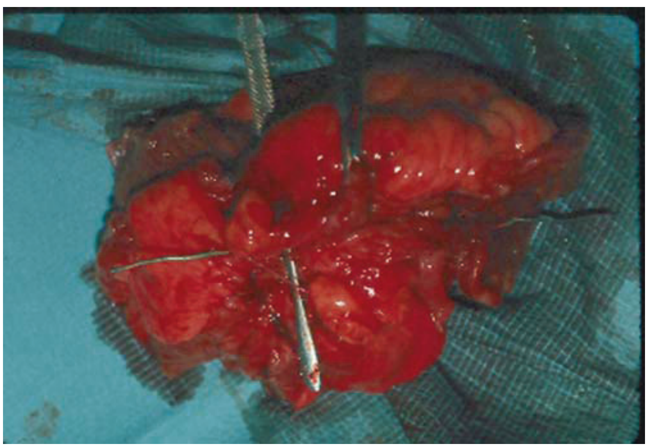

FIGURE 20.2. Fistulizing Crohn's ileitis.

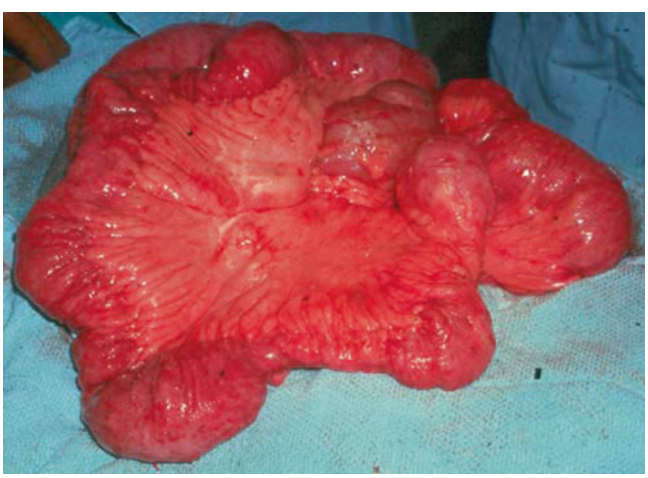

FIGURE 20.3. Multiple jejunoileal strictures in Crohn's disease.

ileocolonic reconstruction (Fig. 20.4). Laparoscopic approaches to this surgery have become more common over the past 10 years.[16,17] Whether performed by open or laparoscopic techniques, the principles remain the same. The diseased segment of terminal ileum and a comfortable portion of the cecum and right colon are mobilized. Occasionally, if the colon is uninvolved, resection of the terminal ileum alone is possible if there is enough disease-free ileum proximal to the ileocecal junction to permit anastomosis. "High" mesenteric division, in an effort to clear enlarged lymph nodes, is not necessary and can lead to a wider than necessary resection. Mesenteric division by ultrasonically activated scalpel, bipolar diathermy system, or traditional suturing techniques is safe and effective. Hemostasis is equally effective in animal models using all of these techniques.[18]

Anastomosis is effectuated by hand-suturing or stapling methods. Neither technique has been shown to be less prone to complication.[19] However, side-to-side anastomoses have been shown to be superior to end-to-end anastomoses in terms of leakage rates, overall postoperative complications, length of hospital stay, and rates of anastomotic recurrence.[20–22] Stapled, side-to-side anastomosis is therefore the preferred technique. Drains are not usually necessary.

When multiple segments of the small bowel are involved, options for surgical management depend on the proximity of effected areas. At the time of primary surgery, it is often wisest to resect two relatively short segments of disease that lie in close proximity. As this type of resection sacrifices the intervening area of uninvolved bowel, this technique should be applied only when the total area resected is relatively short. It is here that surgical judgment comes into play. One surgeon's "relatively long" may be another's "relatively short."

If contiguously involved segments are separated by a considerable length of normal small bowel, multiple resections or resection and stricturoplasty are indicated. Multiple resections and anastomoses can be safely performed.[23] Stricturoplasty offers an adequate solution to segmental narrowing in the setting of quiescent disease. Short strictures are amenable to stricturoplasty using a technique similar to the Heineke-Mikulicz pyloroplasty (Fig. 20.5). Longer strictures, usually less than 15 cm, are treated with a Finney-type anastomosis (Fig. 20.6). Very long segments (greater than 15 cm) can be successfully treated with side-to-side isoperistaltic stricturoplasty.[24–26] Stricturoplasty is safe, and reported long-term recurrence rates at the site of stricturoplasty are low.[14]

Simple ileocolic resection does not usually involve the pelvic structures. However, in the setting of fistulizing disease, adjacent pelvic organs such as the bladder, fallopian tube, ovary, or rectosigmoid can be involved in the inflammatory process as "innocent bystanders." Ileosigmoid fistula is most common.[27] Enterovesical fistulas occur in about 2% of cases, usually from the small bowel.[28,29] In these cases, it is not generally necessary to resect the bladder or colon if it is disease free. Rather the fistulizing segment is resected and the hole in the rectosigmoid or bladder is closed primarily. However, resection of an involved fallopian tube has been suggested in this setting.[30]

Colonic Disease

Crohn's disease can be limited to the colorectum either segmentally or as pancolitis. Crohn's colitis often spares

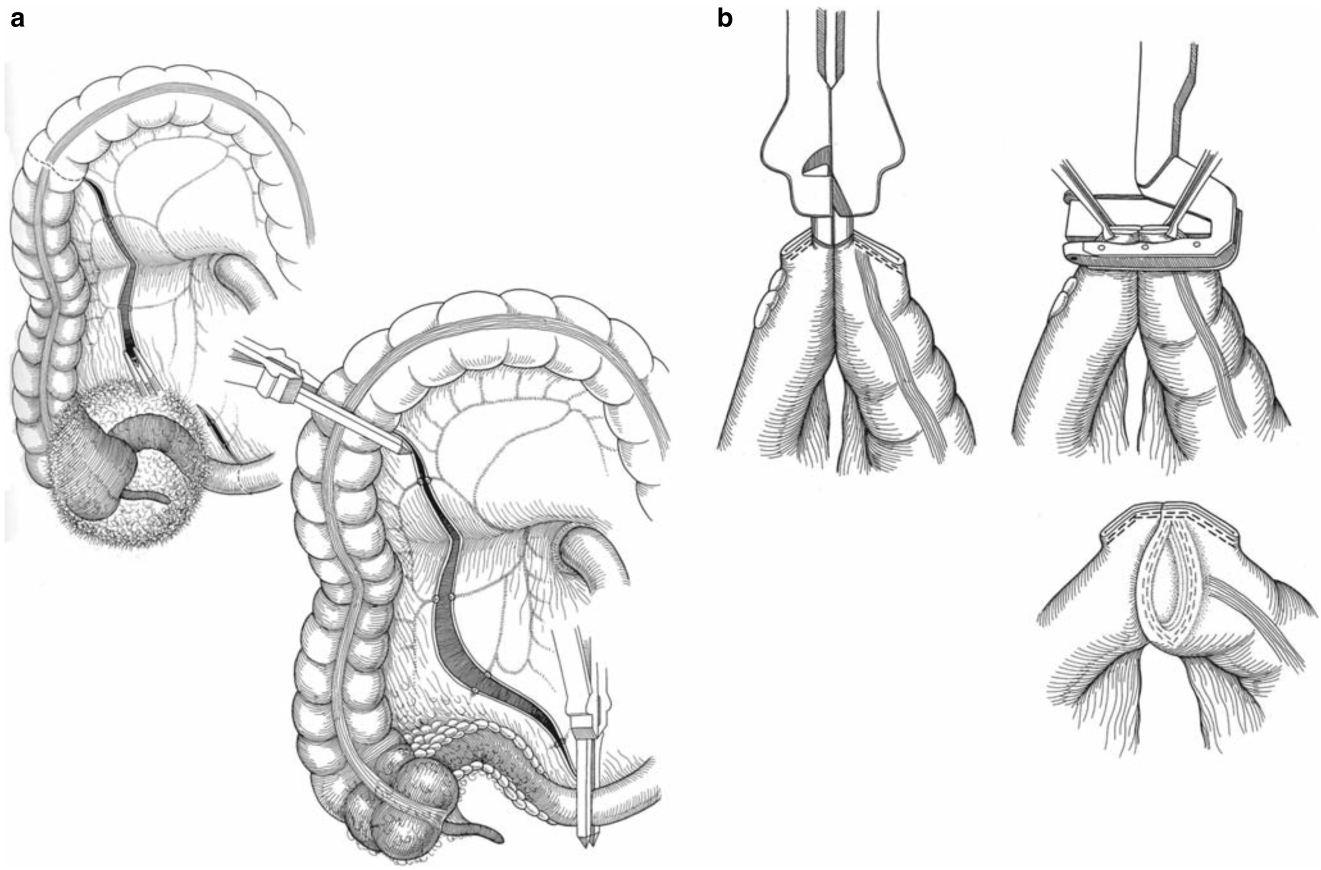

FIGURE 20.4. (**A**) Ileocolic resection is the most commonly performed procedure for Crohn's disease. (**B**) Technique of stapled side-to-side functional end-to-end ileocolonic anastomosis. (From Bauer et al.,[215] with permission of Elsevier.)

the rectum; however, anorectal manifestations of CD are more commonly associated with CD colitis than ileocolic or isolated small bowel disease. Surgical management of this entity differs from the surgical management of small bowel disease in that the presence of the colon is not essential to a normal life.

Depending on the severity and extent of disease, CD colitis requiring surgery can be managed by segmental resection, subtotal colectomy with ileoproctostomy or total proctocolectomy and standard ileostomy. Subtotal colectomy with ileostomy and Hartmann closure of the rectal stump is useful in the emergent situation or for a severely depleted patient. Colonic stricturoplasty is possible but rarely indicated. Continent ileostomy and ileal pouch–anal anastomosis are generally not recommended. However, some authors have recently advocated these procedures for those patients who have isolated colonic disease without perineal involvement.[31–34] Complication rates were higher than those seen in CUC but were similar to complication rates found after subtotal colectomy and ileoproctostomy.[32,35]

Surgery

A short or isolated segment of colonic involvement can be managed by segmental resection[36] or stricturoplasty.[37] This approach leaves the maximum amount of uninvolved colorectum and often yields better functional results. Unfortunately, short segmental colonic disease amenable to this form of therapy occurs in only 6% of cases. More extensive disease or multiple skip areas sparing the rectum are better managed by subtotal colectomy and ileoproctostomy. A recent comparison showed that both procedures were equally effective treatment options.[38] Patients undergoing segmental colectomy had earlier recurrences, however. The choice of operation is dependent on the extent of colonic disease, with a trend toward better outcomes with ileoproctostomy when two or more colonic segments are involved.[38]

Segmental colectomy, subtotal colectomy, and total proctocolectomy with ileostomy can be accomplished by open or minimally invasive techniques.[39–43] As with small bowel resections, operative times are longer using laparoscopic and hand-assisted modalities. Reported short-term benefits of minimally invasive over open techniques have included less postoperative pain, faster return of bowel function and oral intake, and shorter hospital stay.[17] Rates of conversion from laparoscopic to open surgery occur in about 7% of cases.[40] Reasons for conversion include fistula, mass, and inability to adequately define the anatomy.

The principles of resection are the same with open and minimally invasive techniques. Preoperative optimization

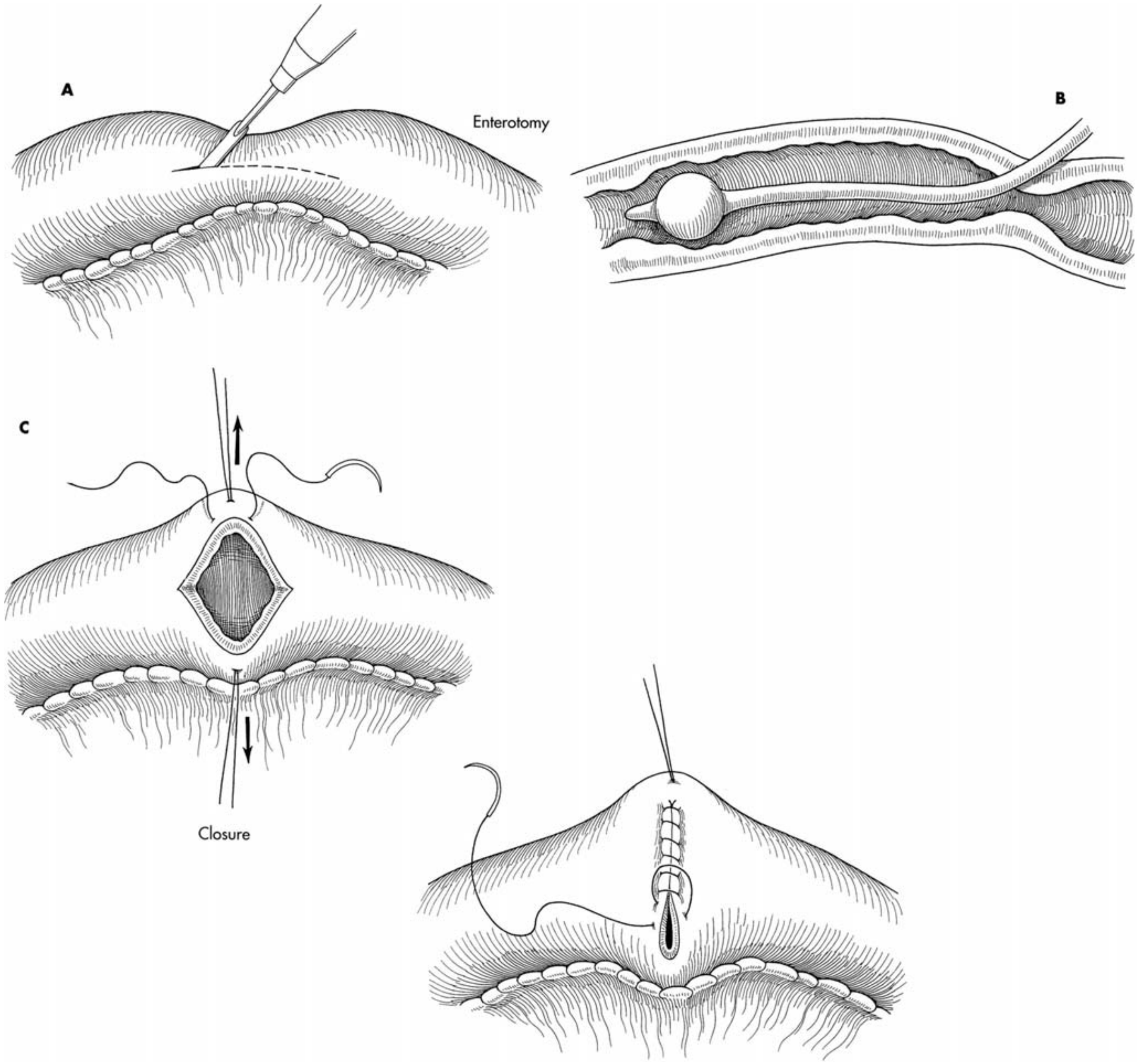

FIGURE 20.5. Stricturoplasty is performed by closing a longitudinal incision transversely. Short strictures are amenable to stricturoplasty using a technique similar to the Heineke-Mikulicz pyloroplasty. (From Bauer et al.,[215] with permission of Elsevier.)

of the patient's medical and nutritional status is always advisable. Many surgeons still use a mechanical bowel preparation despite recent evidence suggesting that colonic resection in the elective setting can be safely performed without it.[44] Segmental colectomy is usually performed for isolated, relatively short segment disease. The mesentery can be divided relatively close to the bowel. The anastomosis should be performed using grossly normal, soft bowel. The anastomotic ends must be well vascularized and free from tension. Suturing or stapling techniques are appropriate. When complete, the anastomosis should not lie in the bed of an abscess. Mesenteric defects should be closed whenever possible.

Subtotal colectomy with ileorectal or ileosigmoid anastomosis is generally the procedure of choice when the total length of involved and previously resected bowel is more than two thirds of the colon. This procedure is appropriate when the rectum or rectosigmoid is relatively free of disease, the anal sphincter is competent, and there is minimal or no perianal disease. When compared to total proctocolectomy, this surgery offers the advantage of elimination of the rectal dissection with its attendant risk to surrounding structures and sexual function.[45] In addition, a permanent stoma is avoided. Subtotal colectomy is performed in the standard fashion. Prophylactic drainage of the pelvic space does not improve outcome or influence the severity of complications.[46]

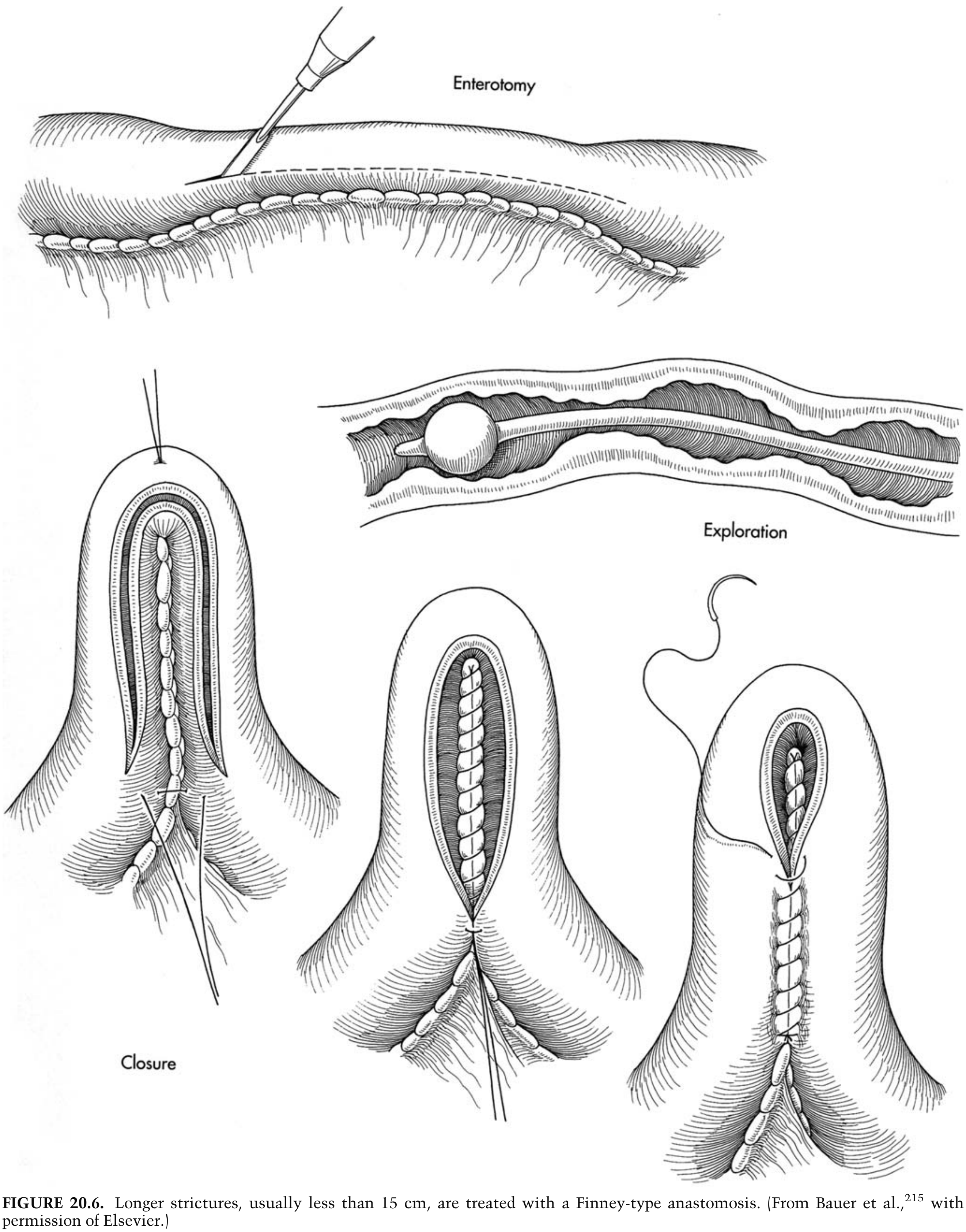

FIGURE 20.6. Longer strictures, usually less than 15 cm, are treated with a Finney-type anastomosis. (From Bauer et al.,[215] with permission of Elsevier.)

Functioning ileoproctostomy is present in 39% of patients at a mean follow-up of 9.5 years.[47] The reoperation rate following segmental resection is 66% at 10 years, the majority of re-resections being for recurrent large bowel CD. The 10-year reoperation rate is higher following segmental resection than after subtotal colectomy and ileoproctostomy.[48]

Toxic dilatation of the colon occurs in the setting of Crohn's colitis but with less frequency than that seen in chronic ulcerative colitis, occurring in about 2% of cases.[49,50] In this and other situations where emergent or urgent colectomy is indicated, subtotal colectomy and ileostomy with preservation of the anus and rectum or rectosigmoid are often the best surgical choices. In the urgent or emergent situation, especially in a depleted or severely ill patient, pelvic dissection and anastomosis should be avoided if possible. Similarly, if the diagnosis of CD is uncertain or the history of disease is brief, anoproctectomy is best deferred. This strategy allows the possibility of restorative surgery if the ultimate diagnosis is chronic ulcerative colitis.[51]

Management of the distal segment in these circumstances depends on the status of the anus and rectum. If the distal colorectum is minimally involved and if there is little or no perineal disease, then subsequent ileoproctostomy remains an option at a later procedure. Creating an anastomosis in the setting of fulminant disease is generally ill advised. In those cases where perianal disease is extensive or the rectum is not deemed suitable for later use, "ultra-low" Hartmann closure of the distal rectum is a reasonable alternative to total proctocolectomy.[52] If preservation of the distal bowel is possible, then maturation of the proximal rectosigmoid as a mucous fistula has been advocated by some.[53] This tactic requires leaving a relatively long segment of excluded bowel, however. Others have suggested leaving the closed rectosigmoid under the skin, thus avoiding a second stoma.[54,55] This technique is associated with a lower pelvic sepsis rate when compared to intrapelvic closure, but the morbidity, mainly in the form of wound infection, is appreciable. A segment long enough to reach the anterior abdominal wall is also necessary. In many cases this is not feasible as the point of distal resection leaves a segment too short to reach the abdominal wall without tension. Intraperitoneal closure of the rectal stump with postoperative transanal catheter drainage is applicable when the rectosigmoid remnant is relatively short. This approach has been associated with a low rate of stump leakage.[52,56,57]

Proctectomy and permanent diversion are frequently necessary in the presence of CD-associated anal stenosis and rectal involvement.[58] Therefore, a more aggressive approach should be considered in the elective setting for patients with diffuse and distal CD colitis. Total proctocolectomy with standard ileostomy is the procedure of choice in this situation. Among properly selected patients this procedure is associated with low morbidity, lower risk of recurrence, and longer time to recurrence.[59] After total proctocolectomy, patients are more likely to be weaned off all Crohn's-related medications. In the less common setting of severe anal and rectal disease with proximal colonic sparing, proctectomy and end sigmoid colostomy is a therapeutic alternative.[60] Progression of colonic disease may necessitate subsequent colectomy and ileostomy, however.

Technique of Rectal Resection

Before undertaking proctectomy, an intimate and thorough understanding of pelvic anatomy is of paramount importance. The surgeon must keep in mind the course and location of the nerves (Fig. 20.7) and vascular structures (Fig. 20.8) entering the pelvis as well as their relationships to the pelvic viscera. The nervous system extends into the pelvis via the superior rectal and superior hypogastric plexuses, the sacral and pelvic plexuses, the sacral and sympathetic trunks, and the obturator nerves. To avoid sexual and urinary dysfunction, knowledge of the locations and relations of these structures to the anorectum is critical.

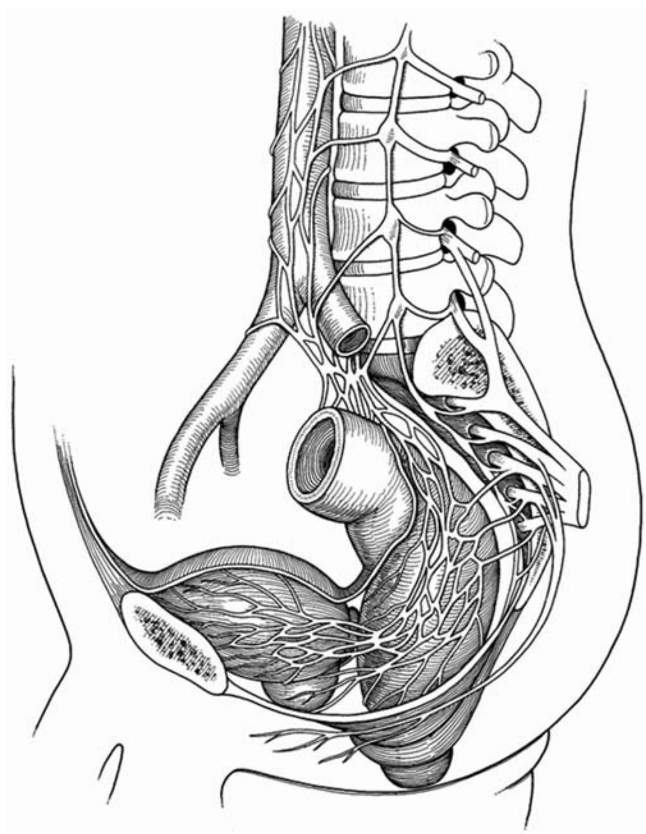

FIGURE 20.7. Sympathetic innervation of the pelvic viscera is supplied by the lumbar spinal cord. The lumbar sympathetic nerves join the preaortic plexus at the inferior mesenteric plexus. Nerves from this location follow the aorta inferiorly to the hypogastric plexus. The presacral nerve arises from this plexus just superior to the sacral promontory. The nerve bifurcates posterior to the rectum, sending right and left branches anterolaterally at the brim of the true pelvis. These nerves continue inferiorly, applied against the posterolateral rectal fascia. They join the nervi erigentes to form the pelvic plexuses at the second sacral foramina. Branches course anterolaterally to reach the pelvic sidewalls. Innervation is supplied to the rectum, anal sphincters, bladder and genitalia. (From Bauer et al.,[215] with permission of Elsevier.)

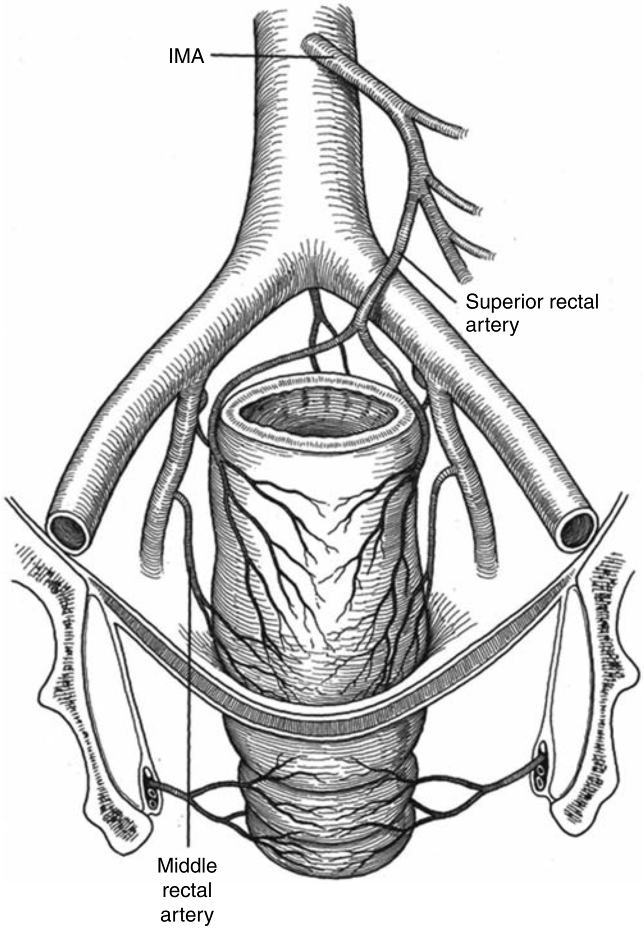

FIGURE 20.8. The blood supply of the pelvic structures is derived from branches of the internal iliac and inferior mesenteric arteries. The terminal branch of the inferior mesenteric artery becomes the superior rectal artery after crossing the left common iliac artery. Right and left branches arise at the level of the third sacral vertebra. The common iliac arteries bifurcate at the level of the lumbosacral articulation to form the internal and external iliac arteries. The internal iliac artery runs posteriorly and caudally toward the greater sciatic foramen. Branches are sent to the pelvic sidewalls, viscera, genitalia, buttocks, and thigh. The middle rectal arteries arise from the internal iliac arteries and run anterolaterally in the rectal stalks to reach the rectum at the level of the levators. The internal pudendal arteries, also branches of the internal ileac arteries, pass lateral to the ischial spines and enter the ischiorectal fossae to run along the pelvis sidewall in Alcock's canal. The right and left inferior rectal arteries are branches of the internal pudendal vessels. They run anteriorly and medially in the ischiorectal fossae to supply the lower anus. (From Bauer et al.,[215] with permission of Elsevier.)

The patient should be placed in the perineolithotomy position. The feet and legs should be appropriately padded and supported. Pneumatic compression boots should be applied prior to positioning. Rectal washout via the anus is recommended. If complete abdominoperineal resection is planned, closure of the anus with a heavy silk purse-string suture helps keep the perineal field clean. Catheterization of the bladder is performed if cystoscopy and ureteral stents are not planned. Prophylactic antibiotics should be given prior to incision.

Complete abdominoperineal anoproctectomy requires two separate fields. Two surgical teams working simultaneously in these separate fields considerably shortens operating time. Both fields can be prepared and draped at the start of surgery.

Rectal dissection usually begins at the sacral promontory by dividing the pelvic peritoneum at the pelvic brim. The ureters run lateral to this fold and should be identified and preserved (Fig. 20.9). In the reoperative setting, preoperative cystoscopy and ureteral stenting can aide intraoperative identification of the ureters and potentially avert ureteral injury.[61,62] However, prophylactic ureteral catheters do not ensure the prevention of these injuries, but may assist in their immediate recognition.[62] If proctectomy is performed subsequent to previous pelvic surgery, the small bowel may be adherent to itself and other pelvic structures. Meticulous and careful adhesiolysis may be required before the contents of the true pelvis can be identified. A short rectal remnant in a scarred pelvis may require intraoperative proctoscopy for identification.

Once the retrorectal space is entered, the hypogastric nerves applied against the sacrum are generally easily identified. In the setting of benign disease, rectal dissection should hug the rectal wall to avoid injury to the pelvic plexus (Fig. 20.10). The rectal stalks can be divided with

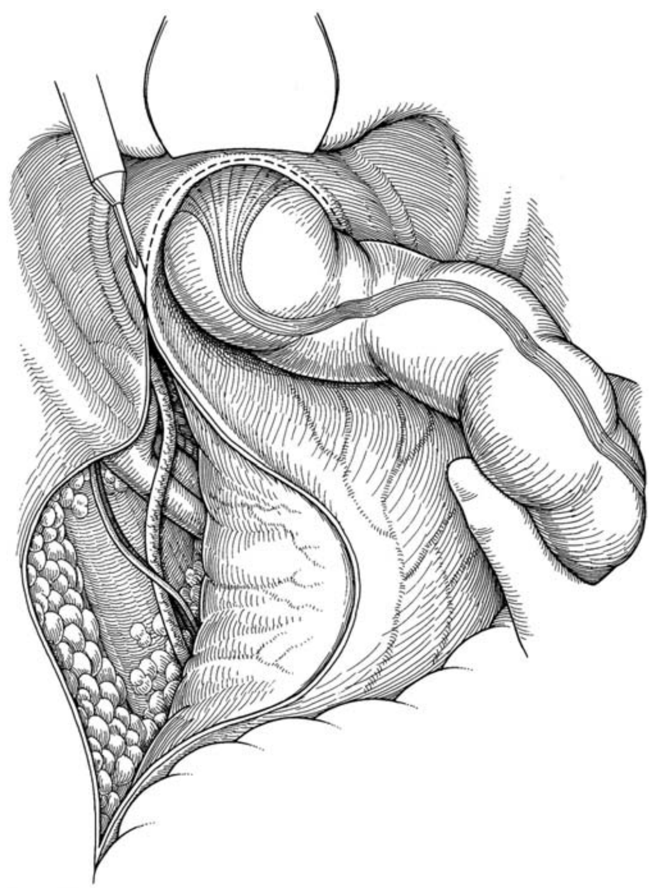

FIGURE 20.9. Division of the retroperitoneal attachments of the rectosigmoid with medial reflection of these structures reveals the left ureter. (From Bauer et al.,[215] with permission of Elsevier.)

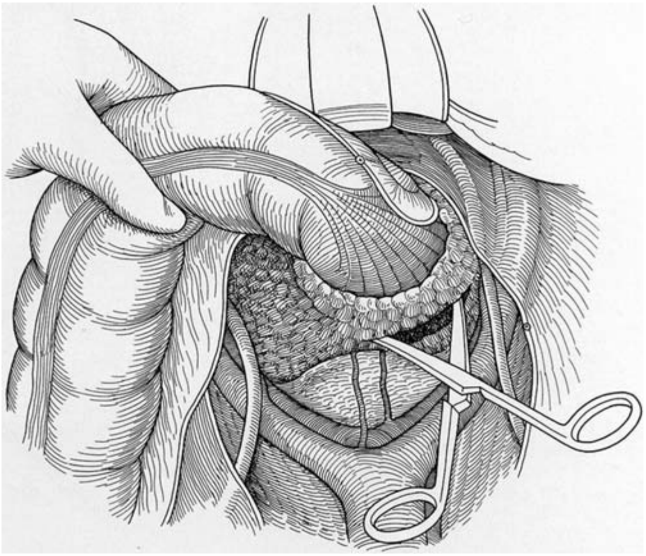

FIGURE 20.10. Rectal dissection begins in the retrorectal space. In the setting of benign disease, dissection should hug the rectal wall to avoid injury to the pelvic plexus. (From Bauer et al.,[215] with permission of Elsevier.)

electrocautery or harmonic scalpel as the middle hemorrhoidal vessels are generally small. There is no need to perform a total mesorectal excision (TME) unless the indication for surgery is rectal cancer or dysplasia. If necessary, TME is performed in the standard manner as described elsewhere.[63]

The anterior dissection should be carried out posteriorly to the rectovesical (Denonvilliers') fascia (Fig. 20.11). This plane avoids damage to the seminal vesicles and the fine nerve filaments overlying them. Dissection can be carried to the levator sling from the abdominal approach. If preservation of the anus is intended, the rectum is stapled across and divided at this level. If anoproctectomy is planned, the dissection is completed from the perineum (see following discussion).

Once the specimen has been removed, through-and-through irrigation of the pelvis with warmed normal saline is performed. The surgical field is inspected for hemostasis. Closed suction drains to the sacral hollow are recommended. If possible, an omental pedicle should be laid in the sacral hollow to fill the noncollapsing dead space. Often the omentum has been resected during the current or previous surgery or is not amenable to this maneuver because of inadequate length. In these cases, the peritoneum of the pelvic floor should be closed to prevent ingress of the small bowel.

Perineal Resection of the Anus and Distal Rectum

The anus and distal rectum can be removed from the perineal approach. Abdominal and pelvic teams can work simultaneously once the rectum has been mobilized to the pelvic floor. An elliptical incision is made in the perianal skin (Fig. 20.12). This location of this incision should be chosen so that the closure of the wound across the midline will not result in a pronounced "pit" or depression at the

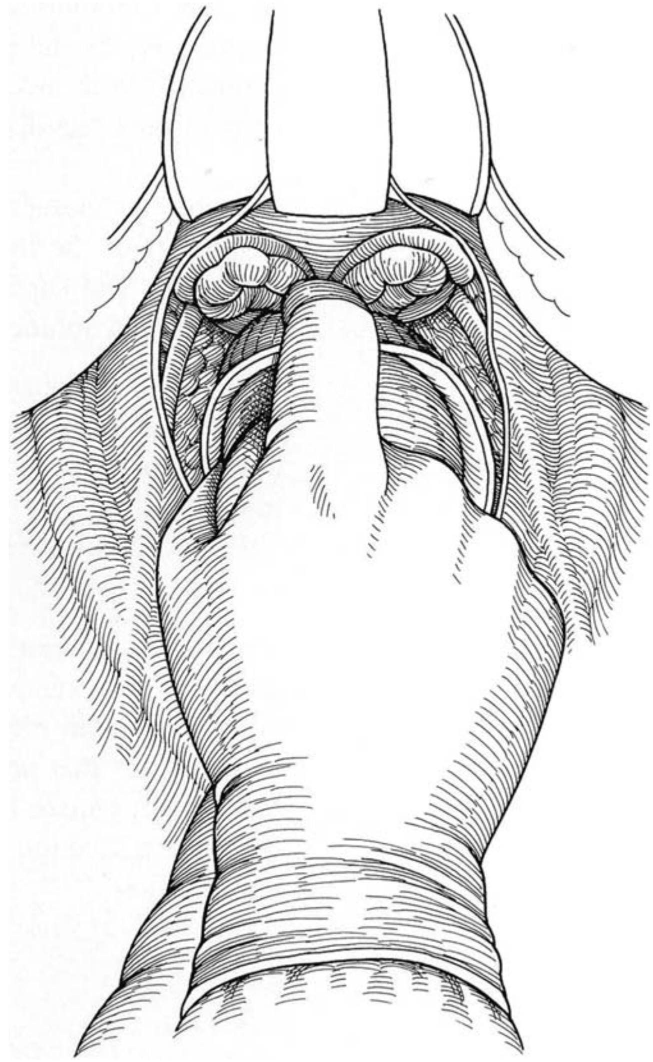

FIGURE 20.11. The anterior dissection should be carried out posteriorly to the rectovesical (Denonvilliers') fascia. (From Bauer et al.,[215] with permission of Elsevier.)

site of the anus. Creating this "pit" leads to accumulation of debris at its depth with subsequent irritation. Carrying the incision too far from the anus results in an overly long wound and a feeling of "tightness" as the buttock skin is brought together.

Dissection is usually facilitated with use of a self-retaining retractor such as the Lone Star Retractor System (Lone Star Medical Products Inc., Stafford, TX). The skin of the anal margin is dissected in the subcutaneous plane medially toward the anal musculature. Fistulous tracts within this area can be included in the resection, but longer tracts outside of the line of incision are left for later attention. The intersphincteric groove is identified and dissection turns cephalad resecting the internal sphincter. Significant anal fibrosis may make identification of the intersphincteric plane difficult or impossible. Under these circumstances, the entire sphincter complex is sacrificed.

The retrorectal space is entered by sharply dividing the anococcygeal ligament in the posterior midline

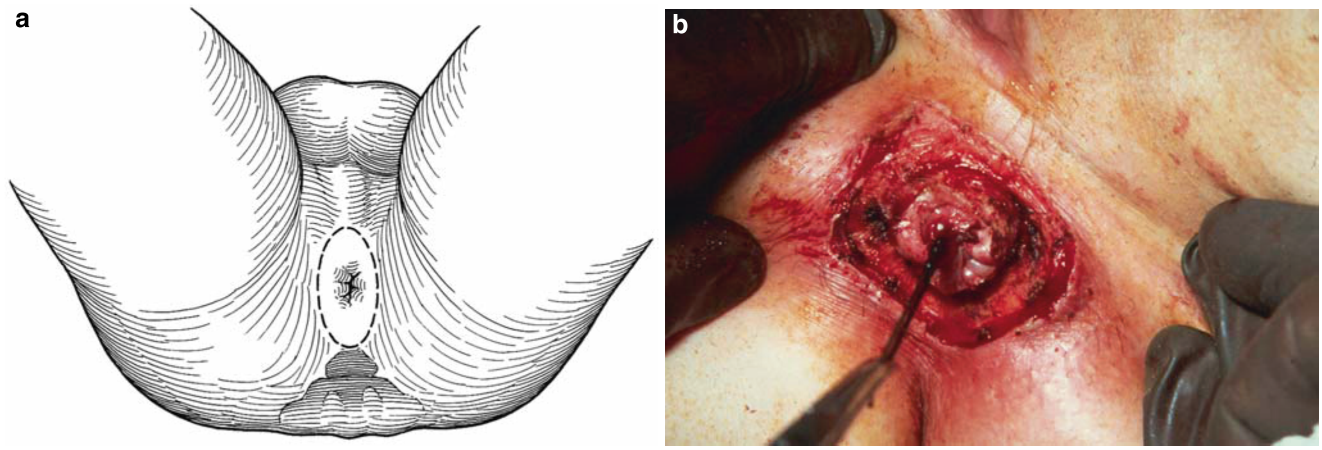

FIGURE 20.12. (**A**) Anoproctectomy begins with an elliptical incision in the perianal skin. (From Bauer et al.,[215] with permission of Elsevier.) (**B**) Dissection proceeds circumferentially about the anus in the intersphincteric plane.

(Fig. 20.13). This space should already have been cleared by the abdominal dissection. Using lateral traction on the anorectum, the contralateral anal attachments are divided with electrocautery. At this point, the rectum or colorectum can be delivered posteriorly behind the anus for removal by the perineal operator. The anterior portion of the dissection is completed last, taking care to avoid injury to the membranous urethra and prostate or posterior vaginal wall. The perineal surgeon should keep in mind that downward traction on the anorectum causes tipping of the prostate or posterior vaginal wall posteriorly. Injury to these structures can be avoided if the dissection follows the anterior rectal wall.

Once the operative specimen has been removed, through-and-through irrigation of the pelvis is performed. Warmed saline poured in the pelvis by the abdominal team will run out the perineal wound carrying blood, fat, and other debris. Irrigation should be continued until the effluent is essentially clear. Hemostasis in both the abdominal and perineal fields is checked. Hemostasis within the pelvic floor and retained mesorectum can be easily ascertained with the use of clear plastic anoscopes inserted in the pelvic outlet.

Primary closure of the perineal wound is the treatment of choice following excision of the rectum, except in cases in which contamination of the perineal wound has occurred during operation.[64] Packing of these wounds, as was advocated following rectal resection for cancer,[65] has generally been abandoned except in cases of severe perianal sepsis. A closed suction drain is laid in the sacral hollow and can be brought out through an abdominal or buttock stab wound. The pelvic floor is generally amenable to closure by plication of the puborectalis across the midline. A layered closure of this muscle is usually necessary as the resulting closure is deepest anteriorly near the vagina or prostate. The external sphincter muscle is the last deep structure closed across the midline. In the absence of perianal sepsis, primary closure of the skin follows (Fig. 20.14).

In some circumstances, primary closure of the perineal wound is not possible because of extensive tissue loss. While open packing of these wounds is possible, prolonged healing times are likely. Use of advanced tissue transfer techniques has been described in these situations.[66,67] Rectus abdominis myocutaneous and gracilis flaps are most commonly used. Gluteus maximus, posterior thigh, chimeric posterior thigh, and latissimus dorsi flaps have also been successfully employed.[66] These procedures are generally performed in conjunction with plastic surgical consultants (Fig. 20.15).

Perianal Disease

Perianal CD occurs in about 25% of cases. Anal involvement becomes more likely with increasingly distal disease of the bowel. More than 40% of patients with colonic involvement will also have perianal disease. Perianal involvement is commonly manifest by “elephant ear” skin tags, violaceous discoloration of the perianal skin, abscess, fistula, and fissure (Fig. 20.16). In a small proportion of cases, perianal disease is the first manifestation of CD.[68] In these cases, evidence of intestinal involvement is usually apparent within the first year after the initial presentation of perianal disease.

Local treatment of perianal CD most commonly involves drainage of abscesses and treatment of fistulas. This can often be a frustrating and unrewarding endeavor. Significant perianal disease and CD involvement of the rectum and anus are often the harbingers of ultimate proctectomy and permanent diversion.[59,69] The management of perianal fistulous disease is addressed elsewhere in this text.

When severe perianal disease is the reason for more than local surgical intervention, the choice of procedure depends in large part on the extent of proximal disease. Perianal disease is often ameliorated by diversion alone, but subsequent proctectomy is frequently required[70] (Fig. 20.17). The long-term rate of permanent fecal diversion is significantly higher among CD patients with distal disease.[59,69] In the presence of severe perianal disease associated with disease limited to the small bowel, resection of the small bowel disease without fecal diversion has been shown to be effective in ameliorating perianal disease in

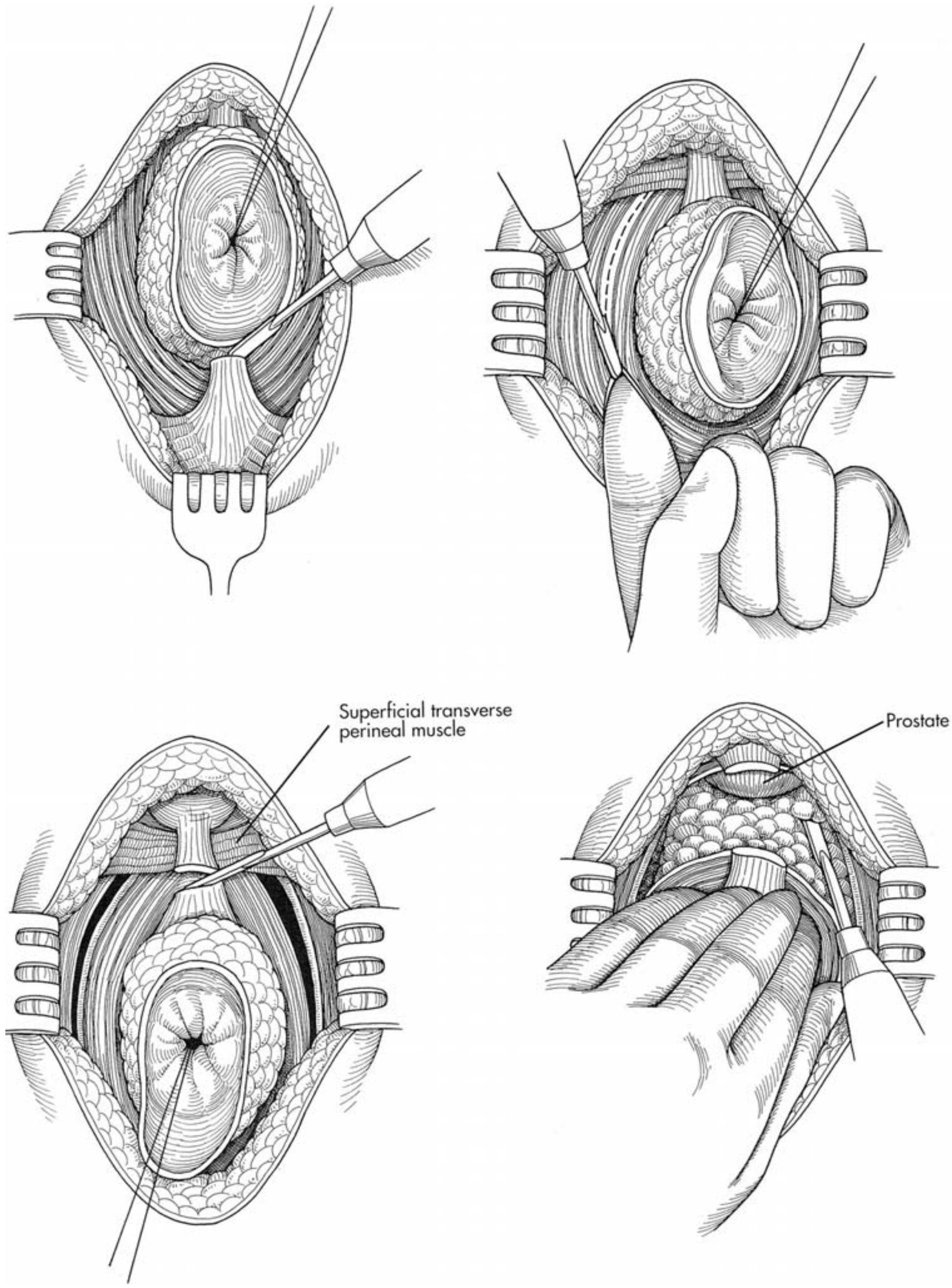

FIGURE 20.13. The retrorectal space is entered by sharply dividing the anococcygeal ligament in the posterior midline. The levators are divided laterally. The anterior portion of the dissection is performed last. (From Bauer et al.,[215] with permission of Elsevier.)

about a third of patients.[71] More commonly fecal diversion with or without proctectomy is required.

For those cases in which perianal disease is severe, proctectomy, either as a first or subsequent procedure is indicated. In these situations, proctectomy with "ultra-low" Hartmann closure of the rectum is often preferable to abdominoperineal proctectomy.[52] This approach avoids the risk of an extensive or nonhealing perineal wound. Diversion often causes perianal sepsis to ameliorate or heal.[70,72] Even if the perianal disease heals or becomes quiescent, leaving the stump of anorectum is not advisable. Cancer in excluded anorectal segments has been reported.[73,74] Surgical extirpation of this segment can often be accomplished by a perineal approach without laparotomy (see previous discussion).[75]

Reoperative Surgery for Crohn's Disease

Recurrence requiring reoperation is significantly associated with anastomosis type, surgical and intestinal

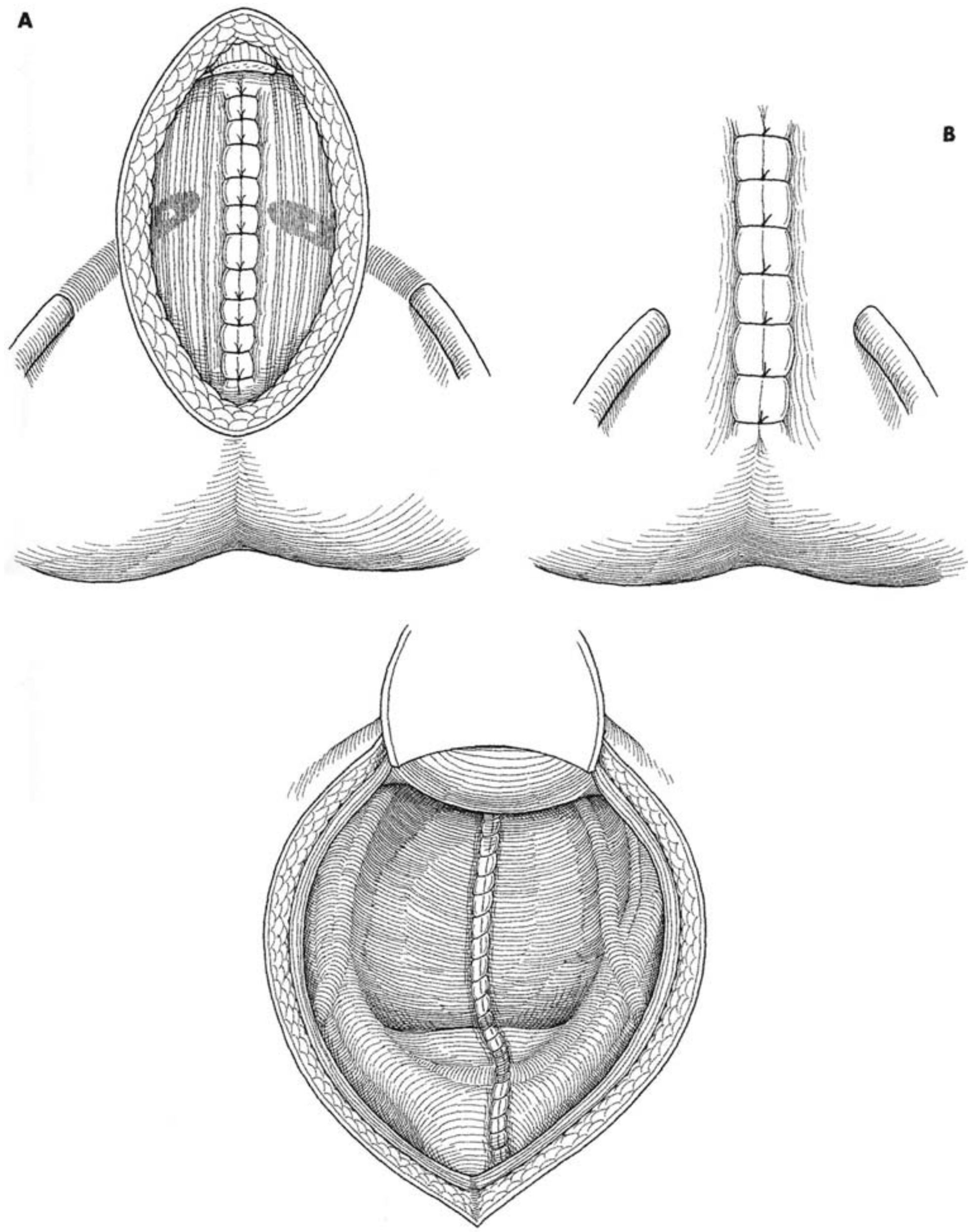

FIGURE 20.14. The levators are plicated across the midline. The wound is closed in layers over closed suction drains. In the absence of perianal sepsis, primary closure of the skin follows. (From Bauer et al.,[215] with permission of Elsevier.)

complications, and age at CD onset.[22] Fistulizing CD is more likely to require reoperative surgery, especially in the first 2 years following resection. The site of the original operative intervention is the most common site for recurrence; however, nearly one third of recurrences involve a different area. The pattern of recurrence is influenced by the site of the original surgery and the technique used at that site. Recurrences generally tend to occur at the anastomotic line after small bowel resection and in the small bowel limb of an ileocolonic anastomosis. Recent studies have shown fewer recurrences at stricturoplasty sites than at resection sites.[76] Disease progression occurred in 25% of the sites not addressed operatively at the original procedure.

Recurrent Disease

After Ileocolectomy

Recurrence after ileocolectomy usually involves the small bowel side of the anastomosis. Mean time to recurrence requiring reoperation is 4 years.[76] Within 10 years of the initial intervention, more than half of patients require a second procedure.[77] Early recurrence is unpredictable.[78] The operative strategies applied to recurrent CD are generally similar to those used for primary disease.[76]

Recurrent ileal disease at the ileal side of an ileocolonic anastomosis is generally managed by secondary ileocolic resection. The ileal margin is cleared to grossly normal-appearing bowel. The colonic side of the resection is

FIGURE 20.15. The gracilis muscle has been harvested.

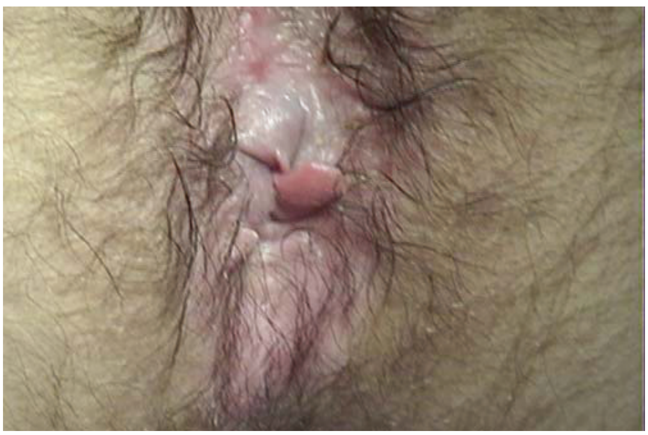

FIGURE 20.16. Perianal involvement by Crohn's disease. Note the "elephant ear" skin tags and violaceous discoloration of the perianal skin.

limited to a small segment adequate for a new anastomosis. Resection should be limited to grossly diseased bowel. Stricturoplasties can be performed on stenotic segments located more proximally. It should be borne in mind that reoperative surgery for recurrent CD after primary ileocolonic presentation has been associated with the highest rate of short bowel syndrome.[79]

After Segmental Colectomy

After segmental colectomy, reoperative colonic surgery for recurrent CD is required in one third of patients.[80] Female gender and perianal involvement appear to be independent risk factors for re-resection. Left-sided and subtotal resections are associated with higher surgical recurrence and stoma rates than right-sided procedures. A second segmental colectomy for recurrence is possible but applicable in only a limited number of cases. Anorectal involvement, especially with perianal disease usually mandates completion proctocolectomy and ileostomy. This can be expected in a quarter of those patients requiring reoperation. At the second colonic surgery, preservation of a short segment of normal bowel is generally not warranted, and completion subtotal colectomy and ileorectal anastomosis is a better strategy, if the rectum and anus are relatively spared. Completion proctocolectomy with permanent ileostomy is indicated if the anorectum is involved.

After Small Bowel Resection or Stricturoplasty

About half of all patients who have undergone small bowel resection or stricturoplasty require a second procedure for recurrent ileal or jejunal disease. When an anastomosis or stricturoplasty is constructed with small bowel, the majority of recurrences are limited to the anastomotic line; however, about one third occur at one or more separate locations.[76] As with primary surgery, preservation of intestinal length is of paramount importance, especially in the reoperative setting. Resections should be limited to grossly abnormal bowel, and stricturoplasties should be performed at amenable areas of stenosis.

Specific Complications

Anastomotic Dehiscence/Fistula

Anastomoses performed for CD patients are presumed to be intrinsically more prone to leakage than those performed

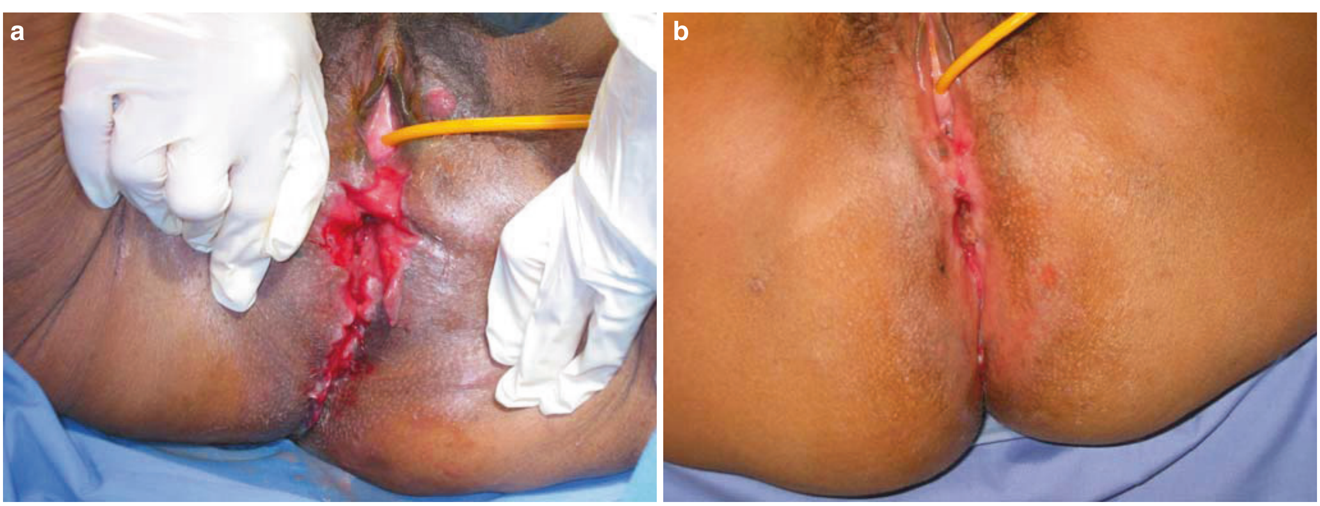

FIGURE 20.17. (**A** and **B**) Severe perineal Crohn's disease, before and after fecal diversion.

for other benign and malignant conditions. This assertion has never been conclusively demonstrated. When CD anastomoses are not under tension, have good proximal and distal blood supply, and grossly show no evidence of CD, the anastomotic failure rate is no greater than for anastomoses performed for any other disease process. Commonly, CD anastomoses are performed in less than optimal circumstances in the reoperative and septic settings. Intraabdominal septic complications such as anastomotic leak, intraabdominal abscess, and enterocutaneous fistula occur in up to 13% of cases.[81] Early complications after elective abdominal surgery for CD are not associated with steroid dose, immunosuppressive therapy or use of infliximab.[82,83]

Free anastomotic disruption results in generalized peritonitis. This must be managed as a surgical emergency. After optimizing the patient, prompt exploration is in order. This can be exceptionally difficult surgery in the early postoperative period. Debris and fecal contamination should be copiously lavaged from the peritoneal cavity. The site of perforation should be identified whenever it is reasonably safe to do so. Surgical options include primary repair, resection, and reanastomosis, both with or without proximal diversion, and diversion and drainage only. Diversion and drainage with or without anastomotic repair is almost always preferred in this setting.[84] Sepsis may also occur from a recurrent or partially drained abscess from the original surgery or a new abscess caused by intraoperative spillage of intestinal contents. In these cases radiographically guided percutaneous drainage is preferable to repeat exploration because of the likelihood of difficulty at reexploration.

Postoperative enterocutaneous fistula formation is usually the result of a contained anastomotic leak; however, "missed" iatrogenic enterotomy or injury, or even recurrent fistulizing disease, may be responsible. The fistula will usually appear after spontaneous or surgical drainage of a wound infection. Initial management of an enterocutaneous fistula should include correction of fluid and electrolyte imbalances, drainage of collections, treatment of sepsis, and control of fistula output. Guided percutaneous drainage of any residual collection is the procedure of first choice and will result in healing in a substantial number of cases.[85] An established fistula lessens the chances of healing without further surgery. Surgery can often be deferred if the fistula can be controlled and the patient is not septic. The help of a wound ostomy and continence nurse specialist (WOCNS) in fistula management is invaluable. The routine use of somatostatin infusion and somatostatin analogues remains controversial; although there are data suggesting reduced time to fistula closure, there is little evidence of increased probability of spontaneous closure.[86] Nutritional support is essential. This can be in the form of enteral feeding when possible, although supplemental parenteral nutrition is often required. Surgical repair should be attempted when spontaneous fistula closure does not occur; however, a delay of 3 months or more between surgeries is advisable.[87] Surgical treatment, usually including resection of the involved segment, can be safely performed by open or minimally invasive means.[88]

Anastomotic Stricture

Anastomotic stricture can occur at any gastrointestinal anastomosis. Strictures may be related to the surgical procedure itself or progression of Crohn's disease. Causes not related to CD include local ischemia, anastomotic tension, and sepsis. In general, colorectal anastomoses after low anterior resection appear to be particularly prone to this complication. Colonoscopic balloon dilatation of these strictures is successful in more than half the cases.[89]

Presacral Hemorrhage

Dissection in the presacral space, especially in the scarred pelvis, can tear branches of the presacral plexus or the sacral basivertebral veins emanating from the sacral bone itself. With the patient in the lithotomy position, pressure in these veins is two to three times that of the inferior vena cava. This can result in life-threatening intraoperative hemorrhage. Management of this problem is difficult, and prevention is easier than treatment. Careful sharp dissection of the posterior aspect of the rectum will avoid tearing the presacral fascia.

Treatment modalities include packing,[90] sterile thumbtacks,[91] inflatable devices,[92] muscle tamponade,[93] muscle fragment welding,[94] and application of endoscopic staplers.[95] Local hemostatic agents in conjunction with other methods such as diathermy, cyanoacrylate tissue adhesives[96] and application of bone wax[97] are among other alternatives that may help to treat this serious complication. Tight packing of the presacral space virtually always works but often requires a return to the operating room to remove the packing.

Pelvic Abscess

Pelvic abscess in the setting of CD can be a complication of the underlying disease or a complication of surgery. The diagnosis is usually suspected on clinical grounds and confirmed by computed tomography. In either case, the preferred initial treatment includes percutaneous drainage and medical therapy. About two thirds of patients can be expected to respond to this form of therapy, but recurrence occurs in 12% within 1 year.[98] Failure of nonsurgical therapy is significantly related to the presence of a fistula and concurrent steroid use. Time to resolution of abdominal or pelvic abscesses in Crohn's disease is similar with percutaneous drainage and surgery. One third of patients treated with percutaneous drainage require surgery within 1 year. Earlier intervention for abdominal and pelvic abscesses is associated with shorter time to resolution.[99]

Reoperation for pelvic abscess is indicated when nonoperative therapy fails to completely solve the problem. In this case, the patient is optimized prior to surgical intervention. Surgery is generally performed with the patient in the perineolithotomy position. Preoperative antibiotics and lower extremity venous compression devices are used. Cystoscopy and bilateral ureteral catheterization is recommended. Once the abdomen has been entered, thorough exploration for the cause of the abscess is undertaken.

Perineal Hernia

The risk of perineal hernia following proctectomy is uncommon in general[100] and exceedingly rare in the setting of inflammatory bowel disease (IBD).[101] This is probably due to the fact that most surgeons perform an intersphincteric anorectal (perirectal) dissection in IBD cases. This technique spares the puborectalis musculature, allowing a reinforcing closure across the perineal floor. Closure of the pelvic peritoneum, primary closure of the perineal wound, and avoidance of wound infection seem to play the major roles in primary prevention.

The typical perineal hernia protrudes through the muscles and fascia of the pelvic floor and usually presents as an asymptomatic, easily reducible perineal bulge. Less commonly, the hernia may be associated with pain, dysuria, bowel obstruction, or perineal exenteration. In these situations, surgical repair is indicated.

Repair of perineal hernias can be accomplished by an open or laparoscopic[102] abdominal approach, by a perineal approach, or a combined approach. Results are similar with abdominal and perineal techniques.[101] The perineal approach is more easily accomplished. The combined abdominoperineal approach involves an incision in the perineal skin over the hernia. The wound is carried into the sac. The contents of the sac, which may include rectum (when present), colon, bladder, or small bowel, are reduced. The sac is inverted into the pelvis where it is excised by the abdominal team. The defect in the pelvic floor is exposed and repaired, usually with the aid of a prosthetic mesh. Synthetic mesh can be used if it is placed in an extraperitoneal position and there is no evidence of infection. Porcine dermal collagen has been recommended for this purpose as it becomes incorporated by tissue in-growth and revascularization, making it a safe and acceptable alternative to synthetic mesh.[103] However, adequate fixation of meshes can be difficult and it may be one reason why perineal hernia recurrence is frequent. Insufficient anchoring of the mesh to bony structures is often the main problem, and therefore the use of orthopedic bone-anchoring systems has been advocated.[103] Myocutaneous flaps have also been successfully employed to treat perineal hernias.[104]

Cancer

Patients with Crohn's disease have an increased risk of developing both colonic and small bowel malignancies.[105–107] Small-bowel cancer in patients with CD enteritis occurs at a younger age than that seen among patients without IBD. Cancers are generally found in involved areas of the ileum.[108] The risk of colonic cancer is related to the extent and duration of colonic involvement. Patients with CD limited to the small intestine are at no greater risk for colorectal cancer than the general population.

Small bowel adenocarcinoma is rare even in the setting of CD. Usual presenting symptoms include abdominal pain, obstruction, and weight loss.[109] The ileum is most frequently involved and advanced lesions are common at the time of diagnosis. Factors associated with dysplasia or carcinoma include older age at diagnosis, longer duration of disease, and greater extent of disease. Operative resection following standard oncologic principles is indicated. Two-year survival in a small series was reported at 39%.[109]

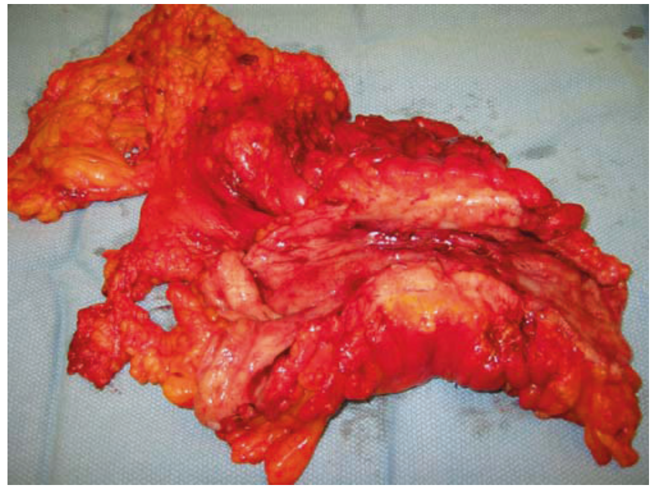

FIGURE 20.18. Carcinoma involving a colonic stricture in Crohn's colitis.

The extent of colonic resection in the setting of CD complicated by colonic carcinoma is controversial (Fig. 20.18). Outcome data concerning optimum management are lacking. Malignant mucosal transformation has been associated with duration and extent of CD inflammation. Metachronous lesions have also been reported.[110] It therefore seems reasonable to assume that there is a "field effect" placing the entire extent of inflamed mucosa at risk. If this is in fact the case, then subtotal colectomy with ileoproctostomy would be the rational surgical procedure when cancer has been detected in the setting of universal CD colitis with rectal sparing. If the rectum is involved by CD or if significant perianal disease exists, then total proctocolectomy with standard ileostomy is advisable. Segmental colectomy may be considered if the carcinoma and inflammation are confined to a relatively short segment. In all cases, surgical resection for cure should include the lymph node bearing tissue as in any other oncologic resection.

Rectal cancer has also been reported in CD, especially in patients with perianal involvement.[110] Adenocarcinoma can be difficult to detect because of rectal fibrosis and stricturing. Biopsy provides the only reliable diagnostic modality. Staging is often not possible with endorectal ultrasound as the probe cannot be easily inserted into the rectum. In these cases, computed tomography (CT) or magnetic resonance imaging (MRI) is the next-best test. Multimodal treatment, including preoperative neoadjuvant therapy when indicated, is similar to that used in sporadic cancer. Proctectomy with total mesorectal excision is usually the procedure of choice. Restoration of intestinal continuity is often not feasible, especially when significant perianal CD is present. Total or partial colectomy is added depending on the extent of the Crohn's disease. The outcome is the same as in sporadic cancer at a corresponding stage but the prognosis is often poor due to the advanced stage of cancer at diagnosis.[111]

FIGURE 20.19. Squamous carcinoma involving perianal fistula in Crohn's disease.

Adenocarcinomas and squamous carcinomas occurring in perianal fistulous tracts have also been described as an extremely rare complication of perineal CD.[112] Carcinomas tend to occur in a background of chronic perianal deformity, specifically scarring, fibrosis, and complex fistulous tracts (Fig. 20.19). Simple physical exam is not generally helpful in establishing a diagnosis because of extreme distortion of the local anatomy. Diagnosis is usually made by biopsy, and lesions are typically discovered late. Squamous carcinoma is initially treated with chemotherapy and radiation (Nigro protocol). Wide local excision and abdominoperineal proctectomy with or without chemoradiation have also been successfully used.[112] Adenocarcinomas have been more commonly treated by surgery only.[112] This usually involves abdominoperineal proctectomy or total proctocolectomy. Overall cure rate at short follow-up has been reported at about 40% for all lesions.

Unhealed Perineal Wound

Nonhealed perineal wound or perineal sinus are the terms applied to those wounds open 6 months after proctectomy (Fig. 20.20). This complication has been reported to occur in upward of 30% of cases.[113] The incidence of this complication has not decreased despite the fact that most surgeons now close the perineal wound primarily over suction drains.[114] Factors associated with a significantly greater risk of perineal sinus are younger age, CD involvement of the rectum, perianal sepsis, high fistulas, extrasphincteric anorectal excision, and fecal contamination at operation. Independent predictive factors of perineal sinus are age, rectal CD, and fecal contamination.[113] The techniques used in an effort to close these wounds have included radical excision, rectus abdominis flap, gracilis transposition, and omentoplasties. Long sinuses (>10 cm) and sinuses presenting late (>12 weeks after proctocolectomy) were seldom cured by surgical treatment in older series.[113] Vacuum-assisted closure devices have been used successfully in the treatment of complex perineal wounds.[115] Muscle flaps used in conjunction with vacuum-assisted closure devices have been shown to improve closure rates.[116]

FIGURE 20.20. Nonhealed perineal wound.

Curettage and reshaping of superficial nonhealed wounds is sometimes helpful. "Cleft closure" popularized by Bascom for treatment of pilonidal disease[117] has been used to treat nonhealed perineal wounds after proctectomy.[118] This approach is simpler than muscle flaps or omentoplasty. This surgery can be performed in the outpatient setting. Closure of the wound off the midline and out of the natal cleft is believed to aid healing.

Chronic Ulcerative Colitis

Chronic ulcerative colitis (CUC) is characterized by inflammation and ulcerations limited to the columnar mucosa of the colorectum (Fig. 20.21). As with CD, extraintestinal manifestations are possible. The cause is not known but is thought to be related to altered autoimmunity. Chronic ulcerative colitis generally involves the rectum and a variable portion of the colon in a continuous fashion. The disease process is characterized as pancolitis, left-sided colitis, or proctosigmoiditis, depending on the extent of proximal involvement. Prognosis tends to reflect disease extent. Perianal involvement in the form of fissures, fistulas, or abscesses is unusual, and when present is often the result of chronic diarrhea. A diagnosis of CD should be suspected whenever perianal disease is present.

The initial treatment of CUC is generally medical. Surgical intervention is usually indicated for failure of medical therapy, treatment of complications, or cancer treatment or prevention. Other less common indications for surgery include unmanageable extraintestinal manifestations, growth retardation, and hemorrhage. Toxic dilatation of the colon with or without perforation requires emergency intervention. Thirty to forty percent of CUC

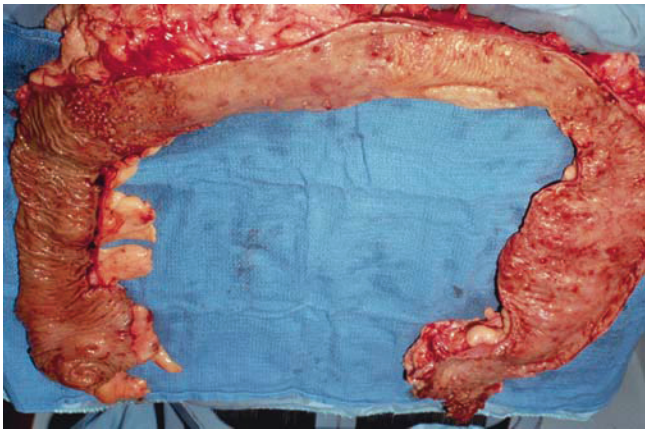

FIGURE 20.21. Chronic ulcerative colitis extending to the hepatic flexure.

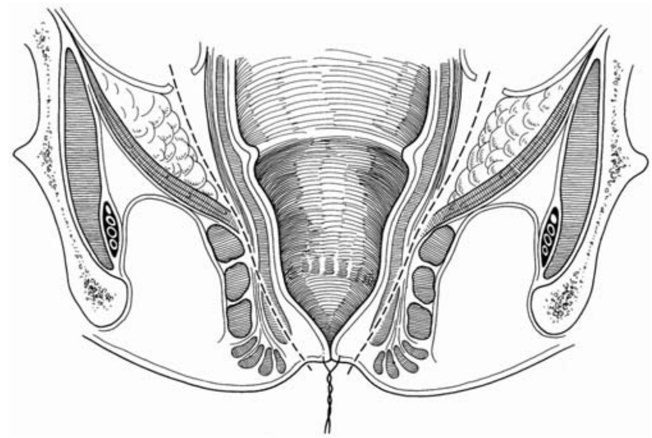

FIGURE 20.22. Limits of intersphincteric dissection for anoproctectomy. (From Bauer et al.,[215] with permission of Elsevier.)

patients require surgery. Surgical options include total proctocolectomy with standard end ileostomy, subtotal colectomy with ileoproctostomy, total proctocolectomy with continent ileostomy and restorative proctocolectomy (RPC) by near-total proctocolectomy, ileal-pouch, and ileal pouch–anal anastomosis (IPAA). Each of these procedures has advantages and disadvantages, and the surgical approach must be tailored to each individual patient.

Total Proctocolectomy and Standard (Brooke) Ileostomy

The oldest and simplest procedure for patients with CUC requiring surgery is total proctocolectomy (TPC) and standard (Brooke) ileostomy. This procedure is associated with the fewest complications. The major disadvantage of TPC is the incontinent stoma requiring a permanently worn appliance. Despite this, quality of life is generally improved after eradication of colonic disease, and the level of improvement approaches that seen after more complex restorative surgery.[119,120] This surgery can usually be accomplished in one stage, even in the urgent setting. Laparoscopic and hand-assist techniques have been used successfully to accomplish this surgery, even under emergency circumstances.[121,122] TPC may be the most appropriate choice for patients with inadequate sphincter function or an associated rectal cancer.

Two-stage TPC sometimes may be more appropriate in the emergency situation. Avoidance of the perineal portion of the dissection is often preferable in the sick or depleted patient. In this setting, total abdominal colectomy and mucus fistula, subcutaneous placement of the rectosigmoid stump, or Hartmann closure of the rectum may be the procedure of choice. In cases of hemorrhage, the rectum may be the source of bleeding, in which case proctectomy is mandatory.

When malignancy is not present, total abdominal colectomy and proctectomy are accomplished in the same fashion as that used for other benign disease. Intersphincteric dissection for the anoproctectomy is preferred (Fig. 20.22). Total mesorectal excision is indicated when rectal malignancy is present. As changes of CUC are confined to the bowel mucosa, this dissection is usually fairly straightforward. Open or minimally invasive techniques are equally effective.[43,123] Complications after TPC occur less frequently than with other CUC procedures. In a small proportion of cases, significant problems with sexual and urinary function will occur, even following intersphincteric anorectal dissection.[124] Early and late ileostomy complications are frequent, however.[125]

Reoperations Following Total Proctocolectomy

Delayed Perineal Wound Healing

Delayed healing of the perineal wound occurs after TPC for CUC in about one third of cases.[126] This is somewhat less than the rate seen in the setting of CD. Management strategies parallel those outlined above.

Stoma Problems

The most common complication of standard ileostomy is peristomal skin irritation. This usually results from leakage of stool under the appliance faceplate. This complication is generally caused by the stoma being too short, and can generally be avoided by scrupulous technique used at the time of construction. Other ileostomy complications include prolapse, retraction, and peristomal herniation. These complications are addressed elsewhere in this text.

Subtotal Colectomy and Ileorectal Anastomosis

An alternative to permanent ileostomy for CUC patients requiring surgery is subtotal colectomy and ileorectal anastomosis. This procedure maintains the anal route of defecation and avoids many of the pelvic complications associated with rectal dissection. However, proctitis and cancer risk remain problematic in many patients. This operation is not advisable for patients with severe rectal disease or those with limited rectal compliance. As this procedure leaves a substantial amount of diseased mucosa, it is a poor choice for patients with dysplasia or early-stage carcinoma elsewhere in the colon, or when the surgical indication is extraintestinal disease. Subtotal colectomy and ileorectal anastomosis may be an acceptable alternative for the CUC patient with advanced colonic cancer and limited life expectancy.[127]

The need for ongoing surveillance and a subsequent proctectomy rate of greater than 30% have caused this procedure to fall from favor in the era of pelvic pouch surgery.[128] However, recent reports have shown a dramatic decrease in fecundity rates following ileal pouch–anal anastomosis.[129] For this reason, selected female patients might consider this operation as an interim solution during their childbearing periods. This procedure can be performed in one or two stages. Minimally invasive surgical approaches have been shown to be safe and effective.[130]

Specific Complications

Anastomotic Leakage

The most common early complication of ileorectostomy is leakage at the anastomosis. This generally presents with symptoms and signs of localized or generalized peritonitis. Feculent drainage may be observed through perianastomotic drains if they were placed. Patients with generalized peritonitis or free perforation need exploration, drainage, and diversion. Takedown of the failed anastomosis, Hartmann closure of the rectal stump, and end ileostomy are the safest choices. Repair of the anastomosis and proximal diversion by ileostomy or ileostomy and pelvic drainage are alternative strategies. In the stable patient, nonoperative management can be attempted.[131] This usually includes adequate drainage of any collections, usually by CT-guided intervention. Broad-spectrum antibiotics and nutritional support with total parenteral nutrition (TPN) are usually indicated.

Continuing Proctitis/Dysplasia

Failure of ileorectal anastomosis is usually related to persistent, intractable rectal disease, poor functional results, or the development of rectal cancer or dysplasia.[128] Surgical options for a failed ileorectal anastomosis include proctectomy and standard ileostomy, proctectomy and continent ileostomy, and proctectomy with conversion to IPAA.

Secondary Proctectomy

Secondary proctectomy after failed ileoproctostomy is accomplished using the intersphincteric technique except in cases of rectal malignancy. Preoperative cystoscopy and ureteral stenting are useful adjuncts to aid in identification of the ureters during this surgery. In most cases, the rectum has been previously transected at the sacral promontory or above, leaving the pelvis undisturbed. If the rectal dissection was carried down below this level, scarring can be severe and identification of tissue planes difficult.

Reconstructions by IPAA, continent ileostomy, or standard ileostomy are possible. If total proctectomy is contemplated, then an abdominoperineal approach is necessary. In cases where malignancy has been excluded, division of the ileorectal anastomosis is followed by dissection of the mesorectum close to the rectal wall. The specimen is delivered by the perineal wound. The peritoneal floor is closed and the levators are closed across the midline. A suction drain is left in the sacral hollow. In the setting of rectal cancer, preoperative neoadjuvant therapy may be indicated, and total mesorectal excision is generally employed.

Total Proctocolectomy and Continent Ileostomy

The continent ileostomy or Kock pouch was described in 1969.[132] This procedure offered the first alternative to a permanently worn appliance for CUC patients who required total proctocolectomy. The continent ileostomy is constructed from the terminal 45 cm of ileum. The most distal 15 cm of ileum is used to make the intussuscepted nipple valve and outflow tract. The reservoir is constructed from the immediately proximal 30 cm of intestine (Fig. 20.23). The outflow tract ends in a flush ileostomy, usually located in the right lower quadrant (Fig. 20.24). The stoma is placed lower on the abdominal wall than a standard ileostomy. The reservoir is emptied by a bullet-nosed catheter inserted through the stoma.

The intussuscepted nipple valve is the "Achilles heel" of this procedure. Nearly half of patients with continent ileostomies require revisional surgery, most commonly performed to repair the valve.[133] Various modifications of the originally described technique have been implemented in an effort to improve the reliability of the valve. Stripping the serosa from the intussuscepted segment, staple fixation of the valve,[134] and application of a special "rotational suture" proved to be useful and effective adjuncts.[135] Prolonged postoperative pouch intubation was also shown to help reduce valve complications.[136] Mechanical support of the valve at its junction with the pouch further improved valve stability. A strip of fascia,[137] Marlex, or Prolene,[138] and later an ileal limb[139] were used to buttress the valve. While short-term results were promising, a dramatic rise in the rate of late fistula formation was associated with use of the various plastic materials.[140,141] However, even with these improvements, the continent ileostomy never gained widespread favor with surgeons because of the high reoperative rate.

FIGURE 20.23. Completed continent (Kock) reservoir.

FIGURE 20.24. Continent ileostomy stoma. The stoma is flush with the skin and situated lower on the abdomen.

Despite the increased morbidity associated with this procedure, patient satisfaction with the continent ileostomy remains high.[142,143] The development and subsequent popularity of restorative proctocolectomy incorporating ileal pouch–anal anastomosis has caused the continent ileostomy to become a second-line procedure. It is generally reserved for selected patients who have failed RPC or who are otherwise unsuitable for restorative surgery, generally due to sphincteric disease or weakness. Currently, the procedure is performed in limited numbers at centers with a particular interest in this technique and with the ability to manage eventual complications should they occur.

Complications of Continent Ileostomy

The continent ileostomy is associated with a variety of early and late complications. Of these, hemorrhage, pouch leakage, and ischemia of the outflow tract or valve tend to occur in the early postoperative period. Most late complications involve the nipple valve. These include valve slippage, fistula, and prolapse. An overall reoperation rate of 12% to 66% has been reported in large series. Recent studies showed 44% to 58% of patients required reoperative surgery, which included an 8% rate of reservoir loss.[133,144]

Early Postoperative Complications

Hemorrhage

Hemorrhage from the reservoir usually presents on the fifth to seventh postoperative day. The in-dwelling catheter returns bloody fluid spontaneously or after irrigation. Bleeding is occasionally brisk, and transfusion may be required. The site of bleeding is most often one or more of the pouch suture lines.

This complication can usually be managed nonoperatively in the hemodynamically stable patient. Bleeding often ceases spontaneously if the pouch can be maintained free of old blood and clot. This can be accomplished by hourly pouch irrigation with warmed normal saline. Addition of norepinephrine to the irrigation fluid may be helpful. Systemic vasopressin has been used successfully in extreme cases. Fiberoptic or rigid ileoscopy should be avoided because of the risk of perforation. Surgical exploration to control hemorrhage is almost never required. When laparotomy is necessary, excision of the pouch and creation of a standard ileostomy is usually necessary.

Suture Line Dehiscence

Suture line dehiscence is an uncommon complication, occurring in about 2% of cases. Leakage from the reservoir presents with the symptoms and signs of localized or free visceral perforation. Fluid resuscitation and systemic antibiotics are virtually always indicated as initial management. Dehiscence occurring during the immediate postoperative period is often poorly contained and frequently leads to generalized peritonitis. In this circumstance, reexploration for drainage and proximal diversion is necessary. Excision of the reservoir is almost never indicated. Between the second and fourth weeks, localized abscess and pouch-cutaneous fistula are more common. A contained peri-pouch abscess is initially managed by CT-guided catheter drainage. Water-soluble contrast study through the ileostomy catheter confirms healing when drainage of enteric contents ceases. Persistent leakage or frank fistula formation that has not responded to nonoperative measures mandates surgical intervention (see following discussion).

Early Fistulas

The continent ileostomy is prone to internal and external fistulas. External fistulas cause an abnormal communication between the pouch and the skin. These generally occur as a result of a failure of one of the pouch suture lines. Internal fistulas traverse both limbs of the intussuscepted valve, causing communication between the lumen of the pouch and the lumen of the valve. Either can appear as an early or late complication.

Early postoperative fistula formation occurs in about 2% of cases. Pouch-cutaneous fistulas are somewhat less common than fistulas involving the nipple valve. An early external fistula, when it occurs, often arises from the region of the confluence of the reservoir suture lines near the base of the nipple valve. It typically presents during the second or third postoperative week as either a localized peristomal abscess or cellulitis. Spontaneous or surgical drainage leads to an enterocutaneous fistula.

This complication usually can be managed without laparotomy. Systemic antibiotics and sump drainage of the reservoir are indicated. A collection, if present, is drained by incision or percutaneous catheter. Healing is usually complete within 2 or 3 weeks. Total parenteral nutrition and octreotide have been used in this setting with mixed results. If the fistula does not close by nonoperative means, then laparotomy is indicated. Deferral of surgical intervention until 3 months after the initial procedure is advised. The catheter is left in the pouch and a standard ileostomy appliance is placed around it. This should control leakage from the fistula. If the fistula cannot be managed, then the timing of surgery must be accelerated.

If the fistula is located near the stoma, a peristomal incision can be used to gain access to the peritoneal cavity. Mobilization of the outflow tract and a radial extension of the stoma site are often required to gain access to the pouch side of the fistula. If the external opening is not near the stoma, then midline laparotomy is recommended. Under these circumstances, the outflow tract and valve need not be mobilized if adequate access to the fistulous site is gained. Once located, the pouch defect is freshened and closed in two layers using fine absorbable sutures. The valve and outflow tract do not require revision unless directly involved. Six weeks of continuous pouch intubation postoperatively is recommended.

Early nipple fistulas also present during the second or third postoperative week. These fistulas may result from local valve ischemia caused by any one or a combination of the maneuvers employed in an effort to maintain valve intussusception. Leakage of intestinal contents around the capped ileostomy catheter is the common early presentation. If the period of continuous pouch intubation has ended, then incontinence through the stoma is noted. The magnitude of leakage will depend on the size of the fistulous tract and its proximity to the base of the valve. Larger tracts nearer the base of the nipple will cause a greater volume of leakage.

This complication is managed nonoperatively in the immediate postoperative period. An initial trial of antibiotics and continuous sump drainage of the reservoir is warranted. Drainage of intestinal contents around the catheter is controlled by placing a standard ileostomy appliance around the intubated stoma. A small percentage of cases will heal completely without further intervention within 1 to 2 weeks. Others, especially those located near the tip of the valve, may heal to the point where continence is only minimally affected when the catheter is removed. These valve fistulas are best left alone unless the patient is intolerant of the volume of leakage.

Fistulas resulting in symptomatic incontinence that do not close by 4 to 6 weeks from the initial surgery will usually require operative repair. Revision of the valve is generally required (see following discussion).

Ischemia

Compromise of the blood supply to the distal portion of the ileum causes ischemia of the outflow tract, the valve, or both. Compression or disruption of the intussuscepted mesentery of the nipple valve is usually the cause. A valve longer than 5 cm, excessive fattiness of the valve mesentery, and overvigorous suturing or stapling of the valve at its mesenteric borders predispose to ischemia by compression. Direct damage to the vasculature of the valve may occur during removal of mesenteric fat.

Ischemia usually becomes manifest within 48 hours of surgery. Dusky discoloration of the stoma, bleeding around the catheter, and bloody returns with irrigation are the hallmarks of poor distal vascularity. Fever and pain are common, especially with tissue necrosis. Frequent irrigation of the ileostomy catheter, systemic antibiotics, and close observation are the best early treatments. Ischemia caused by mesenteric edema may resolve without additional therapy. Progression of the ischemic process can result in necrosis of the outflow tract, the valve, or both.

Ischemia of the Outflow Tract

Chronic ischemia of the outflow tract leads to stenosis of the stomal segment, usually at skin level. Continence is almost always maintained. The problem becomes manifest when the patient begins intubation of the pouch. The stoma becomes progressively harder to catheterize because of skin-level stenosis. This complication is best managed by a 1- to 2-month trial of continuous pouch intubation. The catheter is capped with a plastic button and the reservoir emptied intermittently. If the problem persists after this period, elective operative repair by double Z-plasty is recommended (see following discussion).

Ischemic necrosis of the outflow tract causes separation at the mucocutaneous junction and ileal "retraction" by dissolution of the distal bowel. The subcutaneous tissues at the stoma site are exposed, usually resulting in peristomal cellulitis. Sump suction of the reservoir and systemic antibiotics are indicated as early management. Healing will usually occur without immediate surgery, although stricture is almost certain to follow. Continence is maintained unless the valve is also affected (see following discussion).

Stomal revision can be delayed until the pouch has completely healed, usually 2 to 3 months after the initial surgery. The patient can maintain patency at skin level either by continuous intubation or with a baby's pacifier placed in the stoma site between intubations. Stomal revision by double Z-plasty is recommended (see following discussion).

Ischemic Necrosis of the Valve

Further progression of outflow tract ischemia results in valve loss by ischemic necrosis. This complication occurs in less than 2% of cases. The patient usually experiences pain and fever. Blood clots, necrotic debris, and sutures or staples may return with reservoir irrigation. Leakage of intestinal contents around the catheter occurs as tissue loss results in valve shortening. When valve necrosis is identified, sump suction of the reservoir and systemic antibiotics should be instituted. Immediate operation is rarely indicated, as healing, albeit with incontinence, usually occurs spontaneously.

Revisional surgery can often be delayed until the pouch has healed completely. The ileostomy catheter is left in the reservoir throughout the hospital period and for the 2 to 3 months following discharge. Leakage is controlled by the addition of a standard appliance fitted around the intubated stoma. Two to 3 months after the initial surgery, the patient is readmitted to hospital for revision. Creation of a new valve involves "turning the pouch" (see below).

Late Complications

Valve Slippage

The most common late postoperative complication of the continent ileostomy is desusception or slippage of the nipple valve[133,144] (Fig. 20.25). Early experiences with the procedure were complicated by valve desusception in from 40% to 50% of cases. Even with advances in valve stabilization techniques and increasing experience, the incidence of valve dysfunction remains relatively high.[133,144] An increasing number of patients are presenting with valve dysfunction more than 25 years since the last surgery. Most of these patients require surgical revision of the valve. More than one quarter of patents having one revision will need a second revision.

Considerable effort has been devoted to development of techniques for improving valve stability. Destruction of the serosa, thinning of the mesentery, and suture or staple fixation of the valve are now standard modifications of Kock's original technique. Circumferential silk sutures placed from the pouch to the outflow tract have also contributed to reduction in the rate of valve slippage. Additional work has focused on supporting the valve at the junction of the pouch and the outflow tract. A limb of ileum, in continuity with the reservoir, has been used as a "living collar" to buttress the valve. This approach appears to yield a lower rate of valve slippage than conventional techniques.[145] Anchoring the valve to the pouch wall has also been suggested as a means of improving valve stability.[134]

Valve slippage is most likely to occur within the first postoperative year. The problem usually begins with dehiscence of the opposing mesenteries within the intussuscepted valve. The nipple unrolls asymmetrically, causing disproportionate lengthening of the mesenteric wall of the outflow tract. The intact, antimesenteric portion of the valve is pulled toward the longer mesenteric wall, angulating the valve mechanism. Angulation of the valve initially causes difficulty with intubation of the valve as the catheter tends to hit the elbow of the valve. An angulated valve is usually continent, however. Further desusception including the antimesenteric portion of the valve leads to progressive valve shortening and incontinence.

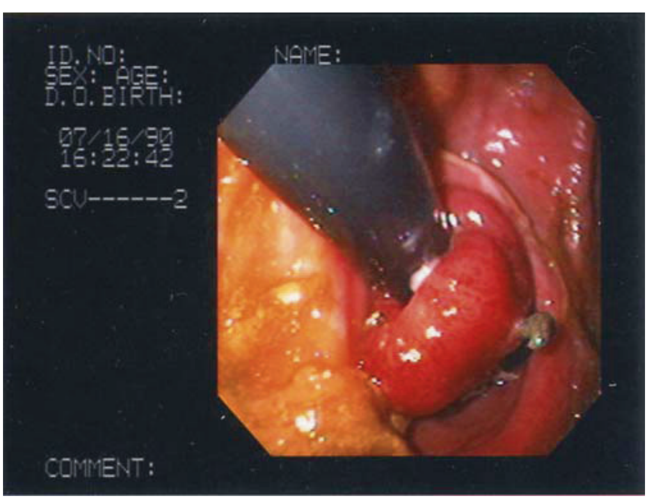

FIGURE 20.25. Endoscopic view of a "slipped" Kock pouch valve.

Progressive partial desusception with resulting angulation often leads to complete inability to intubate the pouch. Intestinal obstruction is therefore a common emergency presentation. Initial management is directed at relieving obstructive symptoms. Pouch intubation can be accomplished by flexible or rigid ileoscopy using a pediatric gastroscope or an 11-mm rigid sigmoidoscope. A guidewire or the shaft of a long cotton-tipped swab is left in the pouch and the endoscope is removed. An ileostomy catheter is threaded over the guide, and taped in place.

At the first episode of valve dysfunction, a trial of prolonged reservoir intubation is warranted. This often stabilizes the valve, allowing it to become fixed in the new position. The patient is instructed to leave the catheter taped in place for 2 to 3 weeks. The end of the catheter is occluded with a plastic button that is removed to empty the pouch. At the end of this period, intubation resumes as before. If difficulty intubating persists, surgical revision is indicated. Preoperative flexible pouch endoscopy is useful in assessing the extent of valve revision necessary. Partial desusception can often be repaired, while valve shortening usually requires valve reconstruction.

Valve Revision

Valve Repair

A partially desuscepted valve, otherwise of adequate length, can often be repaired without mobilizing the stoma and outflow tract from the skin and subcutaneous tissues. The pouch is approached through a midline laparotomy incision. The reservoir is carefully removed from the abdominal wall.

The pouch is opened on its anterior wall about 10 cm from the outflow tract. The partially desuscepted valve can often be reintussuscepted by gentle inward pressure applied with a Babcock clamp placed on the mesenteric edge of the valve. The intussusception is maintained by two or three applications of a bladeless stapling instrument inserted through the open, intrapouch end of the valve. One of these staple lines should fix the valve to the wall of the pouch. Care must be taken to avoid closing the afferent inflow limb, which enters the pouch near the base of the valve. The ileostomy catheter should pass easily through the reconstructed valve. The pouch defect is closed with a single staple line. Pouch integrity and valve competence are tested with air prior to abdominal closure. The ileostomy tube should be secured in place, and left for 6 weeks. If there is any question about the adequacy of the valve, then valve reconstruction should be performed.

Valve Reconstruction

A new valve is constructed from the 15 cm of small bowel immediately proximal to the pouch. Full mobilization of the pouch and outflow tract are required. This can occasionally be accomplished by an extended peristomal incision, but midline laparotomy is more often necessary. The small bowel leading to the pouch also needs to be completely mobilized. Once mobilization of the pouch is complete, it can be delivered through the abdominal wound.

Remnants of the outflow tract and the old valve are excised from the pouch. The pouch is opened from this point for another 10 cm along its antimesenteric aspect. The new valve is created by orthograde intussusception of the proximal inflow tract. The afferent ileum is transected 15 cm from its junction with the reservoir. The proximal 10 cm of ileum is prepared for intussusception by removing the mesenteric fat, abrading the serosal surface, and placing silk sutures as at the initial surgery. A Babcock clamp is passed into the inflow tract, grasping the ileum about 5 cm from the reservoir. The bowel is intussuscepted and fixed in place by sutures and staples. The catheter is inserted into the pouch, and a collar of pouch is sewn to the new outflow limb with silk sutures (Fig. 20.26).

The reservoir is rotated 90 degrees about its axis, bringing the new outflow tract to an anterolateral position. The cut end of the proximal ileum is anastomosed to the pouch at a convenient location using a circular stapling instrument. The reservoir walls are reapproximated and closed with sutures or staples. The afferent limb is occluded with a noncrushing intestinal clamp, and the ileostomy tube is inserted through the new valve. The pouch is tested for continence by insufflating air and removing the catheter.

Silk sutures are placed from the pouch to the parietal peritoneum near the stomal aperture prior to exteriorizing the new outflow tract. The outflow tract is then brought through the old stoma site, and the fixation sutures tied. A closed suction drain is placed in the right gutter between the anterior abdominal wall and the reservoir. The drain end is brought out at a distance from the stoma. The abdomen is closed in standard fashion. The outflow tract is trimmed flush with the skin, and the stoma matured with absorbable sutures. The ileostomy catheter is left in the reservoir, and connected to dependent drainage. Intermittent capping of the tube begins about a week after surgery, but the tube should be left in place a full 6 weeks after surgery.

Late Fistulas

Most late fistulas occur within 2 years from the time of the initial surgery. Nearly all late fistulas are related to the presence of a foreign body, either a silk suture or plastic mesh. The exception to this general rule is the patient with Crohn's disease. These patients are five times more likely to develop a fistula than patients with CUC. Pouch or valve fistulization in the setting of CD is often difficult or impossible to repair, and pouch excision with conversion to standard ileostomy is usually indicated.

An external fistula usually presents with evidence of cutaneous sepsis. Peristomal cellulitis or subcutaneous abscess usually precedes frank fistulization. Once the tract is established, leakage of intestinal contents ensues. Pouch-cutaneous fistula is an uncommon late complication. Flexible ileoscopy is often helpful in establishing the diagnosis and estimating the chance of nonoperative closure. If the cause of the fistula is a foreign body, it must be removed either operatively or endoscopically before the pouch will heal. If the offending agent (usually a silk suture) can be endoscopically removed, then treatment by continuous pouch intubation and oral antibiotics for 2 to 4 weeks usually succeeds in closing the defect. If the foreign body cannot be retrieved or the fistula does not close, then operative removal by excision with primary closure of the pouch is indicated.

Late internal fistulas of the nipple valve occur more frequently and are more troublesome than external fistulas. Leakage of intestinal contents through the unintubated stoma is the common presentation of this complication. The size of the fistula and its location along the length of the valve determine the degree of incontinence. Leakage is generally greater when the fistula lies near the base of the valve. The fistula does not affect ease of reservoir intubation. Operative revision is indicated when the amount of leakage inconveniences the patient.

Repair of Valve Fistula

The pouch is approached through a peristomal incision. The outflow tract is freed circumferentially. The wound is enlarged by medial and lateral incisions 2 to 3 cm long. The pouch is removed from the abdominal wall and delivered into the wound. The valve is exposed by opening the pouch along its antimesenteric wall. The nipple fistula is identified. A foreign body, if present, is removed. A small rim of normal ileum around the foreign body is also excised. The nipple is desuscepted to a point a few millimeters beyond the fistula. This is relatively easy if the fistula is at the base of the nipple. The edges of the fistula on both ileal walls are freshened, and closed with long-term absorbable sutures. The intussusception is restored, taking care to avoid overlapping the suture lines. The pouch is closed with sutures or staples. An ileostomy catheter is placed within the pouch and valvular competence is ascertained. If the fistula cannot be adequately repaired by this technique or the valve remains incompetent, then valve reconstruction using the inflow limb is indicated (see above). In either case, once maturation of the flush stoma is complete an ileostomy catheter is inserted and secured to the abdominal wall. Pouch intubation is maintained for 6 weeks.

Skin-Level Stenosis

Stenosis of the peristomal skin occurs in 8% of patients. Patients suffering this complication find insertion of the ileostomy catheter difficult, painful, and accompanied by modest bleeding. Double Z-plasty of the peristomal skin offers the most satisfactory long-term results.

Double Z-Plasty

The scar at the mucocutaneous junction is excised circumferentially. The subcutaneous outflow limb is mobilized completely to the level of the fascia. Slightly curved, 1.5-cm tangential skin incisions are made at opposite

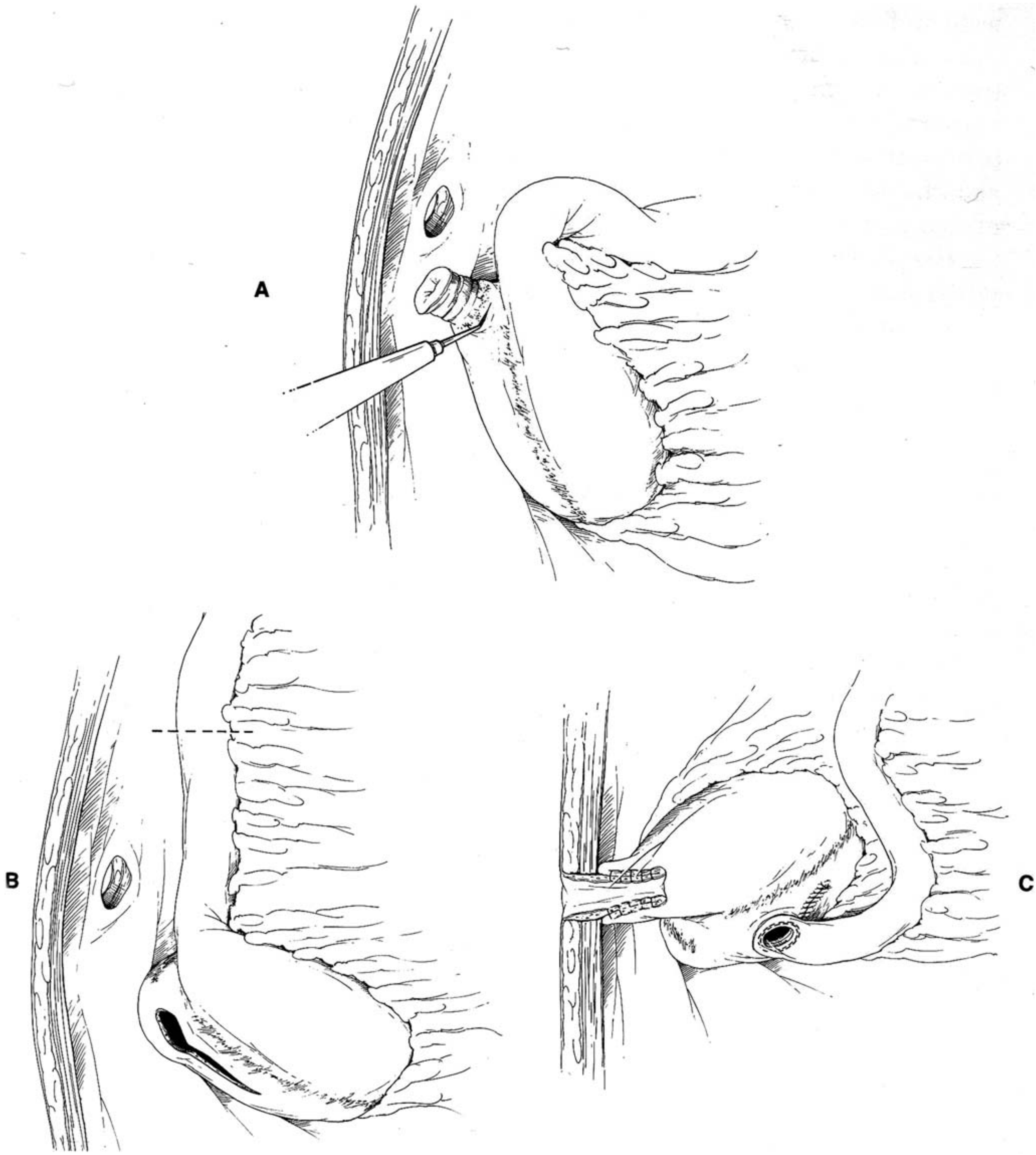

FIGURE 20.26. The pouch is freed from the abdominal wall. The old valve is excised. A new valve is fashioned from the 15 cm of ileum proximal to the pouch. The end of the ileum is stapled to the pouch and the new outflow tract matured. (From MacKeigan and Cataldo,[216] with permission.)

points on the stomal circumference. The skin edges are undermined creating two rotational flaps. The ileal walls opposing the skin incisions are divided longitudinally for a distance of 1.5 cm on each side. The skin flaps are rotated into the groove cut on either side of the ileum. The two Z-plasties are completed by suturing the full thickness of the ileal wall to the dermis of the flaps. The revision is completed by fixing the remainder of the ileal circumference to the skin with absorbable sutures. Prolonged postoperative pouch intubation is not required.

Valve Prolapse

Prolapse of the intact nipple valve is uncommon, occurring in less than 3% of cases. There seems to be a greater tendency toward prolapse in patients who have undergone previous nipple revision. Continence is generally maintained between episodes of prolapse unless the valve has also unraveled.

Prolapse is most often, but not always associated with an overly large fascial aperture at the stoma site. Prolapse can also be caused by an overly long outflow tract. Rarely, failure to site the valve completely within the pouch engenders valve prolapse. Increasing intraabdominal pressure during exercise or late pregnancy can precipitate nipple extrusion. Reduction can usually be accomplished by gentle manual pressure. Iced witch-hazel compresses may reduce stomal edema, facilitating reduction after long-standing prolapse. Once reduced, the reservoir can usually be intubated without difficulty.

Initial nonoperative management of nipple valve prolapse is indicated especially if the prolapse occurs during pregnancy. Conservative therapy involves continuous pouch intubation after valve reduction. The tube is left in place throughout labor and delivery. If cesarean section is indicated, the extracorporeal portion of the catheter is draped laterally with a sterile, adhesive sheet. Midline incision is usually required depending on the stoma location. Operative delivery proceeds according to obstetrical principles, exercising care to avoid injury to the reservoir. Once the uterus has involuted, routine pouch intubation can commence with little risk of recurrent prolapse.

In the nonpregnant patient, recurring episodes of valve prolapse generally require revisional surgery. When a large fascial defect is causative, relocation of the reservoir and stoma to a new site, usually the midline or the left lower quadrant, yields better results than attempts at fascial repair.

Repair of Valve Prolapse

The stoma and outflow tract are mobilized through a peristomal incision. The incision is extended medially and laterally if necessary, and the abdominal cavity is entered. Alternatively, the abdomen is entered through a limited midline incision. The pouch is carefully mobilized from the anterior abdominal wall. The junction of the pouch and the outflow tract is inspected. The valve should be situated within the pouch, not the outflow tract. The outflow tract beyond the pouch should just reach the skin surface. If doubt exists concerning any of these features, the pouch can be opened on its anterior surface and the valve inspected from inside the pouch. If the valve or outflow tract appears to be inadequate, then valve repair or reconstruction is indicated. Otherwise resiting the stoma is warranted.

The new stoma site is determined by comfortable placement of the outflow tract. Transrectus placement on the opposite side is preferable when possible. A circle of skin at the new site is excised. Dissection is continued into the abdominal cavity. The outflow tract is brought through the new stoma site, and the reservoir is fixed to the anterior abdominal wall. The valve should sit within the pouch below the fascia. The fascial defect at the old stoma site is closed with heavy, long-term absorbable sutures. The wound is covered with sterile towels, and the flush stoma is matured with absorbable sutures.

Restorative Proctocolectomy

The concept of near-total proctocolectomy and straight ileoanal anastomosis was first introduced in 1947 by Ravitch and Sabiston.[146] This procedure quickly fell from favor because of the profuse diarrhea it engendered. In 1978, Sir Alan Parks reported the combination of abdominal colectomy and mucosal proctectomy with an ileal pouch and pouch–anal anastomosis.[147] The original description of the procedure included an S-shaped reservoir, mucosal proctectomy ("mucosectomy"), and hand-sewn ileal pouch–anal anastomosis. The addition of the ileal pouch led to acceptable functional results.

Since that time, restorative proctocolectomy (RPC) has become the procedure of first choice for most CUC patients requiring colectomy. The original triple-loop S- pouch has been supplanted by the double-loop J-configuration[148] because of easier construction and fewer functional problems with emptying (Fig. 20.27). Quadruple-loop W-[149]

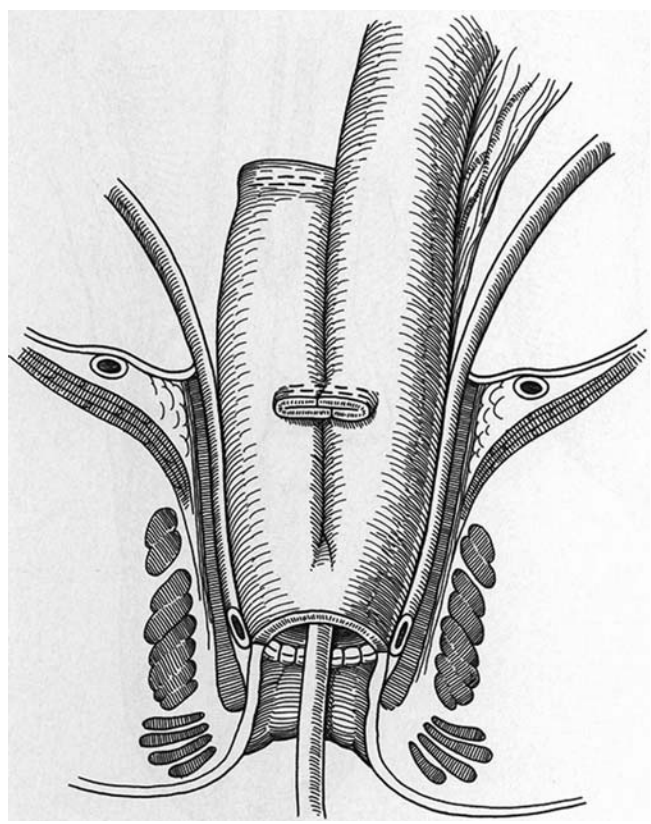

FIGURE 20.27. Double-loop J-pouch with hand-sewn pouch–anal anastomosis at the dentate line. (From Bauer et al.,[215] with permission of Elsevier.)

and lateral H-[150] pouches have also been described but are generally less frequently used. RPC is usually successful in patients with indeterminant colitis as well as those with CUC. However, about 30% of patients initially thought to have indeterminate colitis will have the diagnosis changed to CD within 10 years of surgery.[60,151]

The J-pouch is made from the distal 30 cm of ileum using a long linear stapler-cutter. Most surgeons today perform the IPAA with a "double-staple" technique and omission of mucosectomy.[152] This is accomplished by fashioning the ileal pouch–anal anastomosis with the use of a circular stapling instrument after stapling across the rectum at the level of the levators. This technique usually leaves a small rim or cuff of columnar rectal mucosa as well as the anal transition zone. While mucosectomy offers a more complete eradication of diseased mucosa, it is often difficult to perform and may impair continence if performed poorly. A recent meta-analysis suggests that nighttime seepage of stool is increased and resting and squeeze pressure are lower after mucosectomy. However, mucosectomy does seem to confer benefit in terms of decreased incidence of symptomatic distal proctitis ("cuffitis") and residual dysplasia.[153]

In the elective setting and with a suitable patient, this procedure is generally performed in two stages. The abdominal colectomy, pouch construction, mucosectomy (when performed), and IPAA with covering loop ileostomy are completed first. The ileostomy is closed at a second operation, usually about 3 months later. For highly selected patients, the ileostomy can be omitted and the operation performed as a single surgery.[154–156] Sicker patients may require a three-stage procedure in which subtotal colectomy, Hartmann closure, and ileostomy are performed first followed by completion proctectomy, ileal pouch, and pouch–anal anastomosis with ileostomy. At a third operation, the ileostomy is closed. This strategy can also be utilized in two stages when the pouch is created and diversion omitted at the second operation.[157]

As with other IBD procedures, minimally invasive techniques have been applied to RPC. The procedure can be safely performed in this fashion but with longer operating times. Postoperative hospital time, pain, and ileus are reduced.

There is a 6- to 12-month period of pouch adaptation after ileostomy closure or after the primary procedure if performed in one stage. Once the pouch has matured, CUC patients undergoing RPC can expect to have between four and six bowel movements in a 24-hour period. Continence should be perfect or near-perfect in nearly all cases.

Restorative Proctocolectomy Complications

Restorative proctocolectomy patients can be expected to have nearly twice as many complications as patients undergoing TPC and standard ileostomy.[119] Both early and late complications can occur. Besides the usual early complications of major abdominopelvic surgery, RPC can be associated with problems involving the pouch, the pouch–anal anastomosis, and the stoma.

Pelvic Sepsis

Pelvic sepsis following RPC has been reported to occur in 5% to 24% of cases.[158–161] This complication occurs from a variety of pouch-associated causes and can take many forms. A small number of risk factors are generally associated with pelvic sepsis. These include long-term perioperative steroid use, malnutrition, and anastomotic tension.[162] Immunomodulators such as cyclosporine and infliximab have not been definitively linked to this complication. Surgical correction is often required to treat pouch-related sepsis. Most studies show poorer long-term functional results and increased rates of pouch failure following this complication. Pelvic sepsis occurs more frequently when RPC is performed in the setting of indeterminate colitis and CD than in CUC.

Pouch Ischemia

The pouch is prone to suture line leakage and ischemia. Ischemia of the pouch is uncommon and generally easily recognized at surgery. It usually results from ileal devascularization caused by division of mesenteric vessels during mesenteric lengthening maneuvers. Excision of the devascularized intestine is usually required. A new pouch can be constructed from the next most proximal portion of ileum but mesenteric length issues may interfere with successful pouch–anal anastomosis. For these reasons, this complication is best avoided.

Ischemia can also result if mesenteric vessels are torn during delivery of the pouch into the pelvis. This event is usually heralded by persistent bleeding welling up around the pouch. This kind of persistent bleeding mandates evaluation by removing the pouch from the pelvis and inspection of the pouch mesentery. Transanal release of the anastomosis if it has been formed may be required. Suture ligature of the torn vessel may be sufficient to control bleeding, but the pouch must be carefully inspected for signs of ischemia prior to anastomosis. Insufficient hemostasis of the middle hemorrhoidal vessels can also cause this sort of bleeding. If this is the cause, bleeding will persist after the pouch is removed from the pelvis.

Rarely, axial twisting of the pouch during delivery into the pelvis can also lead to pouch ischemia. This complication is difficult to detect especially with the use of the circular stapler unless the pouch is routinely visualized after the anastomosis has been formed. Pouch ischemia may not become manifest until a few days after surgery. It presents with midabdominal pain, bloody pouch returns, and intestinal obstruction. Computed tomography show a twist in the pouch mesentery. Gentle pouch endoscopy confirms the diagnosis. If pouch necrosis has occurred, laparotomy, pouch excision, and ileostomy are required. Pouch volvulus with ischemic necrosis has also been described as a late complication.[163]

Pouch Suture Line Leak

Leakage from one of the pouch suture lines occurs in less than 2% of cases.[164] It can also occur at the stapled ileal end or "pouch appendage" at the top of the typical J-pouch. Poor healing of the staple or suture lines in generally felt to be responsible. This complication may be related to preoperative steroid use. Infliximab and cyclosporine do not appear to increase this complication.[165] A suture line leak will not necessarily be apparent in the diverted patient but may only become manifest at contrast pouchography or after ileostomy closure. Recent evidence suggests that pouch leakage in some cases may be related to the use of certain linear stapler-cutters that cut beyond the staple line if the tissue is not loaded properly in the instrument.[166]

A pouch leak occurring in a patient not diverted at RPC or one whose ileostomy has been closed will generally show symptoms and signs of localized or generalized peritonitis. In cases where generalized peritonitis has developed, urgent exploration with secondary ileostomy is indicated. Direct repair of the defect can be performed if the site of leakage is readily apparent. Drainage of the area is indicated.

Pelvic Abscess

Pelvic abscess following RPC occurs in from 4% to 6% of cases.[158,167] While this may be caused by a contained pouch suture line or IPAA dehiscence, a leak cannot always be demonstrated. Other causes include intraoperative soilage of the presacral space and infected pelvic hematoma. Pelvic abscess most commonly occurs in the early postoperative period after nondiverted RPC or ileostomy closure in the staged patient. The patient with a pelvic abscess complains of lower abdominal or low back pain. Urinary symptoms are also common. Fever and leukocytosis are usually present. CT scan is usually diagnostic.

In the stable patient, pelvic abscess can be managed by CT-guided drainage and systemic antibiotics. Transanal pouch decompression is also recommended. Nonoperative management is successful in 75% of cases. If nonoperative measures fail, then laparotomy and pouch reconstruction are indicated (see below).[164]

Radiographic study of the contrast-filled pouch ("pouchography") may be useful in determining the integrity of the pouch suture lines and the IPAA prior to ileostomy closure. At some centers, CT pouchography is supplanting simple contrast pouchography as the procedure of choice. Disruption of the ileoanal anastomosis is a sensitive but not specific predictor of subsequent pelvic sepsis.[168] If a pouch or IPAA sinus is noted, closure of the ileostomy should be delayed until a subsequent exam has demonstrated healing. This usually takes 2 to 3 months. In some cases, examination under anesthesia and curettage of a narrow sinus may speed the process. When a small defect communicates with a larger fixed presacral collection, healing is often delayed. This situation can be managed by opening the posterior wall of the pouch transanally with an endoscopic cutter stapler. This marsupializes the pouch into the presacral space. The mucosa will cover the defect leaving a pouch diverticulum.

Ileal Pouch–Anal Anastomosis Leak

An IPAA leak is a major source of morbidity following RPC. Pelvic sepsis is generally secondary to leakage at the ileal pouch–anal anastomosis. This occurs in about 6% of cases.[169] IPAA leakage can cause generalized peritonitis, pelvic abscess, perineal or vaginal fistula, or an IPAA sinus. The surgeon should attempt to prevent this complication in every case by scrupulous attention to intraoperative technique. Full mobilization of the small bowel mesentery should always be performed. Selective division of mesenteric vessels may be necessary. In all circumstances, a well-vascularized, tension-free anastomosis is imperative.

Factors suspected of playing a role in septic IPAA complications include perioperative medications, specifically steroids and immunomodulators, anastomotic technique, and nutritional status. IPAA leakage is reportedly more common following hand-sewn anastomoses than with stapled anastomoses[169–171]; however, a recent meta-analysis failed to demonstrate a difference in early septic complications between the two techniques.[172] Preoperative steroid usage is associated with a higher rate of pouch-related septic complications.[173,174] Immunomodulators other than steroids did not seem to have this effect.[175] Anastomotic complications are more frequent in those patients with anemia requiring blood transfusion in the perioperative.[176]

With stapled IPAA, the anastomotic line is generally above the levator plate. This predisposes to intrapelvic and potentially intraperitoneal leakage of enteric contents in the nondiverted patient. In this setting, the patient with generalized peritonitis requires urgent exploration, diversion, and local drainage. At the time of that surgery, careful anorectal exam often demonstrates the point of IPAA leakage. The defect can generally be discovered by gentle digital examination and anoscopy. Clear plastic anoscopes (Novell Plastics, Grand Rapids, Michigan) are exceeding helpful in this regard. If the defect is small, transanal suture repair can be undertaken. Larger defects, especially those complicated by pouch retraction, are usually not amenable to transanal repair. The pouch rarely needs to be sacrificed under these circumstances, but a future revision is likely. In all cases, transanal tube decompression of the pouch is appropriate.

A diverted patient with an early IPAA leak may have vague symptoms including low-grade fever, anal or perineal pain, and urinary symptoms. Many will be asymptomatic and the IPAA leak and resulting sinus tract will only be detected by routine pouchography performed prior to ileostomy closure. Asymptomatic or minimally symptomatic patients can be treated expectantly by deferring ileostomy closure for an additional 2 or 3 months.[177] Attempts at IPAA revision are generally not warranted unless nonoperative management has failed.

Ileal Pouch–Anal Anastomosis Perineal Fistula

Fistula formation can occur as an early or late complication of RPC. An IPAA fistula usually presents with perineal or vaginal discharge of gas, pus, or stool (Fig. 20.28). Fever, pain, swelling, and tenderness, hallmarks of a perianal or ischiorectal abscess, may have been antecedent symptoms and findings. An abscess in the region may have drained spontaneously or may have been drained at surgery. Physical exam typically reveals the external opening of a preineal or

FIGURE 20.28. Complex ileal pouch–anal anastomotic fistula to the perineum with a seton in place.

low vaginal fistula. The secondary opening is usually solitary and lies within 5 to 10 cm of the anus. When a fistula occurs as a late complication or has multiple or distant secondary openings, the diagnosis of Crohn's disease should be entertained. In addition to endoscopic and radiographic studies, serologic testing for perinuclear antineutrophil cytoplasmic antibodies (pANCA) and anti–*Saccharomyces cerevisiae* antibodies (ASCA) may be useful in differentiating CD from CUC and in predicting those patients more likely to develop fistulas after RPC.[178] "Usual" cryptoglandular fistulas are also possible when the anal transition zone has been preserved.

A recent study identified a number of independent predictors of pouch-related fistulas. A diagnosis of indeterminate colitis or Crohn's disease, previous perineal abscess or anal fistula, abnormal anal manometry, male gender, and pelvic sepsis following RPC were associated with greater rates of postoperative fistula formation.[179] Fistula formation accounts for about three quarters of all septic events.[173]

Examination under anesthesia is the procedure of first choice when a fistula is suspected. If the fistula is of cryptoglandular origin, then treatment should be pursued as with any other anal fistula. However, as there is evidence that many pouch patients will have some diminution of the resting sphincter tone regardless of the technique of anastomosis,[180] fistulotomy should be undertaken with great caution.

The most common fistulas arise from the IPAA, with roughly equal numbers of pouch-perineal and pouch-vaginal fistulas.[164] Management of a pouch-perineal fistula usually begins with examination under anesthesia. Careful probing of the tract or injection of hydrogen peroxide usually demonstrates the internal opening at the IPAA. Initial treatment with a draining seton is advised if there is evidence of undrained or poorly drained sepsis. If the fistula presents in a nondiverted patient, a secondary ileostomy may be required prior to or as an adjunct to definitive treatment.

Closure of the fistula depends on successful treatment of the IPAA defect. A number of strategies have been devised to this end. In general, IPAA fistulas involve too much of the anal sphincter complex to safely allow lie-open fistulotomy techniques. Alternative approaches include transanal ileal advancement flap, combined abdominoperineal pouch advancement, direct transanal or transvaginal repair of the defect, fibrin sealant, and anal fistula plug. The results of these procedures vary. Choice of procedure must be tailored to the individual patient.

Transanal Ileal Advancement

Closure of the internal opening can be accomplished by transanal ileal advancement flap.[181,182] This can be performed under regional or general anesthesia and does not require laparotomy. Hospitalization is usually unnecessary unless this surgery is combined with secondary diversion. The anal verge is effaced with a self-retaining (Lone Star) retractor. A dilute solution of lidocaine with epinephrine is injected in the region of the internal opening. Dissection begins distal to the level of the internal opening. This is generally in the anal transition zone for stapled anastomoses and in the anoderm for hand-sewn anastomoses. The incision is carried sharply for one third to one half of the anal circumference. The pouch is carefully dissected free of the surrounding structures so that a "flap" of pouch can be mobilized to cover the subjacent defect. If the serosa of the pouch is obscured by fibrosis, then dissection can proceed within the muscle layers of the pouch small bowel. Using this plane rather than that at the level of the small bowel serosa helps to avoid damage to the sphincter mechanism and the tissues surrounding the distal pouch. This technique raises a semilunar flap of small bowel mucosa and smooth muscle. Dissection proceeds in a cephalad direction until the flap comfortably reaches beyond the internal opening. The pouch edge is trimmed to include any staples that may still be present. Gentle curettage of the tract removes the granulation tissue. A long tract can be unroofed to the level of the external sphincter. The internal opening in the exposed internal anal sphincter muscle is closed with fine, long-term absorbable sutures. The flap is reflected back toward the dentate line and sutured in place, thereby covering the internal fistulous opening.

Pouch Advancement

While transanal ileal advancement has the advantage of a lesser surgical procedure, the success rate is only about 40% to 60%.[182,183] Diversion does not seen to improve the rate of fistula closure.[182] Better results have been reported by combined abdominoperineal pouch advancement, demonstrating a 79% pouch salvage rate.[184] At this procedure, the pouch is mobilized using both the abdominal and perineal approach. Ureteral catheters are a useful adjunct at the time of surgery. The anastomosis is divided transanally, preserving the sphincter complex. Use of a self-retaining retractor (Lone Star) or a clear plastic anoscope (Novell Plastics) is an invaluable aid in this process. The pouch is completely mobilized from the sacral hollow after laparotomy. As with the initial RPC surgery, mesenteric lengthening by full mobilization and selective division of vessels is usually necessary. The pouch–anal anastomosis is re-created after freshening the apex of the pouch. Stapled and hand–sutured anastomoses are feasible; however, fibrosis at the anus or the pouch apex may preclude effective use of the circular stapler. Checking for IPAA leakage by air or Betadine instillation is highly recommended. If the anastomosis in not intact, transanal suture repair is recommended. Complementary ileal diversion, if not already established, is generally employed.

In some cases the pouch will be firmly adherent to the sacrum. Under these circumstances the pouch can be irreparably damaged during mobilization from the pelvis. In these cases, a new pouch can be fashioned from the next most proximal ileum if there is enough mesenteric length for the new pouch to reach the anus.

Fibrin Sealant/Anal Fistula Plug

The use of fibrin sealant in the treatment of anal fistulas has fallen from favor after initial enthusiasm because of increasingly poor long-term healing rates. Healing of IPAA fistulas with fibrin sealant was reported to show an acceptable rate of healing in a very small number of cases followed for a relatively short period of time.[185] However, there is currently a dearth of recent literature concerning this technique. Attention has now focused on the use of a conical-shaped, porcine collagen plug intended to promote fistula healing. The anal fistula plug (AFP) was shown to be superior to fibrin sealant for cryptoglandular fistulas in a small initial study.[186] To date, there are no reports detailing use of this modality in pouch-related fistulas. While the eventual success rate of this technique remains to be seen, it appears that there is very little downside to its use.

Pouch Vaginal Fistula

Pouch vaginal fistula is a particularly difficult problem after RPC. Repair can be challenging and often requires temporary diversion.[187] Pouch-vaginal fistula occurs in 3% to 16% of female patients undergoing RPC.[188] Sepsis and technical factors are the most common contributors.[189] Pouch vaginal fistula may present early or late. Vaginal discharge of gas and stool are hallmarks of this complication. Recurrent vaginitis, perianal irritation, and frequent urinary tract infections are also common associated complaints. The diagnosis is usually established by routine clinical exam but examination under anesthesia may be required.[190] Pouchography may help to identify a high tract. CT scanning and MRI are often ineffective in demonstrating short tracts. A delayed diagnosis of CD is associated with a longer interval from pouch surgery to fistula formation.[191]

Fistulas may arise from the pouch above the IPAA or at the IPAA itself. Vaginal fistulas below the IPAA are thought to be of cryptoglandular origin.[189] Management depends on the level of the fistula, the amount of pelvic scar tissue, and previous treatments. Initial management in all cases includes drainage of any collections. Placement of setons may be useful in this regard.

Transanal Repair

Local repair can be attempted for low-lying fistulas, at or just above the IPAA. Transvaginal and transanal approaches have been successfully used. Transanal repair is performed by ileal advancement flap as described above. Alternatively, the entire circumference of the pouch can be freed and the entire distal pouch can be advanced to cover the defect.[181] This technique is effective in about 40% to 50% of cases.[190,191]

Transvaginal Repair

Transvaginal repair of low pouch vaginal fistula is technically easier than the transanal approach because of better exposure. This procedure is performed in the lithotomy position. An inverted T-shaped incision is made in the posterior vaginal wall with the horizontal portion lying below the fistulous opening. Two lateral flaps of vaginal mucosa are made, exposing the subjacent pouch and pouch–anal anastomosis. The internal fistulous opening is excised, and the defect closed transversely with interrupted absorbable sutures. The vaginal flaps are replaced and approximated with interrupted absorbable sutures. Placement of a vaginal pack is suggested to help prevent hematoma formation. The packing is left in place for 24 hours. Hospitalization is generally not required.[192] This technique was successful in nearly 80% of a small series, but 40% required one or more repeat procedures.

Pouch Advancement

Better results have been obtained with abdominoperineal pouch revision by complete pouch advancement (see above). Complementary ileostomy is generally performed in conjunction with this approach if the patient is not already diverted. Successful closure of pouch vaginal fistulas has been reported to occur in 53% to 62% of cases using this technique.[191,193] However, abdominoperineal revision is technically more demanding and has a substantial risk of postoperative morbidity. Failure may result in pouch loss and permanent diversion.

Interposition Flap

The use of muscle flaps (gracilis, rectus, etc.) in the treatment of pouch-vaginal fistulas has been reported in small numbers.[194,195] These techniques have been employed after the failure of one or a number of local repairs. They are especially useful in situations where abdominal procedures are contraindicated. Results in small case series have been good.

Pouch Redo

Repeat ileal pouch–anal anastomosis is a valid alternative for patients with IPAA failure. Although pouch failure occurs more frequently after pouch redo than after primary ileal pouch–anal anastomosis, patient satisfaction and quality of life are high in successful cases.[184] The most common indications for ileal pouch redo surgery are intraabdominal sepsis, anastomotic stricture, and retained rectal stump.[196] Abdominal salvage surgery is associated with a failure rate of 21%. A successful outcome is less likely when the procedure is carried out for septic compared with nonseptic indications. The rate of secondary pouch failure increases with length of follow-up.[196]

Repeat pouch procedure is performed using the same techniques as those applied to the initial surgery. Preoperative cystoscopy and bilateral ureteral catheterization aids in identification of these structures. Transanal division of the IPAA is generally helpful when the anastomosis is within 10 cm of the anal verge. Sufficient mesenteric length is required for the new pouch to reach the anal canal. Full mobilization of the entire small bowel mesentery is always required. Division of pouch mesenteric vessels may be necessary. Application of a noncrushing occlusive vascular clamp prior to vessel division helps to ensure that division will not lead to pouch ischemia.

Residual rectal musculature, when present, should be excised. In the absence of rectal cancer and dysplasia, dissection close to the rectal muscularis is sufficient. The new IPAA is created using hand suture or stapling techniques. If pouch redo is performed for unremitting residual proctitis, then mucosectomy and hand-sewn anastomosis is advised. A diverting ileostomy, if not already in place, is suggested.

Secondary Mucosectomy

Stapled IPAA generally leaves a variable length of columnar mucosa above the dentate line. This rectal remnant is generally about 1 to 3 cm in length, but may be longer. About 9% of patients have symptoms of urgency, frequency, and bleeding attributable to CUC in the retained rectal remnant ("cuffitis").[197] Most patients respond to topical treatment with mesalamine suppositories.[198] If medical therapy fails, secondary mucosectomy is indicated. Secondary mucosectomy is also indicated when dysplasia is found in the mucosa of the rectal remnant.

For retained segments of 3 cm or less, transanal resection and pouch advancement is generally feasible (Fig. 20.29). If the retained segment is longer than 4 cm or the pouch is not sufficiently mobile, then an abdominoperineal procedure is required. In either case, mucosectomy should begin at the dentate line. Use of a self-retaining retractor (Lone Star) and submucosal infiltration of lidocaine with epinephrine are useful adjuncts. The dentate line is incised sharply. The rim of mucosa is grasped with triangular clamps and dissection proceeds in the submucosal plain. Precise identification of the subjacent fibers of the internal sphincter muscle is imperative. Dissection can be accomplished mainly with blunt technique. Use of electocautery should be kept to a minimum. In this fashion, a complete mucosal tube is generated. The dissection ends when the IPAA staple line is reached.

The pouch is mobilized transanally if possible. If adequate length is not achieved, abdominal pouch mobilization and pouch advancement are required (see above).

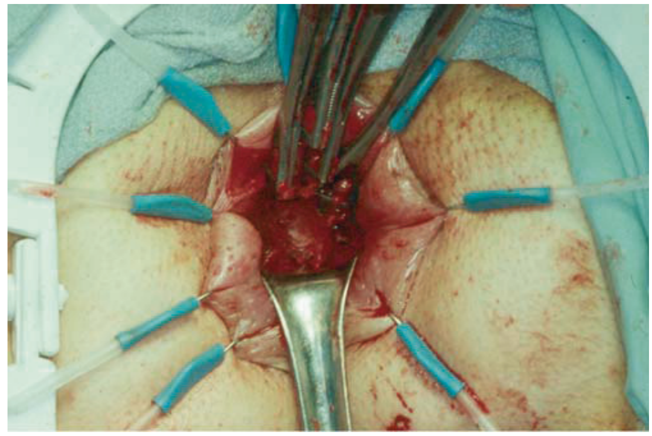

FIGURE 20.29. Anorectal mucosectomy. Note the white fibers of the internal anal sphincter muscle.

A new IPAA at the dentate line is formed with absorbable sutures. Transanal tube decompression of the pouch is advised. Complementary diversion, especially with pouch advancement, is suggested.

Ileal Pouch–Anal Anastomosis Stricture

Stricture at the IPAA occurs after RPC in about 14% of patients.[199] An IPAA diameter of 11 mm or less generally causes obstructive symptoms and can contribute to pouch stasis and pouchitis. This complication is usually managed by outpatient IPAA dilatation under anesthesia. This can be accomplished under direct vision using rigid proctoscopes in 11-, 15-, and 19-mm sizes. Digital examination is performed first. This gives a hint as to the location of the lumen in cases of profound closure. The 11-mm scope is inserted through the anus, and the lumen of the scope is centered about the anastomotic orifice. The scope is held in this position and the obturator reinserted. With a thumb holding the obturator in place, gentle direct pressure is exerted on the scope until it pops through the stricture. Modest bleeding can be expected. If the scope does not advance through the anastomosis relatively easily, the obturator is removed and alignment of the lumen with the scope is checked. The obturator is replaced and more direct pressure is applied. Once the 11-mm scope has passed, the same procedure is used with the 15-mm scope. If possible, the 19-mm scope can be similarly employed; however, dilatation to 15 mm is usually adequate.

This technique is generally successful but may require repeat application. Similar results have been reported using endoscopic balloons.[200] Weekly office visits and gentle finger dilatation for the first 4 weeks following the outpatient procedure help maintain IPAA patency.

Obstructed Defecation/Pouch Prolapse

Obstructed defecation in the absence of IPAA stricture is usually the result of outflow tract issues or pouch prolapse. A recent survey of colon and rectal surgeons yielded 83 patients with prolapse of the ileal pouch.[201] Noticeable tissue passing through the anus and symptoms of obstructed defecation were common presenting symptoms. Nearly half of patients with pouch prolapse presented within 2 years of RPC. The majority of these patients required surgical repair. Procedures included transanal repair, transabdominal pouch pexy (with and without the use of prosthetic material), and transabdominal revision or pouch removal.[201]

I have found transanal application of endoscopic stapling instruments useful for resection of prolapsing portions of the pouch wall and division of pouch septa. These instruments fit through a standard 19-mm proctoscope. Multiple applications are usually required.

Cancer Following Restorative Proctocolectomy

Pelvic colorectal cancer occurs rarely following RPC with and without mucosectomy.[202–209] The risk appears to be exceedingly small. It is increased in patients with cancer or dysplasia in the colectomy specimen. Neoplastic transformation of the pouch mucosa in the setting of pouch villous atrophy has been described[210,211]; however, a recent prospective study failed to confirm these findings.[212] Should such a cancer develop, it is often found late and at an advanced stage. Preoperative neoadjuvant therapy is probably indicated with subsequent resection of the pouch and return to a standard ileostomy.

Pouch Excision

Failure of the pouch can be expected in up to 10% of cases. The most common causes of pouch failure is ongoing perianal sepsis.[151] Pouch excision is required by some of these patients. This procedure is not without complication.[213] Removal of an ileal pouch is necessary when complications are insurmountable or functional results are unsupportable. In these settings, there are two options: pouch removal with standard or continent ileostomy; or permanent proximal diversion, leaving the pouch in situ. Permanent proximal diversion is technically less demanding and easier on the patient. However, mucus discharge, anal pain, and sepsis, when present, may persist. For these reasons, pouch excision is recommended for suitable patients.

Pouch excision requires a combined abdominoperineal approach. The pouch is freed from the sacral hollow after standard laparotomy. Intersphincteric dissection of the anus is preferred, but is often difficult if there has been long-standing perianal sepsis. Use of plastic anoscopes (Novell) often facilitate dissection. Once removed, the perineal floor is closed in layers by reapproximating the muscles and skin. A closed suction drain is left in the presacral space and brought out through a buttock stab wound. Standard or continent ileostomy is configured in the standard fashion. Patients requiring pouch excision for ulcerative colitis have more liquid ileostomy loss but a comparable quality of life to those treated by standard proctocolectomy and ileostomy.[214] A persistent perineal sinus is the most common late complication.[213]

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Complications of Surgery After Pelvic Radiation

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General Principles of Radiation Therapy

Radiation therapy is an important modality in the management of pelvic malignancies. Of cancer diagnosed in the year 2005, approximately 45% of male patients (prostate, rectal, bladder) and 25% of female patients (uterine, rectal, cervical, and bladder) had pelvic malignancies. More than half of all patients diagnosed with cancer receive radiation as part of their treatment.

Radiation damages DNA through the creation of ion radicals. This genetic damage prevents the cell from carrying out normal function and may result in immediate cell death or, more likely, cell death at the time of replication. Radiation therapy is effective in sterilizing tumor cells by selectively exploiting the more rapidly dividing growth cycle of malignant cancer cells as well as their lack of normal DNA repair mechanisms as compared to those of normal tissue. Curative radiation therapy is typically administered over a 5- to 8-week period of time to maximize the damage to tumor cells by a process of reoxygenation, while allowing normal tissue the ability to recover from radiation damage.[1] Radiation is measured in units of gray (Gy), with one Gy defined as the absorbed dose of energy per kilogram of soft tissue equal to one joule per kilogram. The radiation dosages required to sterilize solid tumors and thereby offer curative intent are based on evidence accumulated from retrospective and prospective studies. Dosages required to sterilize microscopic disease are frequently in the range of 45 Gy, whereas dosages required to sterilize gross disease are often between 65 and 80 Gy.[2]

Radiation Therapy Techniques

Radiation for the pelvis is best administered using a linear accelerator or from locally placed radioactive sources (isotopes) termed brachytherapy. Intercavitary brachytherapy is commonly used for gynecologic malignancies, while permanent interstitial seed implants may be used for the treatment of prostate cancer.[3] The advent of computed tomography (CT) treatment planning and three-dimensional planning has allowed for improvements in the ability to administer radiation therapy.[4] Intensity modulated radiation therapy (IMRT) further improves the ability of linear accelerators to deliver higher doses to tumors by sparing incidental treatment of normal organs.[5,6] Cervical and uterine malignancies are frequently treated with a combination of external beam and brachytherapy utilizing an intracavitary implant. This technique allows for treatment of the pelvic lymph nodes and primary tumor with homogeneous external beam radiation fields to sterilize microscopic disease. The cervical brachytherapy boost achieves a very high, curative dose with a steep dose gradient to minimize surrounding tissue exposure.[7]

The goal of the radiation oncologist is to provide the maximum treatment benefit while minimizing patient toxicity related to radiation damage of normal tissues. The essence of any radiation therapy plan is the dose-volume histogram (DVH) (Fig. 21.1). The DVH graphically illustrates the ability of a radiation therapy plan to give effectively high doses of radiation to volumes of interest (tumor) while restricting the radiation dosage and volume of critical structures (healthy organs) treated. The DVH in Fig. 21.1 is for a patient receiving definitive external beam radiation for prostate cancer. The y-axis represents the percentage of contoured organ and the x-axis represents the dose in Gy received. The radiation prescription is for the planning tumor volume (PTV), graphically represented as the steep line on the far right. The PTV is a theoretical volume that accounts for target (in this case, prostate) motion related to daily setup variability and patient movement. In this figure, one can see approximately 95% of the prostate is receiving 78 Gy. The rectum is receiving 45 Gy to 25% of the volume and 14 Gy to 50% of the volume. The bladder is receiving 65 Gy to 25% of the volume and 35 Gy to 50% of the volume.

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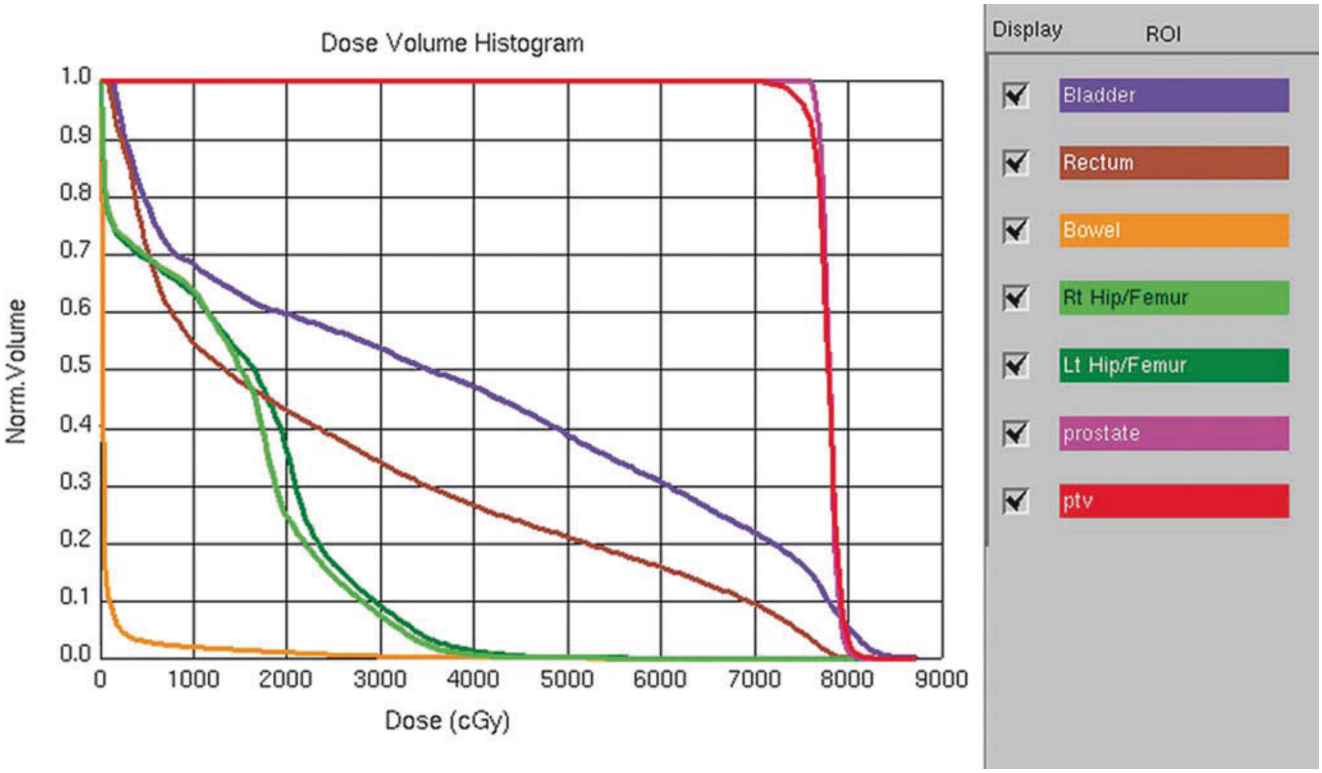

FIGURE 21.1. A dose-volume histogram for a patient receiving external beam radiation therapy for prostate cancer. ROI, region of interest; PTV, planning target volume

Acute and Late Toxicities by Organ with Pathophysiology

Radiation-induced normal tissue toxicities are divided into *acute*, which occurs largely during and shortly after completion of radiation therapy, and *chronic*, which may begin approximately 3 months to 4 years after radiation treatment. Acute tissue reaction and loss of function can be due to several factors: tissue inflammation, apoptosis of functional epithelial cells, bacterial invasion, and the inability of the radiation-damaged stem cells to replace lost functional cells within specific tissue.[8,9] As many as half of all patients receiving pelvic radiation have some mild side effects, but less than 5% of patients require a break in treatment or supportive medical management due to side effects with radiation alone. However, significant side effects are typically doubled when chemotherapy is administered concomitantly.[10] Chronic tissue reaction is related primarily to vascular sclerosis and death of slowly proliferating cells. Damage to blood vessels and subsequent hypoxia and ischemia contribute to tissue fibrosis.[11] Chronic tissue reaction also occurs secondarily to chronic injury as a consequence of severe, acute injury. The time interval required to manifest chronic tissue injury is determined principally by the rate of tissue turnover time. Increasing dose and volume of daily radiation treatments cause greater stem cell depletion, which results in slower tissue regeneration, and a more severe response to radiation damage. Chronic alterations in the tissue microenvironment result in aberrant tissue healing. Molecular and genetic characterization of these alterations in surviving cells may help identify mechanisms to prevent or reverse acute and chronic radiation damage.[12] Surgical disruption of vascular supply is a major risk factor for the development of chronic fibrosis in the setting of postoperative radiation. Diabetes and atherosclerosis may contribute to the incidence and severity of chronic complications.[13]

Because the differential between the dose necessary to achieve curative therapy and that which would be tolerated by normal surrounding tissues before a lasting clinical injury would be sustained may be minimal, emphasis has been placed on establishing the tolerance of normal tissue and the percentage or volume of an organ that may receive radiation without sustaining a clinical deficit. Tolerance dose (TD) of normal tissue to radiation is heterogeneous and highly dependent on the specific tissue. Traditionally, toxicity for specific organs has been defined in terms of minimum and maximum tissue tolerance of 5% and 50% 5-year specific tissue damage, respectively. Values for pelvic organs are listed in Table 21.1. As an example, the ureter has a 5% probability of stricture or stenosis at 5 years if treated with 70 Gy of radiation therapy, but the risk of stricture formation increases to 50% if the absorbed dose is as high as 100 Gy. The kidney is one of the most sensitive organs of the abdomen and may develop nephropathy in 5% of patients at 5 years at total dosages as low as 17 Gy. In contrast, the uterus can tolerate doses in excess of 100 Gy with a low incidence of complication.[14]

TABLE 21.1. Tolerance Doses (TDs) of Pelvic Organs to Radiation Therapy.

Organ	*Injury*	*TD 5% at 5 years*	*TD 50% at 5 years*
Intestine	Perforation	45	55
Rectum	Ulcer, fistula	60	80
Bladder	Fibrosis, contracture	65	80
Kidney	Nephosclerosis	23	28
Ureters	Stenosis	70	100
Peripheral Nerves	Neuropathy	60	100
Vagina	Ulcer, fistula	90	100
Uterus	Necrosis, perforation	100	200

Rectum

Acute clinical side effects of radiation therapy to the rectum may include bleeding, tenesmus, urgency, and diarrhea. There is a histologic correlation with clinical symptoms, and these findings may include edema, inflammation, reduction of crypt cell mitoses, inhibition of glandular secretion, and eosinophilic crypt abscesses.[8,9] Chronic side effects are most frequently rectal bleeding and enteritis, but may include mucosal changes as well as gross structural defects resulting in fistula formation, stenosis, or strictures.[13,15,16] Histopathologically, these changes are seen as overt fibrosis and hyalinization of the arterial walls with resultant chronic ischemia.[17]

Bladder

Acute complications are primarily limited to inflammation and mucositis manifesting clinically as alterations in voiding pattern with symptoms of frequency, urgency, incontinence, and dysuria. These symptoms are explained by the loss of the bladder epithelium and the normal barrier to the irritation caused by urine. Histopathologically, these changes are reflected by submucosal inflammation, epithelial atypia, and perineural inflammation. Late radiation effects on the bladder are the result of chronic inflammation, interstitial fibrosis and contracture, as well as obliterative endarteritis of the blood vessels that perfuse the bladder. Late complications are the result of loss of function in the basal layer of cells and the lack of differentiated functional cells that would otherwise create the bladder epithelium, fibrovascular changes secondary to vascular ectasia, and luminal occlusion.[18] The late clinical manifestations are chronic frequency, incontinence, painless hematuria, and a contracted bladder, but may also include vesicovaginal fistulas.[19,20]

Ureters

The endothelial and smooth muscle cells of the ureters divide slowly and therefore express radiation damage as a late reaction. The chronic radiation damage to the small blood vessels and endothelial cells of the ureters ultimately results in ischemia and fibrosis.[11]. Clinically this damage manifests as stenosis or complete obliteration of the ureter, often with subsequent hydronephrosis.[20]

Reducing Incidental Radiation

Large strides have been made in the effort to reduce incidental radiation of healthy tissue in the treatment of pelvic malignancies. While the rates of clinical incidence of specific complications are difficult to establish, there is optimism that the numbers of patients who seek surgical management of intractable radiation complications will decrease.

Complications of Surgery After Pelvic Radiation

As mentioned in the introduction, the familiarity of the surgeon with the effects of radiation encountered during surgery are critical for recognizing, reducing, and treating the complications associated with surgery in a previously irradiated field. This section discusses the specific complications encountered in urologic procedures after radiation.

Salvage Prostatectomy

Radiation (either interstitial or external) as primary therapy for prostate cancer accounts for approximately one third of the local therapies for prostate cancer in the United States. Depending on stage, recurrence of prostate cancer may occur in up to 40% to 60% of patients following radiotherapy. However, only a small fraction of these patients may be candidates for salvage prostatectomy, and this is evidenced by the small number of reported series of this operation. Relatively well-founded concerns of the complications associated with radical prostatectomy after radiation have limited the use of this salvage technique. After external beam radiation and interstitial brachytherapy, tissue planes become difficult to traverse secondary to massive amounts of fibrosis and scarring. The desire to avoid postradiation prostatectomies has led to other treatment options such as cryotherapy and androgen deprivation therapy; however, results with these therapies have been disappointing, leading more recently to a resurgent interest in salvage prostatectomy. Several series suggest that salvage prostatectomy in the properly selected patient may offer cures in up to 70% of well-selected patients.[21] Recognized complications include incontinence, erectile dysfunction, bladder neck scarring, and rectal injury. However, more recent data suggest improved outcomes with postradiation prostatectomy. This section describes the inherent difficulties present when trying to perform a postradiation prostatectomy or salvage prostatectomy and reviews the literature available on salvage prostatectomy.

In 2004, Stephenson et al.[21] from Memorial Sloan-Kettering published their retrospective series of 100 patients who had undergone salvage prostatectomy. The authors specifically compared a contemporary cohort of patients (after 1993) with a more historical series of patients (pre-1993). Not particularly surprisingly, they demonstrated an improvement in almost all variables examined in their most recent experiences versus their pre-1993 data. Many of these differences can be explained by an improvement in surgical technique, recognition of the complications of radiation therapy, and an improved understanding of the surgical anatomy. However, the improved outcomes also represent a significant improvement in the delivery of radiation, particularly with regard to decreasing dosages to surrounding structures, thereby limiting surrounding damage and fibrosis. Regarding the patient population, there were several factors that differed between the two groups. These included the more advanced disease in the pre-1993 group, the higher proportion of patients undergoing preradiation pelvic lymph node dissection, and the greater number of pre-1993 patients who underwent retropubic interstitial radiotherapy. These factors are also likely to have contributed to a decreased complication rate in the contemporary group. For example, rectal injury during salvage prostatectomy has been reported to be as high as 25%. In this series the authors showed an incidence of rectal injury of 2% versus 15% in the historical group. They also reported their continence rates at 68% "continent" and 39% "completely dry," which represented a substantial improvement over previous series. Furthermore, nerve-sparing procedures and preservation of potency has traditionally been thought to be impossible in the salvage prostatectomy group; however, in a highly select group of patients there was a potency rate of 16%. Lastly, the reoperative rate, a major detraction from performing a salvage prostatectomy, was significantly decreased from 15% to 3%. One complication that remained stable between the pre- and post-1993 eras was the anastomotic stricture rate, which was approximately 30%.

Another large study recently published by Ward et al.[22] included 199 patients: 177 had external beam radiation, 18 underwent brachytherapy, and four had a combination of both. This group reported no surgical mortalities and a low rectal injury rate of 4% in the patients undergoing retropubic prostatectomy. Rectal injuries were repaired via primary closure, and no patient required urinary or fecal diversion. The bladder neck contracture rate, the most frequent complication in this series, was only 22%, and the complete continence rate was 53%. However, patients who underwent brachytherapy had a low complete continence rate of 36%. The authors surmised that the tissue reaction after brachytherapy may render surgery after this type of radiation therapy more technically challenging and may contribute to lower continence rates.

While other groups have also reported their experiences with salvage prostatectomies, most series are not as large as the previously described study. Sanderson et al.[23] from the University of Southern California described their experience with 51 patients who underwent salvage prostatectomy in 2006. Rectal injury occurred in just one patient who subsequently underwent a primary closure but developed ultimately a rectourethral fistula. Their data also showed a 41% rate of bladder neck contracture, which was defined as "anastomotic narrowing requiring any surgical or nonsurgical intervention." Of importance in this study was the assessment of patient satisfaction using the UCLA prostate cancer index. The reported continence rate of 46% is similar to most other studies, but the authors found that with the use of artificial urinary sphincters, patient satisfaction regarding urinary function was good overall.

Contemporary discussion of salvage surgery should include the laparoscopic approach, as aptly trained surgeons are attempting this procedure. Although it seems that use of this technique would result in increased surgical morbidity, Vallancien et al.[24] have reported on their experience of seven patients who underwent "finger-assisted" laparoscopic surgery. Their average operative time was 190 minutes with an average blood loss of 387 mL, with one patient having an approximate blood loss of only 50 mL. They do not report any rectal injuries, ureteral damage, or anastomotic leakage. They also found that five of seven patients were continent and two patients experienced stress incontinence. Based on this experience and taking into consideration the results published by other groups, laparoscopic salvage prostatectomy does appear to be a viable option in the hands of highly skilled laparoscopic surgeons. Although there are no reports to date, one might surmise that the same would apply to robotic salvage prostatectomy.

Salvage prostatectomy may be a patient's best chance at cure from localized recurrent prostate cancer after radiation therapy. It is a technically demanding procedure with a significantly increased rate of complications, but with improved radiotherapy delivery and surgical techniques it has become a more viable option for the appropriately trained surgeon. Candidates for the procedure should be screened to rule out metastatic disease by appropriate radiography including CT and bone scans. They should also have a life expectancy greater than 10 years, a preradiation and preoperative prostate-specific antigen (PSA) of less than 10 ng/mL, and an understanding and acceptance of the risk of increased surgical morbidity.[25]

Surgical Considerations of Salvage Prostatectomy

Prior to embarking on a salvage prostatectomy, several points should be discussed. First, although the rate of rectal injury has dropped substantially it remains higher than that of a "virgin" radical prostatectomy. Accordingly, patients should receive a full Nickels-Condon mechanical and antibiotic bowel preparation. Although one of the series discussed above suggests that a primary repair of the rectum can be accomplished if a rectal injury occurs during surgery, this remains debatable. Factors that may influence the decision to perform a primary repair may include the size of the injury (lacerations greater than 1 cm should strongly be considered for diversion), the viability of the tissue edges, and the availability of interposable tissue such, as the omentum. Patients who do not receive a full bowel preparation should also be strongly considered for diversion. Patients who sustain a rectal injury should receive a two finger anal dilation intraoperatively and a soft mechanical diet after surgery. During salvage prostatectomy, it is critical that the prostate be taken off of the rectum sharply rather than with blunt finger dissection, which can increase the risk and the severity of a rectal injury. Additionally, the rate of bladder neck contractures after salvage prostatectomy is significantly higher than that following virgin prostatectomy. Hence, a high index of suspicion for complications related to this after surgery should be maintained.

Salvage Cystectomy

The discussion of cystectomy after radiation must begin with the discussion of the role of radiation in bladder cancer. In the United States, the vast majority of patients with muscle invasive bladder cancer are treated with radical cystectomy. In countries such as the United Kingdom, radiation may play a larger role. Several institutions in the United States have employed bladder-sparing protocols that, in the highly selected patient, may have overall survival rates similar to those for cystectomy. The most recent bladder-sparing protocol utilizes a trimodal therapy of transurethral resection, chemotherapy, and external beam radiation, with an incomplete response to the treatment resulting in a "salvage" cystectomy. Unfortunately, there is little reported data describing the difficulties and complications in removing a bladder in a previously radiated field.

Kim and Steinberg[26] from the University of Chicago published a review article describing the current status of bladder-preservation in the treatment of muscle invasive bladder cancer. They report that with the use of transurethral bladder resection, external beam radiation, and cisplatin-based chemotherapy, the 5-year overall survival in carefully selected patients is 48% to 63%. With approximately 36% to 43% of patients being disease-free with an intact bladder at 5 years, as many as 64% of patients eventually require a cystectomy after a failed attempt at bladder preservation.

Similar to the postradiation prostatectomy, the postradiation cystectomy is a very challenging operation and requires experience with both "virgin" cystectomies and "salvage" procedures. Early data suggested significant mortality associated with the operation, but more recent data have shown it to be a viable procedure.

Nieuwenhuijzen et al.[27] from Amsterdam reported on 27 patients who underwent salvage cystectomy after failed interstitial and external beam radiotherapy for bladder cancer between 1988 and 2003. These patients underwent initial interstitial radiotherapy or external beam irradiation along with the implantation of iridium afterloading for additional radiation. Of the 27 patients, 16 succumbed to their bladder cancer, two died from unrelated causes, and nine patients survived. Regarding surgical complications, the authors reported an early (less than 30 days) serious complication rate of 22%, including abdominal wall dehiscence, ureteroileal problems, gastrostomy leakage, deep venous thrombosis, bleeding, and intestinal obstruction in one patient each. Minor complications occurred in two patients, and consisted of two wound infections and one patient with pneumonia. A late complication rate of 48% included ureteroenteric stricture in four patients, an abdominal wound hernia in five patients, various fistulas in three patients, and stomal stenosis in one patient. The type of urinary diversion did not change the complication rate or the recurrence rate.

At our institution we have reviewed our results in patients who have undergone salvage cystectomy after radiation. In our 45 salvage patients treated from 2001 to 2007, all patients received prior external beam therapy, for various reasons. Our short-term complication rate was 24%, which is comparable to that of other series, and included four urinary leaks, one fascial dehiscence, two deep vein thromboses, two episodes of sepsis, and two myocardial infarctions. Long-term complications occurred in 20% and were primarily related to recurrences. We did not find any significant differences in terms of blood loss, intensive care unit stay, length of hospital stay, or operative times between our salvage cystectomy group and our "virgin" cystectomy group.

Similar to the preceding study, this was independent of the type of diversion they underwent. All available literature suggests that a "salvage" cystectomy may be performed with acceptable complication rates comparable to that of traditional cystectomy (Table 21.2).

TABLE 21.2. Salvage Cystectomy Data.

	Cystectomy (n = *213)*		*Salvage cystectomy* (n = *45)*	
	Mean	*SD*	*Mean*	*SD*
Age	61.01	14.47	70.09	9.59
Preoperative creatinine	1.20	1.03	1.06	0.28
Alkaline phosphatase	75.53	36.67	43.10	47.98
Years post–tobacco use	11.21	14.04	8.28	10.55
Total pack years	35.16	27.97	43.82	31.15
Preoperative hemoglobin	13.28	1.95	12.54	2.10
Operative time (h)	7.38	2.04	7.25	1.85
Blood loss (mL)	1189.53	991.82	1102.22	1202.66
Packed red blood cells (units)	2.07	2.34	2.49	3.12
Length of ileum used (cm)	24.53	15.89	13.21	8.82
Length colon used (cm)	11.50	12.59	7.25	7.18
Hospital stay (days)	13.27	7.65	15.27	13.19
Intensive care unit days	2.56	2.50	3.86	6.25
Postoperative creatinine	1.20	0.55	1.12	0.41

Urinary Diversion

As postradiation salvage operations become more common, the selection of the most appropriate type of urinary diversion has become an important issue for the urologic surgeon. Traditionally, it was thought that the only type of diversion that is acceptable in these patients would be an incontinent diversion typically utilizing the transverse colon, as this segment of bowel is the furthest from the irradiated field. Although this is certainly an acceptable and safe approach, several centers are reporting the use of continent urinary diversions and the use of small bowel for either ileal conduits or neobladders. It should be mentioned that most of the published reports have come from high-volume centers where cystectomies and even salvage cystectomies are commonly performed.

Bochner et al.[28] published a series examining the use of small bowel in continent diversions in patients with prior pelvic radiation from the University of Southern California. Among the 88 patients who had salvage operations, 18 underwent a Kock pouch orthotopic neobladder. Most of these patients had failed radiation from outside facilities and had radiation dosages of 60 to 72 Gy. Seventeen patients had terminal ileum used while one patient had sigmoid colon because the ileum showed signs of radiation enteritis. The average operative blood loss was 840 mL, which was consistent with their experience in the nonirradiated population. The two major complications that were associated with the neobladder involved a prolonged urinary leak that resolved after catheter drainage and one episode of urosepsis that was treated with antibiotics. The three late complications involved stenosis of the nipple valve in one patient, a ureteroileal anastomotic stricture, and an enteropouch fistula. None had any wound issues involving infection or dehiscence. The continence rates were also relatively good, with 67% reporting good daytime continence and 56% experiencing good nighttime continence. The authors concluded that continent diversion after salvage surgery is not only feasible but also practical, as this helps patients maintain their self-image.

Wammack et al.[29] reported their experience with an ileocecal pouch (Mainz pouch), which has been their choice for continent urinary diversion. In this study, the authors compared 36 patients who underwent continent urinary diversion after pelvic radiation to their nonradiated series of 385 patients undergoing continent diversion. The average radiation dosage to the pelvis in this population was 48 Gy. This group includes 33 of 36 patients receiving brachytherapy for cervical cancer. Their results showed complications of the continent outlet in 25% of the radiation group versus 5.7% of the nonirradiated group. Ureteral complications were also higher in the radiated group, with 12% (eight patients) of the 36 radiated patients developing ureteroenteric strictures compared to 6% (25 patients) in the 385 nonirradiated patients. In contrast to this report, our own institution found, in a multivariate analysis looking at stricture rates after cystectomy, that radiation was not a statistically significant risk factor for the development of a ureteroenteric stricture.[30] This group came to the conclusion that the Mainz type of urinary diversion should not be used in this population; however, the authors also mentioned the fact that most of these patients were women who were undergoing radiation for gynecologic disease and who may have received larger field radiation.

There have been additional studies that compare urinary diversion techniques in pre- and postradiation patients. Among these is the study by Chang et al.[31] from Vanderbilt University, in which they looked at 36 patients who underwent urinary diversion after radiation therapy. They found that five patients had hydronephrosis secondary to an ureteroenteric stricture and three of these patients had intervention secondary to this obstruction. It was also found that one patient had colon used for urinary diversion secondary to the visible injury to the small bowel. The authors concluded that in the majority of patients it is not necessary to use transverse colon for the diversion, although surgical judgment as to the condition of the segment of bowel used remains paramount. Another study examined outcomes using the Indiana pouch, which is a continent cutaneous pouch that traditionally involves terminal ileum and ascending colon. Wilkin et al.[32] from the University of Wisconsin retrospectively compared 12 patients who underwent high-dose pelvic irradiation with 14 patients who had no history of radiation. The irradiated patients received an average of 78.1 Gy. The complications that were more common in the radiation group included ureteral strictures/obstruction, renal insufficiency, and incontinence. The authors concluded that although the Indiana pouch is a feasible operation in postradiation patients, there is an increased number of complications, in particular ureteroenteric strictures, and close follow-up of renal function is imperative.

Surgical Considerations of Salvage Cystectomy

Typical findings during a salvage cystectomy include obliteration of the retropubic space, adherence of the colon and/or small bowel to the posterior aspect of the bladder, and a dense desmoplastic response between the prostate and the rectum. Another occasionally encountered complicating factor is a lack of planes between the bladder and the iliac vessels. Similar to salvage prostatectomy, the use of sharp dissection under direct vision around critical structures such as vessels, bladder, and rectum help to reduce inadvertent injuries, and make injuries that do occur easier to repair. A "hot knife" approach that uses electrocautery directly against the pubic symphysis and ramus may be helpful in reducing blood loss and staying out of the bladder. Such devices as the bipolar sealing cautery must be used with caution and only after the proper development of surgical planes.

The type of diversion used after radiation has important implications for quality of life after cystectomy. Historically, the use of small bowel was not recommended after radiation, as it was thought that the rates of complications would be too high. However, several high-volume institutions, including our own, have found no significant increase in complication rates in salvage versus *virgin* cystectomies despite the type of diversion employed. Even in those studies that show an increased complication rate in radiated patients compared to nonirradiated patients, patients often report satisfaction with the choice of a continent diversion despite the risks. The importance of meticulous surgical technique, careful planning, and thorough inspection of tissue cannot be overstated. For instance, it is extremely important to examine the bowel and ureteral segments that are to be used to create the diversion as inflammation or compromise of blood supply may potentially have negative impact on the anastomoses. It is also necessary to exercise caution near the rectal border as blunt dissection in irradiated tissue may result in inappropriate tissue planes and rectal damage. In patients with significant evidence of radiation injury, a segment of bowel external to the radiated field, such as the transverse colon, should be selected. Careful preoperative counseling of the patient is necessary to ensure that all options are available to the surgeon during the procedure.

Surgical Considerations After Radiation for Cervical Carcinoma

One of the most difficult procedures is pelvic surgery following radiation therapy for cervical carcinoma. Particularly in older patients who may have received either cobalt radiation or cesium implants for cervical carcinoma, any surgical procedure undertaken in the pelvis should be done so with extreme caution. Due to the significant dosages of radiation used to treat this malignancy, damage to surrounding structures such as the ureter, small bowel, and bladder are often significantly greater than that seen following radiation administered for prostate or bladder cancer. Although there has been little reported data, most urologists do not favor neobladders in this group of patients. Continent cutaneous diversions such as an Indiana pouch have traditionally been employed for the younger patient who wishes to have a continent diversion. As with any diversion, it is critical to inspect the bowel and utilize alternative segments if severe radiation damage is suspected. Additionally, irradiated ureteral segments should be excised and discarded to provide for healthy tissue for the anastomosis. Ideally, the proximal ureter can provide adequate length, and no pelvic ureter need be used. Nevertheless, techniques to minimize ischemia should be employed. These include tension free anastomoses, a *no-touch* technique to be used during the anastomosis, and the use of ureteral stents to minimize urinary leakage.

Conclusion

As radiation techniques continue to improve, the damage to surrounding structures will be expected to lessen. However, due to the proximity of other structures to pelvic organs, one would expect to always encounter such peripheral damage during surgical procedures in the pelvis. Current literature supports the feasibility and success of surgical procedures in the pelvis after radiation particularly for radical cystoprostatectomy and radical prostatectomy. For high-volume centers, continent diversions and neobladders are being performed successfully. Radiation for cervical cancer still presents unique problems and should be approached with extreme caution. Above all, meticulous surgical technique combined with general surgical principles may help to reduce the number of complications associated with such procedures and yield outcomes similar to those of patients who have not received prior radiation therapy.

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22

Reoperation for Diverticular Disease

Michael J. Stamos and Zuri A. Murrell

Diverticulosis is a very common condition of Western countries, with the majority of people living beyond the age of 60 acquiring the condition. Individuals with diverticulosis have an estimated 10% to 20% chance of developing diverticulitis, and approximately 20% of these patients develop complications of this disease.[1] Reoperation for recurrent diverticulitis following sigmoid resection is fortunately uncommon. The rate of recurrence after colectomy is reported to be between 1% and 10.4% in the limited available literature.[2] More commonly, patients with diverticulitis are reoperated on to close a colostomy after a Hartmann's procedure. This chapter discusses recurrent diverticulitis in terms of timing, diagnosis, imaging studies, and treatment, and discusses the use of the Hartmann procedure, the timing of closure, and the surgical approach for colostomy closure.

Diverticular disease was a rare condition before the end of the 19th century; however, more recently the disease has become very prevalent. In the United States, by the age of 60 an individual's risk is at least 50%, and by the age of 80 few Americans will be without colonic diverticuli.[1,3–5] Approximately 20% of people with diverticuli will have symptoms, and, as stated, approximately 10% to 20% of people with diverticulosis will develop diverticulitis; at least 75% of these patients will have an uncomplicated disease course. [1,3–5] Nonoperative management of acute diverticulitis will fail in up to 29% of patients, leading to urgent operation.[6] Diverticular disease is responsible for 450,000 annual hospitalizations, and 3000 deaths per year in the United States.[1]

When a patient presents with left lower quadrant pain after a previous colon resection for diverticulitis, it is important to maintain a broad differential diagnosis. This should include inflammatory bowel disease, colon cancer, appendicitis, irritable bowel syndrome, bowel obstruction, gynecologic disorders in females and, of course, recurrent diverticulitis. Berman et al.[7] reported on 25 patients who required reoperation for "diverticulitis," and all patients were found to have Crohn's disease. The authors concluded that the presence of extracolonic manifestations, and failure of complete resolution of the inflammatory process should cause the surgeon to suspect Crohn's disease.

When faced with a patient with suspected recurrent diverticulitis, possibly excluding the rare patient with diffuse peritonitis, imaging studies should be obtained. Wolff et al.[2] believe that a computed tomography (CT) scan is the most important test, which is also the test preferred by the authors of this chapter. This radiograph may show inflammation, extraluminal gas, phlegmon, or abscess formation. If an abscess is present and is large (>5–6 cm), it may be amenable to CT-guided drainage (Fig. 22.1). If the CT is equivocal, a Gastrografin enema can be obtained, which may demonstrate diverticula or evidence of recurrent diverticulitis adjacent to the site of the anastomosis, or show remaining sigmoid colon below the prior anastomosis. Once the diagnosis of probable recurrent diverticulitis is entertained, a colonoscopy after the acute episode subsides should be obtained. In addition to potentially allowing visualization of the diverticula, it can evaluate for other pathology (e.g., Crohn's). Patients who present with recurrent diverticulitis should initially be treated similarly to patients experiencing their first bout with this disease. Antibiotics should be initiated, and fluid resuscitation, if needed, should be instituted. The goal should be preventing the patient from undergoing an emergent operation, so that diagnostic studies can be performed, a bowel prep can be given, and a colostomy avoided. Patients who fail such conservative treatment or who present with diffuse peritonitis will need to undergo re-resection or at least diversion and drainage urgently. While the three-stage treatment of diverticulitis is largely relegated to the medical history books, this is one situation where it may have a role. Attempting resection in an emergency situation will potentially result in excess morbidity and even mortality.

There is some controversy about the treatment of patients with recurrent diverticulitis who respond to conservative management. Wolff et al.[2] recommend an aggressive approach of re-resection if there is a documented episode of recurrent diverticulitis following a previous resection in medically fit patients. The authors of this chapter believe that the severity and timing of the repeat episode of diverticulitis should be used to guide therapy, with patients suffering severe/complicated attacks

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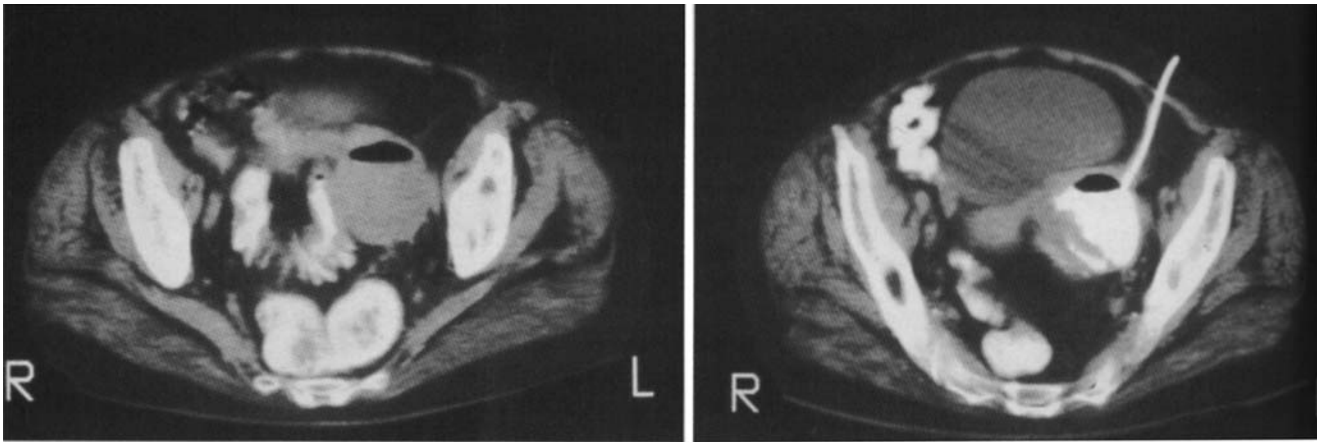

FIGURE 22.1. Compuited tomography scan of patient pre- and postinterventional radiologic drainage of a pericolic abscess. (From Welton et al.,[21] with permission of Springer Science + Business Media.)

occurring within a year or two of prior resection treated more aggressively than other patients.

Re-Resection for Recurrent Diverticulitis After Previous Colon Resection

While the criteria for operating on diverticulitis are evolving, it is accepted that if a patient is taken to the operating room for sigmoid diverticulitis, the entire sigmoid colon should be resected with the distal margin on the pliable rectum. Recurrent diverticulitis after previous colon resection more commonly occurs after inadequate previous resection. The small number of published series examining this entity shows that recurrent diverticulitis following resection is an uncommon occurrence. Benn et al.[8] reported 501 patients who underwent sigmoid resection for diverticulitis, and found recurrent symptoms in 10.4%, and 3% of the overall group required re-resection. Furthermore, these investigators determined that recurrent diverticulitis developed in 12.5% of patients in whom the distal sigmoid colon was used for the anastomosis, versus 6.7% in patients who had a colorectal anastomosis, a reduction of almost 50%. In addition, Farmakis et al.[9] studied 77 patients who underwent sigmoid resection, with 2.6% having recurrent symptoms; however, none required re-resection. In a literature review, Frizelle et al.,[10] found that only 0% to 3.1% of patients required re-resection for diverticular disease after previous sigmoid resection, and given these low numbers, Effron et al.[11] concludes that re-re-resection is not indicated for the first recurrent attack.

Once the decision to operate on recurrent diverticulitis has been made, Wolff et al.[2] advocate marking the patient for a colostomy, a right-sided ileostomy, and the placement of ureteral stents. His group recommends starting the mobilization proximally, with the ultimate goal of moving distally and re-resecting the previous anastomosis. The American Society of Colon and Rectal Surgery (ASCRS) Standards Task Force reports that at the time of re-resection the two main issues are the location of the proximal resection margin and where the distal anastomosis should be performed.[12] The task force also states that an effort should be made not to incorporate diverticula into the anastomosis. Review of the prior operative report or reports, and pathology reports is an important step that can occasionally be illuminating and significantly influence decision making. If the diagnosis of Crohn's disease is entertained, an independent pathology review of the original colectomy specimen may be useful. To summarize, when deciding to reoperate for diverticulitis, it is first important to confirm the diagnosis, and next to elucidate the severity of symptoms to determine if an operation is necessary.

Reoperation After a Previous Hartmann's Procedure

Only 50% to 70% of patients who undergo Hartmann's resections will undergo closure of their colostomy.[5,10,13–16] These operations are often very complex and are associated with a reported morbidity rate of 10% to 50%, and a mortality rate of 1% to 50%, which is a major reason why 30% to 50% of patients do not undergo closure.[4,5,10,13–20] Many studies have evaluated this operation and the outcomes have not controlled for the Hinchey classification of the disease at original operation, the urgency of original operation, operative time as a surrogate for difficulty, or type of anastomosis at time of colostomy closure. Aydin et al.[5] sought to determine the prevalence of surgical and medical adverse events in patients undergoing Hartmann's closure. They reviewed 121 patients who underwent Hartmann's reversal, and 731 patients who underwent primary resection and anastomosis for diverticular disease. They controlled for many variables including, age, comorbidities, American Society of Anesthesiology (ASA) scores, Hinchey classification, type of surgery, and others. This group found a 48.5% surgical morbidity and a 1.7% mortality for Hartmann's closure, with postoperative ileus being the most common complication, compared to a 26% surgical morbidity and 0.7% mortality for primary resection with anastomosis. They concluded that Hartmann's resection and subsequent closure is associated with higher prevalence of postoperative events compared to primary resection and anastomosis, and that patients must be appropriately selected, and be optimized preoperatively.

Reoperation following a previous Hartmann's procedure typically requires variable amount of lysis of adhesions, mobilization of the splenic flexure, resection of any residual or retained sigmoid colon, and primary colorectal anastomosis. This operation can be quite simple and straightforward, but more frequently is difficult and sometimes even treacherous. The degree of difficulty is usually related to the prior episodes of diverticulitis that led to the Hartmann's procedure. If the prior episode was a relatively localized diverticular process without significant pelvic inflammatory changes or with only minimal peritoneal contamination, it predictably will not be as difficult as in the case of a patient with generalized fecal or purulent peritonitis including those involving the pelvis. Additional information that can be useful is knowledge of the postoperative course of the patient following their previous sigmoid resection. Those patients who had pelvic abscesses form will, not surprisingly, be more difficult, mainly due to the inflammatory process in the pelvis causing significant difficulty identifying and freeing up the residual rectal stump.

The timing of the operation is not well established, but most surgeons prefer to wait a minimum of 3 months following the prior episode before closing the colostomy. Tagging the corners of the rectal stump with a permanent suture such as Prolene (Ethicon, Inc., Piscataway, NJ) is also a useful adjunct, and placement of Seprafilm (Genzyme, Corp., Cambridge, MA) or other adhesion barriers may also facilitate the subsequent operation. Ureteral catheters are not routinely utilized, but intraoperative findings may dictate their selective use. As long as the patient is placed in lithotomy and a urologist is available, this takes only a few minutes and also can be done while the abdominal dissection and/or splenic flexure mobilization proceeds. Identification of the rectal stump can sometimes be facilitated by use of a lighted proctoscope or flexible sigmoidoscope. Often, the easiest plane to establish is the plane immediately in front of the presacral fascia. If the plane between the presacral fascia and the fascia propria of the rectum/mesorectum can be identified, this will often allow significant mobilization posteriorly, which can then be extended around laterally and then eventually anterior to free up the rectal stump. If the rectal stump cannot be freed up adequately or safely in that process, the anastomosis can be performed to any segment of the rectum that can be identified and cleared adequately. Placing a lighted proctoscope or even the circular stapler head sizers into the rectum can often facilitate this step. Frequently, the anterior wall of the rectum is the most accessible in this circumstance and an end-to-side anastomosis can be performed between the proximal colon and the rectum.

One can also consider a laparoscopic approach to this operation. The authors of this chapter prefer this approach, and begin by freeing up the ostomy done locally, closing the end of the colon after resecting the stoma and then placing a Hasson trocar through the remaining fascial defect if adhesions are not formidable. The abdomen can then be evaluated to determine if adhesions would prevent a safe laparoscopic reconstruction.

Conclusion

Recurrence of diverticulitis after prior sigmoid resection for diverticulitis is fortunately uncommon. There are limited retrospective and no prospective data available on the exact incidence, but the available literature would suggest that it approximates 5% to 10%. When a patient presents with symptoms suggestive of recurrent diverticulitis, care must be taken to rule out other diagnoses. In addition, old operative reports and pathologic specimens should be reviewed. After a thorough evaluation, if diverticulitis is diagnosed, it should be treated with antibiotic management, and nothing per mouth. If symptoms resolve, a tougher decision needs to be made—whether to reoperate or not. When considering reoperation for diverticular disease, there are no rules or clinical guidelines to help determine when repeat resection is appropriate or indicated. It is tempting to use the same rules as one would use for a primary operation, although this may not be appropriate. Since application of such rules or principles is usually guided by an analysis of the risk-benefit ratio, it would be appropriate to take a more conservative approach toward a repeat resection, given that the risks are higher. It is notable that even for primary elective resection for diverticular disease, indications are evolving, with recent publications suggesting that a simplistic viewpoint that two episodes of diverticulitis warrant a resection are probably not well founded.[2] When contemplating a repeat resection it is even more important that we have solid indications to operate before doing so. Perhaps of more importance than the number of prior episodes would be timing of those episodes in relation to the original sigmoid resection, the frequency of the episodes, and the severity of the episodes. Other factors that may be important would include the immunologic status of the patient and the patient's ready access to qualified medical and surgical care.

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23

Reoperative Surgery for Gastrointestinal Stomal Problems

Bruce A. Orkin and Farshid Araghizadeh

The creation and management of ostomies are integral components of the general and colorectal surgeon's surgical arsenal in the treatment of gastrointestinal (GI) disorders. Ostomies often result in significant psychological trauma for the patient; thus proper education, formation, management, and closure are critical in ensuring patient satisfaction and maintaining quality of life.

Approximately 750,000 Americans currently live with an ostomy, and more than 75,000 new stomas are performed each year. Although in years past, ostomies were performed for the permanent management of GI tract output, the majority of contemporary stomas are created as a temporary measure, either as an end ostomy in the acute setting, or as proximal diversion for protection of a risky anastomosis with plans for future restoration of intestinal continuity. This chapter addresses complications associated with GI stomas and operative procedures to treat these complications.

Stomal Complications and Risk Factors

Although the majority of patients with stomas will live a long life, many have major or minor complications including ischemia, prolapse, retraction, stenosis, pyoderma, bleeding and varices, abscess and fistula, and, most commonly, hernia. The overall complication rates range from 15% to 40% in reports of large groups of patients.[1–5] This wide variation in stoma-related complications is due, in part, to the definition of stomal complications, duration of follow-up, inclusion of complications of the stoma alone or all complications, the types of stomas especially permanent versus temporary, and the use of crude or actuarial calculations.[6] Stomal complication rates appear to rise slowly over time. The short-term complication rate in patients with a temporary colostomy is about 20%.[7,8] In a series of over 1600 ostomies, Prasad's group[9,10] reported a rise in the complication rate from 26% to 35% over the course of 20 years. In most series, loop transverse colostomies have the highest long-term complication rates due to prolapse, retraction, and pouching problems, and the long-term morbidity of an end ileostomy seems to be higher than that of an end colostomy.[11–15] Patients with Crohn's disease and stomas have the highest complication rates due to both the typical problems noted as well as recurrent inflammatory bowel disease.

Risk factors for development of stomal complications include patient factors such as diabetes mellitus, obesity, connective tissue disorders, as well as disease-related factors.[6,11,14,15] Ostomy complications may also be divided into early and late complications. Early stomal complications occur in the immediate postoperative period, and late stomal complications are seen during long-term follow-up.[9,11,14,15]

Emergent Versus Elective Stoma Creation

Emergently created stomas have a higher complication rate than those constructed during elective operations due to the presence of a distended abdomen, thickened bowel wall, shortened mesentery, compromised blood supply, the need for a large fascial incision to accommodate a dilated intestinal limb, and lack of preoperative stomal siting. Emergent operations requiring a stoma are often performed for toxic megacolon (toxic colitis) with distended and friable bowel, peritonitis with bowel thickening associated with mesenteric shortening, bowel obstruction, and trauma. Under these circumstances, little opportunity exists to choose a stoma site preoperatively. Also, the need for a stoma and the type of stoma (ileostomy vs. colostomy) may not be known before the operation. The distended abdominal wall may flatten the normally present folds and creases that return soon after the resolution of the acute process. Thus, the stoma may be inadvertently located below a fold, in a crease, or in an inaccessible location. Placing the stoma more cephalad on the abdominal wall may help with this problem, though it will be less

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TABLE 23.1. Technical Considerations for Creation of an Emergent Ostomy.

Gentle handling of friable bowel and mesentery
Adequate bowel mobilization
Appropriate fascial opening to accommodate thick bowel and mesentery
More cephalad placement of the stoma
Secondary maturation if patient is physiologically unstable

cosmetic. Creation of a tension-free stoma may be exceedingly difficult with thickened, inflamed and friable intestine with a shortened mesentery, particularly in an obese patient with a distended abdomen. A large fascial opening will usually be required to exteriorize the intestinal limb and its mesentery. Therefore, these stomas are prone to ischemia and necrosis, separation, retraction and stenosis, poor pouching with leakage, and skin irritation. The development of a discrepancy between the size of the fascial opening and the bowel after resolution of the edema and inflammation, leads to the formation of a parastomal hernia. Table 23.1 lists the technical considerations for creation of an emergent ostomy.

Ischemia and Necrosis

Ischemic necrosis of the stoma is a serious problem. It is almost exclusively an acute complication after ostomy construction and is due to compromised blood flow. This may be due to devascularization of the distal end of the bowel, lack of collateral circulation, or compression of the mesentery as it emerges through the fascia. The incidence of stomal ischemia and necrosis is variably reported between 2% and 17%, although in most large series, it is toward the lower end of this range.[10,15,16] This complication is most commonly seen in morbidly obese patients with a thick abdominal wall or in patients with a foreshortened mesentery due to visceral obesity, underlying anatomy, disease or infection, and inflammation. Contributing factors include an inappropriately small fascial opening, twisting of the intestinal limb, inadequate bowel mobilization, tension on the mesentery, and tearing of the mesentery during exteriorization of the bowel.

Left-sided colostomies usually survive and thrive on collateral circulation even after inferior mesenteric and left colic artery ligation, as blood flow from the superior mesenteric artery (SMA) via the left branch of the middle colic artery and the marginal artery of Drummond perfuse the left colic distribution adequately. The viability of a descending colon or sigmoid colostomy after left colic artery ligation may be jeopardized if the SMA or major coronary artery (MCA) is afflicted with flow-limiting lesions or severe atherosclerosis.

The temptation to hastily complete the ostomy construction after a long and arduous operation and the relegation of this task to a junior member of the team must be avoided. A senior team member should be directly involved to ensure satisfactory creation and maturation of the stoma. Ultimately, the surgeon's reward for spending an extra few minutes ensuring a well-formed stoma is a satisfied patient and the avoidance of returning to the operating room for stomal revision and reconstruction. Occasionally, secondary maturation of the stoma may be advisable in an unstable patient. In this procedure, a generous fascial opening is made and the stomal limb is left unmatured and wrapped in moist gauze. When possible, the end is closed with a stapler or the classic Stone clamp. At times the tissue is too thick, inflamed, friable, or thin. In this setting the end may be left opened, although the lumen is generally occluded by compression from the gauze wrapping. The stoma is then matured at the bedside with local anesthetic after improvement in the patient's physiologic status.

The ostomy is evaluated daily after surgery as part of the general care of the patient. The mucosa should be pink and viable. Stomal edema occurs commonly during the first week following surgery, but usually resolves in the ensuing 3 to 4 weeks. The stoma may shrink by one half to two thirds during this period. Ischemia is likely when the stoma becomes engorged and purple. This may progress to gangrene with black or dark green discoloration over several days (Fig. 23.1). The extent of the ischemia may be evaluated by observing the mucosa from the tip down into

FIGURE 23.1. Stomal necrosis and gangrene.

the abdomen through the fascia. This is most easily performed by gently placing a test tube in the stoma down to the fascia and examining the stoma with the aid of a flashlight. The ostomy may also be examined with a small rigid or flexible endoscope. If the ischemia is limited to the tissue above the fascia, partial sloughing may occur, but the stoma will most likely remain viable; ultimately, stenosis or retraction of the ostomy may ensue. If the process extends below the fascia, acute operative revision will generally be necessary, as the ostomy may perforate or fall away from the abdominal wall, resulting in an abscess or even peritonitis. At reoperation, the necrotic segment of intestine and its mesentery is resected, and the proximal healthy limb is exteriorized. For left-sided colostomies the splenic flexure may require mobilization if this maneuver were omitted during the initial operation.

Prolapse

Prolapse occurs in 1% to 16% of patients with a stoma (Fig. 23.2).[17] Although end ostomies certainly may prolapse, loop ostomies seem to do so at a higher rate and earlier. This is probably because of a larger fascial opening and poorer circumferential fixation. Also, the rate of early loop ostomy prolapse is higher than late since many loops are closed within several months of construction. For the noted reasons, prolapse is most common in patients with a loop transverse colostomy who have a large fascia opening, a large diameter lumen, and a propensity for prolapse of the distal limb.[14,18] The prolapse may be constant or intermittent, and may be associated with a parastomal hernia and protrusion of other abdominal contents (bowel, greater omentum, spleen) through the fascial defect. Extensive stomal prolapse may result in mesenteric compression and ischemia of the prolapsed intestine (Fig. 23.3).

Risk factors for this complication include emergency operation with creation of a large fascial defect, obesity, pregnancy, ascites, steroid use, parastomal hernias, and chronic obstructive pulmonary disease. A sudden increase in intraabdominal pressure with coughing, sneezing, or a blow to the abdomen also increases the risk of stomal prolapse. A rigid appliance worn with a tight belt may also contribute to the formation of prolapse.[17,18] MacKeigan[19] recommends preoperative siting of the ostomy through the rectus sheath, proper sizing of the fascial opening, mesenteric fixation, minimizing the redundancy of the intestinal limb, and using an end stoma whenever feasible to reduce the incidence of prolapse. Goligher recommended retroperitonealization of the bowel to reduce the incidence of this complication; however, this technique is rarely used today. A limited, fixed prolapsed stoma that can be easily pouched does not usually result in skin problems, but if a prolapsed ileostomy reduces to a flat stoma, skin irritation is inevitable. Chronic prolapse may result in mucosal trauma, which can lead to intermittent bleeding or pseudoepitheliomatous hyperplasia.

Most stomal prolapses are small and can be managed with appliance adjustment, local care, and patient reassurance. Incarceration of the prolapse is rare. If there is evidence of ischemia and reduction is not possible, or if the prolapse causes pouching or skin or cosmetic problems, revision may be indicated.[18] Prolapsed end stomas may be managed with local revision and fixation to the fascia. Additional resection of redundant bowel is often desirable. Occasionally, a transabdominal repair with either permanent or biologic mesh or relocation of the stoma may also be necessary. For loop ostomies, the most definitive treatment is closure, but if not feasible, division of the stoma

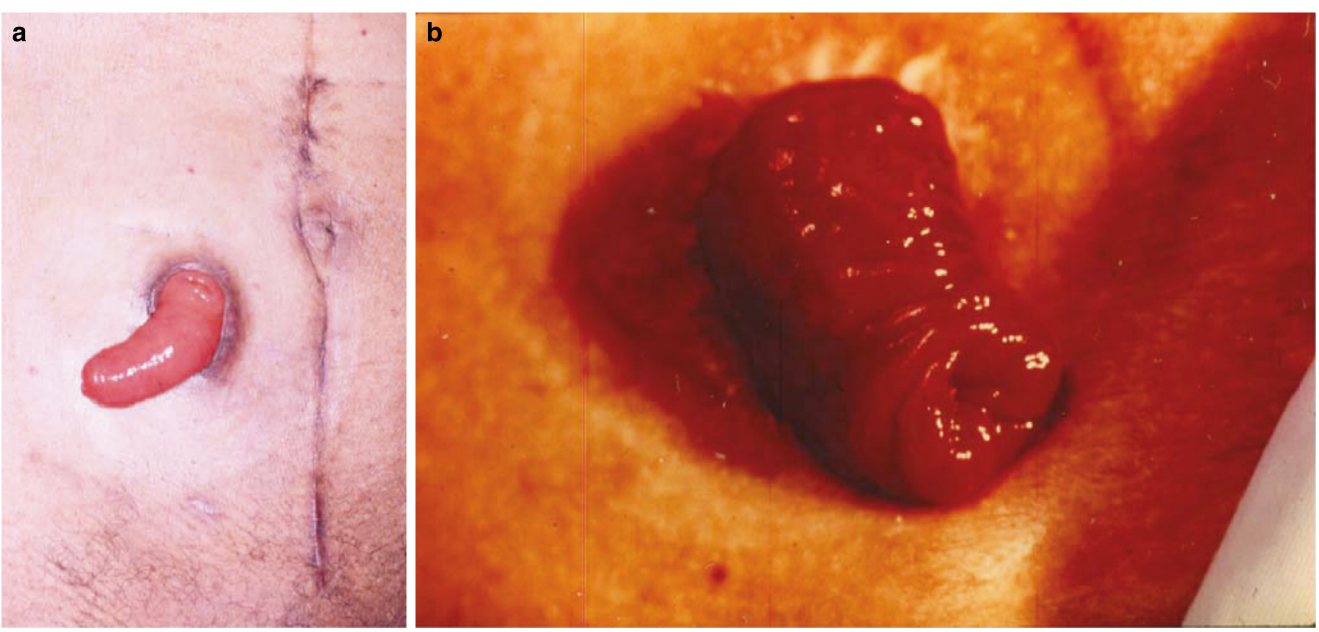

FIGURE 23.2. (**A**) A loop ileostomy with prolapsed distal limb. (**B**) Loop ileostomy prolapse.

FIGURE 23.3. Stomal prolapse and ischemia.

with creation of an end ostomy and either distal closure (local "end-loop" or Hartmann's) or a separate mucous fistula is a good option.[13–18]

Retraction

Stomal retraction is the flattening of a normally protruding ostomy, generally an ileostomy (Fig. 23.4). In a series of 1758 patients, Del Pino and colleagues[10] reported an incidence of 11%, although the overall incidence is probably closer to 3% to 4%.[11,14–16] Retraction occurs as a result of inadequate fixation of the stoma to the fascia and occurs more commonly in loop stomas than in end stomas. This leads to inadequate fecal diversion. This complication is more serious with ileostomies, as some protrusion is necessary for adequate function and pouching. Ileostomy retraction results in serositis, leakage, and skin irritation, as well as the inability to suitably pouch the stoma. As discussed previously, retraction may be the result of ischemic necrosis, tension on the intestinal limb, or a thick abdominal wall. It may also be the reverse of prolapse with poor fascial fixation and a sliding hernia. Retraction is more commonly seen in patients with Crohn's disease.[20]

Nonoperative therapy is appropriate in an asymptomatic ostomate whose appliance fits properly. Observation with careful peristomal skin care and pouching is usually adequate. The use of a convex faceplate may allow the stoma to sit up better and decrease leakage. When symptomatic, surgical revision, either locally or with celiotomy, with or without stomal relocation, may be necessary.

Stenosis

Occurring as an early or a late complication, stenosis affects 4% to 10% of all stomas (Fig. 23.5).[10,21] Early stenosis is usually due to a technical problem such as creation of a skin or fascial opening that is excessively small for the loop of intestine, whereas late stenosis is often a consequence of stomal ischemia and retraction. Stomal stenosis may also occur as a result of separation of the mucocutaneous

FIGURE 23.4. Partially retracted stoma.

junction with subsequent healing by secondary intention. Depending on the etiology, stenosis may be superficial and confined only to the skin, it may involve the bowel to the level of the fascia, or it may extend over a variable length of the bowel in the peritoneal cavity. Although some patients may be asymptomatic, most present with severe peristomal skin irritation due to difficult pouching and leakage, need for frequent appliance changes, and obstructive symptoms, particularly with colostomies. Irrigation of the ostomy and a low residue diet may help, but revision is often necessary. In years past, secondary maturation of ileostomies led to serositis due to serosal exposure with subsequent stenosis—a condition that was called *ileostomy dysfunction*.[22] Primary maturation, as described by Brooke,[23] has eliminated serositis as a cause, but stenosis for other reasons may lead to the same symptoms of crampy abdominal pain, and high-volume liquid output. Fibrous and poorly digested food materials are more likely to block the stenotic lumen. Recurrence of underlying disorders such as Crohn's disease or carcinoma should be excluded as the etiology of these symptoms.

Medical management is generally only a short-term measure, as most stomas with significant stenosis require surgical revision. A low residue diet and regular irrigation of a stenotic colostomy may help keep fibrous material from blocking the outlet. Local dilation of a stenotic stoma is

FIGURE 23.5. A stenotic retracted stoma.

rarely effective and may actually worsen the scarring. Local revision of the stenotic stoma may be performed without a celiotomy if the stenotic segment is short and there is enough healthy bowel for mobilization and rematuration. Extensive adhesions or a long stenotic limb may mandate a celiotomy and bowel resection and reconstruction of the stoma. Allen-Mersh and Thomson[24] report success with local revision for stomal stenosis in nearly 60% of patients.

Parastomal Hernia

A form of incisional or ventral hernia, parastomal hernia is one of the most frequent complications of any ostomy (Fig. 23.6). Generally, a parastomal hernia occurs when the fascial defect of the ostomy becomes larger than the intestinal limb. The hernia sac, lined by parietal peritoneum, may contain only the stomal limb and its mesentery, or may contain other abdominal viscera. The most common abdominal organs involved in these sliding hernias include small and large bowel and greater omentum, but may rarely include stomach, spleen, bladder, ovaries, fallopian tubes, or a portion of the liver. These tissues protrude into the subcutaneous tissue with increased intraabdominal pressure such as coughing or sneezing. Adhesions are common between these organs and the hernia sac. Occasionally, these organs may become incarcerated within the hernia, which leads to an increased risk of acute complications such as strangulation, gangrene, perforation, sepsis, and fistula formation. Several configurations of parastomal hernias have been described by Rubin and Bailey,[25] including a true parastomal hernia with a separate loop of bowel protruding through the fascial defect in the subcutaneous tissues, an intrastomal hernia with a limb of intestine pushing up parallel to the stoma, and a subcutaneous or pseudohernia where the stoma limb itself is prolapsed and twisted in the subcutaneous tissues. A fourth is described

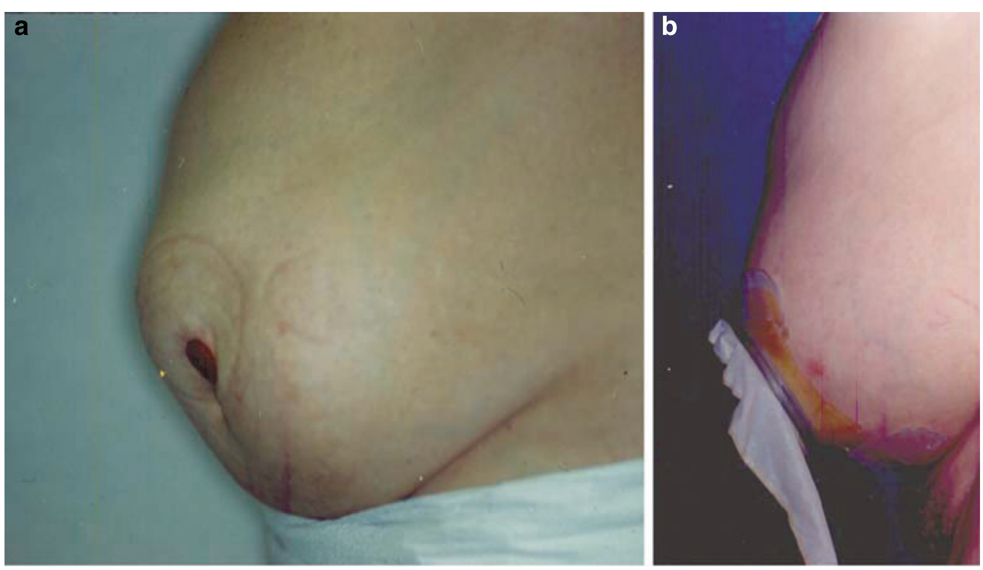

FIGURE 23.6. (**A**) Paracolostomy hernia. (**B**) Lateral view of a large parastomal hernia.

in which there is no hernia but there is localized bulging due to a generally weak fascia.[25]

With an overall reported incidence of 10% to 40%, several authors suggest that parastomal hernias are an inevitable consequence of the defect created in the abdominal wall.[26–31] The incidence of this complication varies with the duration of follow-up and type of stoma. Although the majority of parastomal hernias occur within the first few years of stoma construction, its incidence continues to rise throughout the life of the patient.[11]

Most studies indicate that end colostomies have a higher risk of hernia formation than end ileostomies, presumably due to the necessity for a larger fascial aperture. Greater colonic peristaltic forces, formed output, and advanced patient age may also contribute to the higher incidence in end colostomies. Overall, loop ostomies seem to have a lower incidence, but this may be due to their temporary nature and short duration of follow-up. In an extensive review of the literature, Carne et al.[32] summarized the risk of parastomal hernias in patients with different types of stomas. Patients with an end ileostomy had a 2% to 28% risk, loop ileostomy carried a 0% to 6% risk, end colostomy a 4% to 48% risk, and loop colostomy 0% to 31%.[28]

Historically, stomas were created through the primary incision and matured primarily or secondarily. This technique was associated with a high rate of wound infection, serious problems with pouching, and frequent large hernia formation. [1,26] Subsequently, lateral *iliac* or *lumbar* stomas were popularized. Although infectious complications were fewer and the overall function improved, parastomal herniations plagued this approach. For many years, transrectus abdominis placement of the ostomy has been an axiom of sound surgical technique. Although the data are conflicting, most studies indicate a lower incidence of parastomal herniation for transrectus stomas compared to those constructed lateral to this muscle or through the incision.[11,29,32–35] The most consistent risk factors noted in the literature for the development of parastomal hernias are emergent surgery in patients with peritonitis, edematous and thickened bowel, age greater than 60, prolonged survival, and placement of the stoma through the incision.[11,31]

Symptoms

Most parastomal hernias are asymptomatic, and the ostomate may not even be aware of their presence. The majority of patients present with only a modest bulge; however, some bulges become quite large and may actually contain a large amount of intestine and omentum (Fig. 23.7). Under these circumstances, patients may complain of chronic symptoms of unsightly parastomal bulging often visible through their clothing, abdominal pain, changes in ostomy function, prolapse, difficulty with pouching and associated leakage or skin problems, difficulty seeing the stoma opening beneath the abdominal bulge, intermittent obstruction, and difficulty irrigating. Some may present acutely with prolapse, incarceration, obstruction, or even ischemia and gangrene.

FIGURE 23.7. Giant parastomal hernia associated with an incisional hernia.

Diagnosis

Some hernias are easy to identify but others may be difficult to assess, particularly in the obese patient. The patients should be asked to describe their own observations. Examination should be performed with the patient in the supine, sitting, and standing positions. While the patient is standing, the Valsalva maneuver allows assessment of protrusion by inspection and palpation. Examination with the patient in the supine position may aid in defining the size of the defect and whether the hernia is reducible. The width and length of the defect, the location in relation to other incision scars and landmarks, and the presence of other incisional (ventral) hernias should be noted. If relocation is being considered, possible sites should be identified. In the obese patient, it may be quite difficult to assess the defect, and CT scanning may be helpful (Fig. 23.8). Prior

FIGURE 23.8. Abdominal CT scan demonstrating a large parastomal hernia with a concomitant incisional hernia.

to hernia repair, recurrent neoplastic or inflammatory diseases should be excluded.

Nonoperative Therapy

Treatment is individualized based on the size and progression of the hernia, symptoms, the patient's condition and comorbidities, as well as the patient's wishes. Many small parastomal hernias do not progress and do not require surgical correction. Most are asymptomatic and require only periodic follow-up and observation. Mild symptoms of bulging, peristomal skin irritation, and difficulty with pouching may be addressed by careful and creative enterostomal therapy. Skin care, use of convex faceplates and other alternative pouching systems, and an elastic stoma belt or abdominal binder with a hole for the stoma may be helpful. Loss of weight in the obese cannot be overemphasized.[18,28]

Surgical Repair

Surgical repair of a parastomal hernia is offered if the hernia is enlarging or causing significant symptoms such as pain, obstruction, or an unpleasant bulge. Irrigation of the colostomy may become difficult or even dangerous. The stoma may retract or prolapse, and it may become exceedingly difficult to keep an appliance in place, resulting in odor, soiling, staining, and social limitations.[29]

Ideally, parastomal hernias should be repaired before they become massive and the surrounding tissues severely attenuated. Reduction of parastomal hernias containing substantial amounts of intestines may be exceedingly difficult and may result in a pathologic increase in the intraabdominal pressure with detrimental effects on the cardiopulmonary and renal systems. This "loss of abdominal domain" must be addressed prior to hernia repair. Surgical therapy should be avoided in patients unfit for general anesthesia or with limited life expectancy unless acute complications arise. Patients with recalcitrant Crohn's disease should be approached cautiously due to increased risk of complications and recurrence. Overall, about 10% to 20% of patients with a parastomal hernia will be candidates for surgical repair.[29–37]

The best option for repairing a parastomal hernia associated with a temporary stoma is to close the stoma and repair the defect in layers, with or without mesh. However, permanent stomas tend to be the most problematic. Techniques for surgical repair may be divided into three basic types: local suture repair of the fascia, relocation or re-siting of the stoma, and repair with the use of mesh. The approach may also be via three different routes: local repair through the mucocutaneous junction, parastomal repair through a subcutaneous route, or transabdominal via either celiotomy or laparoscopy.

The method of repair of a parastomal hernia must be individualized for each patient and the type of repair and surgical approach should be carefully selected, as there are distinct advantages and disadvantages to each. Some repairs may be performed on an ambulatory basis. Others require major surgery and a significant period of convalescence.

Operative Techniques

Local Repair with Sutures

Local repair of parastomal hernias through the mucocutaneous junction is the simplest and easiest method of parastomal hernia repair. It is quick and, at times, may be performed on an outpatient basis, yet it is appropriate only for small hernias in patients with strong intrinsic fascia.[38] Nevertheless, it has the highest recurrence rate and therefore is currently used in limited circumstances.

The mucocutaneous junction is sharply divided on the side of the palpable hernia. This may include some or the entire circumference of the stoma. The sac is dissected and its contents reduced. The hernia sac is then excised and the edges of the fascial defect are identified and cleared of peritoneum, fat, and adhesions for 2 to 3 cm within the abdominal cavity. The stoma limb may be resected if prolapsed or mobilized if retracted. The repair is performed with interrupted nonabsorbable sutures on one or two sides to snug the fascia around the ostomy limb. The repair should admit the tip of a Kelly clamp to ensure a snug but not excessively tight closure. The fascial edge is secured to the bowel wall with interrupted absorbable sutures, taking care not to enter the lumen. The subcutaneous tissues may be reapproximated with absorbable sutures. Closed suction drainage of the subcutaneous space may aid in prevention of seroma formation in the postoperative period and is used selectively. The skin opening is fashioned to easily accommodate the stoma limb, and the stoma is matured in the standard fashion for an ileostomy or colostomy. An appliance is placed immediately as the stoma, especially an ileostomy, is likely to function rapidly.

Parastomal Subcutaneous Repair

Thorlakson[39] described a similar repair for larger defects using an L-shaped lateral or medial incision outside the pouching area, which may utilize old scars as part of the incision. A deep subcutaneous flap is developed circumferentially along the anterior fascia. The fascia is then repaired as in the local repair described above with drainage of the resultant dead space. The advantages of this approach include maintaining an intact mucocutaneous junction around the stoma and avoidance of placing a stoma bag on a fresh incision, while its disadvantage is the extensive subcutaneous dissection. Currently, this approach is used only occasionally. Some authors recommend augmenting this repair with a nonabsorbable mesh sutured to the anterior fascia.[39] This onlay method of repair addresses the common scenario of weak fascia and a large defect. However, a large subcutaneous cavity is created, an additional incisional scar is added. Additionally, the peristomal subcutaneous fat may be attenuated and thinned by the hernia sac; once the prolapse has been reduced, there may not be enough fat, and so the stoma will retract.

Onlay Mesh Repair

The approach recommended by Amin et al.[37] is via a lateral incision 10 cm from the stoma that is carried to the rectus sheath and then medially toward the stoma and around the defect in the abdominal wall musculature. The hernia sac is excised when possible and the fascial defect closed with nonabsorbable, monofilament suture. A polypropylene mesh is then placed round the stoma by excising a disk of mesh to accommodate the stoma. The early results of this technique were encouraging, but over time, recurrence is common as the mesh bulges out and the aperture widens, both into and through the rectus.

Relocation

Parastomal hernias with very large fascial defects are best managed by relocating the stoma to a fresh site through intact fascia. The site must be carefully chosen as for any new stoma, but this is often a more challenging task in the patient who has had multiple surgeries and a large hernia. When feasible, the new site should be on the opposite side of the abdomen so that the repair of the hernia is not compromised.[23] Relocation is usually a major operation, due to prior surgeries and adhesions.

Stoma relocation is generally performed via the original, usually midline, incision.[19,40] Lysis of adhesions is performed as necessary. The stoma is disconnected from the skin and subcutaneous tissue, and the hernia sac is excised. The defect is repaired in layers with nonabsorbable suture. A retrofascial mesh patch is commonly used for reinforcement. The new stoma in created in the standard fashion at the marked site. Recently, is has become common to use a large piece of mesh that may extend across the midline and surround the new ostomy site, since this new site is also at high risk for developing a hernia. A 3- to 5-day hospital stay is generally necessary for initial recovery following this operation.

Intraabdominal Mesh Repairs

In some patients a suitable new site is not available because of body habitus, scars, and folds. Many patients also do not want to have the stoma moved as they are accustomed to its location and have adapted their clothing and routine to accommodate its position. Therefore, despite a higher recurrence rate, local revision may be the best alternative. The addition of mesh to strengthen the repair has gradually gained popularity in order to decrease these high recurrence rates.[42] The use of mesh around a stoma carries the specific risks of infection due to seeding from the effluent and erosion of the mesh into the bowel limb.[42–48] Because of these concerns, most surgeons have avoided using mesh around a stoma, especially when the stoma is revised or when bowel is resected or repaired. As it turns out, erosion into the stoma limb is a rare problem if the mesh is placed correctly. The incidence of mesh infection ranges from 3% to 15% in various series.[39,46–48]

Most reports describe the use of single-layer nonabsorbable material such as Marlex or Dacron.[43] More recently double-layered mesh products such as Gore Dual-Mesh Plus composed of expanded polytetrafluoroethylene (e-PTFE) impregnated with chlorhexidine, and Bard Composix made of monofilament polypropylene (PP) and e-PTFE, have been advocated. One side of these products is rough and woven so as to encourage tissue ingrowth. The other side is smooth with very small pores, which discourages the formation of adhesions. During transperitoneal hernia repair, the rough side is placed against the abdominal wall and the smooth side faces the peritoneal contents. Genzyme SepraMesh is similar product, which is co-knitted with PP mesh and polyglycolic acid (PGA). The PGA side is then coated with hyaluronic acid to reduce intestinal adhesions. These products may be particularly useful when placed in a retrofascial, intraperitoneal, underlay position.

Surgisis (Cook Biotech, Inc.) and AlloDerm (BioHorizons) are two biologic mesh products that have been recently used in the treatment of incisional (ventral) hernias. Surgisis is a minimally antigenic, acellular xenograft consisting primarily of type I collagen derived from porcine small intestinal submucosa (SIS) as well as growth factors and glycosaminoglycans, whereas AlloDerm is an acellular dermal matrix derived from donated human skin tissue containing intact collagen fibers, elastin, and proteoglycans. Theoretically, these products serve as a biologic framework, allowing native tissue ingrowth, and are resorbed over 6 to 12 months. If fibroblasts, endothelial tissues, and support cells migrate in, a fascia-like tissue structure that is host derived may grow. The manufacturers state that biologic prostheses are as strong as synthetics, resist infection and adhesion formation, and handle easily. There are some laboratory data to support these claims, but studies evaluating long-term results and recurrence rates of biologic mesh repair of parastomal hernias are lacking.[49–56]

An anterior fascial, onlay procedure or transperitoneal, underlay approach may be used, similar to nonmesh repairs. The *onlay procedure* may be performed as described above, either through an existing scar, or via a lateral or L-shaped incision to gain access to the anterior fascia via the deep subcutaneous plane. The hernia sac contents are reduced and the sac is excised. The fascial edges are cleared of adhesions for 3 to 4 cm internally. If possible, the fascial defect is closed using interrupted permanent sutures, and the mesh is placed over the fascia as an onlay patch. Otherwise, the defect is left to be bridged by the mesh. The fascial defect is overlapped by the mesh circumferentially for at least 3 to 4 cm. Earlier reports described mobilizing the stoma in its entirety and advancing the limb though a hole cut in the center of the mesh.[44,45] More commonly, the mesh is cut in a keyhole configuration so that it may be wrapped around the limb without dividing the mucocutaneous junction. The mesh is then sutured to the anterior fascia with multiple interrupted or running, nonabsorbable sutures that are placed laterally along the outer edge of the mesh and medially close to the stoma limb or along the edge of the fascial defect. Some authors recommend bringing the intestinal limb along one side of the mesh so it is angulated.[39,46–48]

The *transperitoneal, underlay approach* is a more effective technique, as the forces of abdominal pressure will be distributed across the abdominal wall. This method, however, requires a transabdominal approach and an inpatient convalescence period of 3 to 5 days. The abdomen is opened through the old incision. Adhesions are released and the contents of the hernia sac are reduced. The hernia sac may be excised and the parastomal hernia defect may be directly repaired with nonabsorbable suture, as the surgeon prefers. A large sheet of dual-sided, permanent mesh is tailored to widely overlap the fascial defects including the parastomal hernia and any other incisional hernias. A keyhole incision in the mesh is used to accommodate the stoma limb. The edge may be trimmed to give the mesh a concave profile when in place, conforming to the natural curve of the abdominal wall. Four to eight permanent sutures are placed around the perimeter of the mesh to anchor it to the posterior fascia. The edges of the mesh are fixed to the posterior fascia with either running or interrupted sutures or with spiral tacks (ProTacker, Ethicon, Piscataway, NJ) placed at 1-cm intervals. The repair is completed by placing four to six interrupted absorbable sutures between the seromuscular layer of the stoma limb and the inner edge of the mesh. The incision is closed.

Laparoscopic Repair

Laparoscopic repair of parastomal hernias has now started to be attempted because of impressive results with laparoscopic repairs of ventral and incisional hernias. However, this is a technically challenging procedure as it may require extensive lysis of adhesions, mobilization of bowel loops, mesh placement, tacking, and suturing.[57–60]

The abdomen is entered laterally using a Hassan (open) technique to avoid injury to intraabdominal structures. Two or three additional ports are generally used. As with the open procedure, adhesions are released taking care to avoid laceration or thermal injury. When performed laparoscopically, the hernia sac is generally not excised and the defect is not directly repaired. A sheet of dual-sided, permanent mesh is tailored to widely overlap the fascial defects including the parastomal hernia and any incisional hernias. The smooth surface must face down to the peritoneal contents, and the rough side must be up to interface with the peritoneum. A keyhole incision in the mesh is made. Four to six Gore-Tex sutures are placed around the perimeter of the mesh, which will be used to pull the mesh up to the peritoneal wall and anchor it to the fascia. The planned sites for the Gore-Tex sutures are marked on the anterior abdominal wall and are marked with letters. The same letters are marked on both sides of the mesh to easily align the mesh once inside the abdomen. The mesh is rolled tightly with the sutures inside the roll and introduced into the abdominal cavity via a 10-mm port. The mesh is unrolled and oriented correctly. The sutures are passed through the abdominal wall using a suture passer via tiny stab wounds. Once all are passed, the mesh is "parachuted" into position against the abdominal wall by pulling all of the clamped Gore-Tex sutures. The edges of the mesh are secured to the fascia with spiral tacks (ProTacker), placed at 1-cm intervals. Several interrupted absorbable sutures are placed between the seromuscular layer of the stoma limb and the inner edge of the mesh.

As with ventral hernia repairs, early experience suggests that the laparoscopic approach to parastomal hernias will result in less pain, shorter hospital stays, and more rapid recovery. It may also be easier to cover all anterior defects with this approach. However, there may be a higher complication rate, especially early, as inadvertent bowel injury, bleeding, and other complications may be seen with this technically challenging procedure. This technique may ultimately become the approach of choice, although it will be some time before adequate series are available to assess short-term complications and long-term results.

Abdominoplasty and Contouring

A subset of patients presents with poor stoma function due to a large pannus, scars, creases, and parastomal or incisional hernias. Evans et al.[61] described a combined approach to these patients employing abdominoplasty with contouring and stoma revision. They reported eight patients with a variety of combined defects, five of whom had Crohn's disease. Good results were obtained in seven patients, and the only complication reported was one seroma, while all patients noted a dramatic improvement in body image.

Loop Ostomy Hernias

The best treatment of parastomal hernias in patients with loop ostomies is restoration of intestinal continuity when appropriate, and simultaneous repair of the hernia, either primarily or with mesh. Patients with mild-to-moderate symptoms may be managed nonoperatively until stomal closure or until symptoms become unbearable. Loop stomas requiring repair without closure may be approached using any of the described methods.

Results of Parastomal Hernia Repair

The lack of a uniform classification of parastomal hernias, inclusion of colostomies and ileostomies in many studies, the limited number of series in the literature, and short follow-up render evaluation of the results of surgical repair of parastomal hernias difficult.

Parastomal hernia recurrence rates vary widely.[27,32,36,37,45,47,48,62–65] Clearly, longer follow-up is associated with higher recurrence rates and local repairs fail in 50% to 70% of patients. Stoma relocation results in recurrences in up to 70% of patients, although most series report about 30%. Anterior or onlay fascial mesh repairs fail in 0% to 30% of patients and mesh infections approach 15%. Other complications including seroma formation, hematoma, obstruction, and dense adhesions to intraabdominally placed mesh have been described. More recent series concentrate on peritoneal underlay placement of the mesh, with very low recurrence rates, but the available data are immature. Studies directly comparing the results of local repair versus stoma relocation versus mesh repair consistently confirm very poor results with local sutured repair, better outcomes with relocation, and the best results with mesh repair. Long-term results of laparoscopic parastomal hernia repair are currently lacking, but early results are promising. Safadi[67] claimed no recurrences in four patients after 6 months. Unfortunately, a later paper documented failure in five of nine patients (56%), all occurring within 6 months of repair. However, LeBlanc and Bellanger[58] reported a recurrence rate of 8% during an average follow up of 20 months in 12 patients.[58–60,66,67]

Because of the high rate of parastomal hernias, the concept of prophylactic placement of mesh at the time of stoma construction is being evaluated.[68,69] In 2004, Jänes et al.[70] reported a prospective, randomized prophylaxis trial in 54 patients undergoing permanent colostomy. At 12 months, 13 of 26 (50%) patients without mesh had developed a parastomal hernia, while only one of 21 patients with mesh had one. No significant complications were noted.

Summary of Parastomal Hernias

Local repairs of parastomal hernias have the highest recurrence rates and the fewest complications. Relocation procedures are consistently better than local repair but are associated with significantly more morbidity and longer recovery. Repairs with mesh, especially when placed in the retrofascial location, seem to have the best early results, but long-term data are scant. Concerns about mesh infection and erosion rates are real but appear to be sufficiently low. Laparoscopic mesh repair is a promising new approach, but experience and follow-up are very limited. The role for biologic mesh products remains to be determined, due to questions about durability. Unfortunately, regardless of the surgeon's satisfaction following operative repair of a parastomal hernia, recurrence rates remain relatively high. Therefore, prophylaxis use of mesh may become a more common approach.

Bleeding and Peristomal Varices

Occasional bleeding from the mucosa of a stoma is common and generally harmless. Bleeding from peristomal varices, although uncommon, can be a challenging and sometimes life-threatening complication of a stoma. Primarily seen in patients with portal hypertension, peristomal varices represent development of a portosystemic shunt, similar to esophageal varices. Its incidence is difficult to establish given that most published articles are based on a few case reports. This complication may occur in patients with alcohol-induced hepatitis, but is probably most frequently seen in patients with ulcerative colitis (UC) and primary sclerosing cholangitis (PSC), not only due to the association of these two conditions but also because of the incidence of ileostomies in patients with UC.[71,72]

The classic finding of a "caput medusa" (Fig. 23.9) is seen as a tangle of distended blood vessels around the stoma from the mucosa to the skin. A distinct bluish discoloration of the skin surrounding the stoma is visible. Typically, the skin beneath the faceplate becomes thinned and easily damaged. Sudden and massive hemorrhage that may be difficult to control may ensue and is compounded by abnormal coagulation parameters in such patients. Definitive control of the bleeding is difficult, as local pressure is only a temporizing measure. Cauterization of bleeding sites is rarely effective and may actually worsen the problem and result in ulceration. Suture ligation of individual bleeding sites is the mainstay of immediate treatment, but rebleeding of the varices is the rule rather than the exception. Injection of sclerosing agents, such as 5% phenol in almond oil or tetradecyl sulfate, has been advocated but rarely results in long-term control.[73–75] Disconnection of the mucocutaneous junction, placement of interlocking sutures around the circumference of the skin and mucosa, and rematuration is a reasonably effective approach in the short term, but blood loss during the procedure may be impressive, and additional vascular connections develop over the long term.[73,76,77] Relocation of the stoma is often necessary, but a new caput medusa may form in time.[77] Also, such patients are at a higher risk for any surgical intervention because of hepatic insufficiency. The most definitive therapy is to reduce the underlying portal hypertension with a transjugular intrahepatic portosystemic shunt (TIPS) or orthotopic liver transplantation.[71,78,79] Surgical portosystemic shunt procedures, once a mainstay in treatment of portal hypertension, are rarely performed in contemporary surgical practice. Mortality in these patients is directly proportional to the extent of the underlying hepatic disease, and although some authors prefer local therapy alone, most recommend addressing the portal hypertension with shunting (TIPS) as the most effective treatment with the lowest recurrence rates and the longest survival. However, treatment must be individualized based on the patient's condition and risk factors.[78–82]

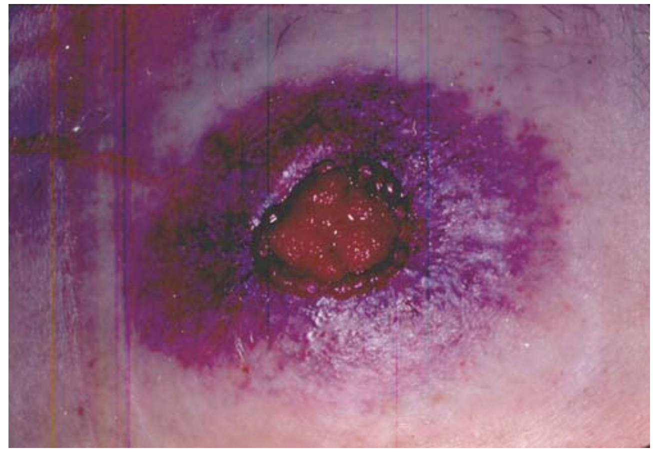

FIGURE 23.9. Peristomal varices (caput medusa) in a patient with portal hypertension.

Trauma and Perforation

Stomal trauma is a common occurrence. Although most blows and bumps to a stoma are well tolerated, occasional direct trauma may result in bleeding or swelling. Abdominal trauma may result in acute stomal prolapse or later herniation. Seat belts are the most common cause of direct trauma, but altercations and falls also account for a substantial percentage. A faceplate that is too small or incorrectly positioned may result in laceration of the stoma. Occasionally, psychiatric patients intentionally injure the stoma or attempt to amputate the stoma. Rare instances of using the stoma for sexual gratification have also been reported as a cause of trauma.

Perforation of a stoma is quite rare and has been described in the setting of forceful catheter insertion during irrigation, which may result in a localized, subcutaneous abscess and subsequent fistula or peritonitis if the perforation occurs below the fascia. A high index of suspicion must be utilized as emergent surgical repair is usually necessary.[4] Difficult endoscopic procedures through an ostomy, particularly if associated with a parastomal hernia, may result in trauma.

Abscess and Fistula

Parastomal abscesses in the early postoperative period have become rare since stomas are no longer placed in the primary abdominal incision. Late development of a parastomal abscess is primarily seen in patients with recurrent Crohn's disease and fistulization (Fig. 23.10). Localized, early postoperative abscesses may be drained through the mucocutaneous junction directly into the appliance. Abscesses associated with mesh repair of a parastomal hernia are treated by drainage of the septic focus and broad-spectrum antibiotics. Persistent infection requires mesh removal for complete resolution.

Parastomal fistulas occur in 1% to 2% of patients in large series and account for up to 15% of cases of stoma revision operations. The most common cause is recurrent terminal ileal Crohn's disease with transmural ulceration, abscess, and subsequent fistula formation. Another possible etiology is a tightly fit aperture in the stoma faceplate, which may erode into the bowel. Occasionally, a small fistula may be observed exiting adjacent to the mucocutaneous junction. Skin irritation and leakage from the appliance result when fistula output is substantial. Small volume fistula output can be simply collected in the appliance.

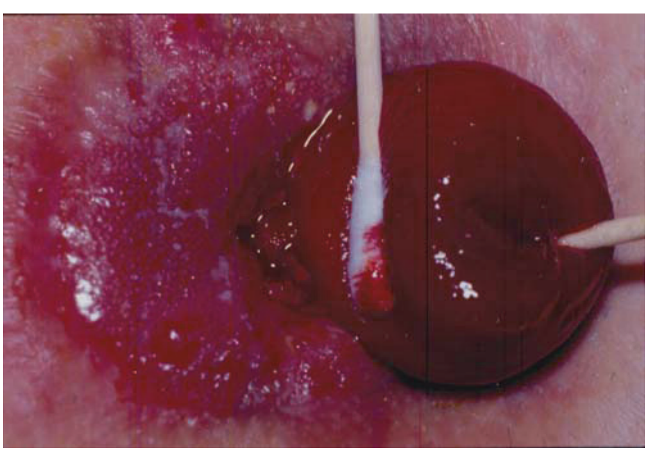

FIGURE 23.10. Para-ileostomy fistula and skin excoriation in a patient with Crohn's disease.

Symptomatic fistulas causing leakage and skin problems require surgical therapy, though successful treatment with fibrin glue have been reported. Fistula related to recurrent Crohn's disease at the stoma is best managed by resection and re-creation of the stoma. Relocation of the stoma may be necessary in patients with concomitant parastomal hernia and severe skin excoriation. Greenstein[83] at Mt. Sinai Hospital in New York identified 15 patients with a para-ileostomy fistula. All had active recurrent disease as the etiology of the fistula and all required surgical resection.

Obstruction

Occurring in up to 14% of patients, intestinal obstruction is most commonly due to an incarcerated parastomal hernia or intraabdominal adhesions.[84–87] Intestinal blockage may also be due to recurrent Crohn's disease or metachronous carcinoma, radiation enteritis, or a tight fascial opening causing an outlet obstruction. In general, adhesions are usually more severe after peritonitis or extensive and repeated surgical procedures, although the extent is quite variable and difficult to predict. Also, progression to obstruction does not correlate with extent of adhesions. Adhesive bowel obstruction is more common in patients with inflammatory bowel disease than in patients with carcinoma. A few authors advocate closing the parastomal space by suturing the mesentery to the abdominal wall to prevent volvulus around the stomal limb, although there are no data showing any benefit.[5,11]

Management of ostomates with intestinal obstruction is identical to those without a stoma. Nonoperative management with bowel rest, nasogastric suction, and fluid resuscitation results in resolution of the obstruction in 50% to 60% of patients. A closed loop obstruction, perforation, intestinal ischemia, and failure of nonoperative therapy warrant surgical exploration.[18] Outlet obstruction caused by fibrous or poorly digested foods may be broken up with gentle irrigation, digital manipulation, or endoscopy.

Parastomal Pyoderma Gangrenosum

A rare cutaneous disorder, pyoderma gangrenosum is thought to be caused by an autoimmune mechanism (Fig. 23.11). The majority of cases are in patients with inflammatory bowel disease, but it may be seen in patients with cancer, hepatitis, Hodgkin's disease, rheumatoid arthritis, and hematologic disorders. Pathologically, pyoderma gangrenosum is characterized by ulcers with dermal neutrophilia. It usually occurs on the extensor surfaces of the extremities, most commonly in the pretibial region, but is also seen along incisions, in areas of trauma, and around stomas.[88,89] First reported in the dermatologic literature by 1930 and later in patients with inflammatory bowel disease, it accounts for about 50% of chronic parastomal ulcers.[90–92] The true incidence of pyoderma gangrenosum in ostomy patients is difficult to estimate, as only limited numbers have been reported and many may have been missed. In

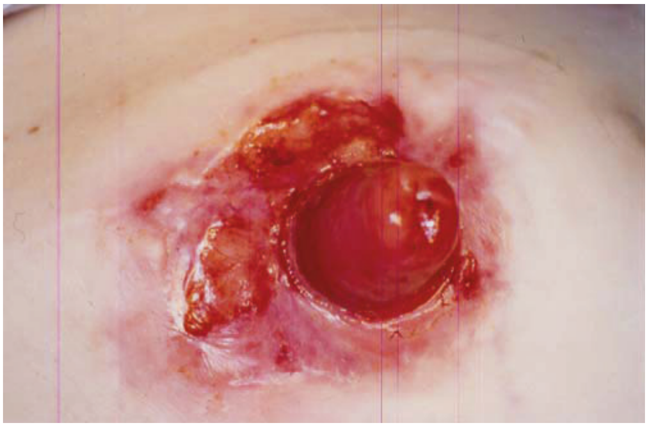

FIGURE 23.11. Pyoderma gangrenosum associated with a Brooke end ileostomy.

most reports, the incidence is approximately 0.6%.[93–97] The development and persistence of pyoderma gangrenosum appears to be related to ongoing inflammatory bowel disease, and as such, control of proximal inflammatory disease, medically or surgically, often results in remission of the pyoderma. Yet, it may occur in patients with an ileostomy following total proctocolectomy. It is likely that this process is a reflection of an ongoing systemic autoimmune process and that the skin is an end-organ that responds variably to this stimulus.[98]

Peristomal pyoderma gangrenosum may begin anywhere from 2 weeks after stoma creation to many years later. Clinically, the process begins with pain, erythema, and tenderness, which make it difficult to differentiate from other skin conditions. Lesions start as small pustules but quickly break down and form violaceous ulcers within hours to days. These serpiginous ulcerations may coalesce into large areas of suppurative breakdown. The lesions are sharply demarcated and may appear punched out with erosion under the edges. Once the ulcers form, the correct diagnosis is made more easily. The ulcers are painful, produce a discharge, and typically become secondarily colonized with bacteria.[96,99–101]

Treatment of parastomal pyoderma gangrenosum is three-pronged: local treatment of the ulcers, controlling stoma function, and systemic therapy as needed. Surgery is reserved for failure of medical therapy. The weeping wounds and pain make it difficult to maintain an appliance, and the appliance makes it difficult to frequently access the wounds for care. Local treatment includes wound care, topical agents, and local injections. Management of the appliance is often challenging, and the services of an experienced and resourceful enterostomal therapist are invaluable. Small ulcers may be treated with a topical agent, covered with a small, nonsticking, thin pad with the faceplate placed on top. The dressing and appliance may have to be changed daily for some time. Larger ulcers may produce copious discharge and preclude the use of an adherent faceplate. They may be managed with larger dressings and nonstick appliances held in place with a belting system. This is only effective when the stoma protrudes adequately. Flat or retracted stomas usually require revision. Occasionally the process is so extensive that a period of in-hospital treatment may be necessary. The Lahey Clinic protocol includes Domeboro compresses, disodium cromoglycate to decrease the local inflammatory process, and topical steroids each applied twice daily. [102,103]

Local wound care includes gentle debridement by washing, wiping, curettage, and hydrophilic dressing. A variety of topical agents have been used including antibiotic ointments, corticosteroid creams, Desitin ointment (Johnson & Johnson Consumer Products), and 0.5% nicotine cream.[104] Topical tacrolimus (0.3% in carmellose sodium paste) has been one of the more effective local immunosuppression agents, and we have had excellent results with it.[105,106] Intralesional injections of steroids such as triamcinolone have been variably effective.[107] Systemic steroids remain the mainstay of treatment and may be administered orally or intravenously, depending on the severity and result in remission of pyoderma gangrenosum in two thirds of patients.[97,101,103] Other systemic medications that are currently used widely include cyclosporine and infliximab (Remicade). [108–110] A recent report described two complex patients treated with intravenous immunoglobulins with good response. [111] Surgical therapy involving stomal revision or relocation is reserved for recalcitrant pyoderma gangrenosum, but does not always result in resolution of the local process. The pyoderma gangrenosum may recur at the new ostomy site.[108] In a series from Mt. Sinai Hospital in New York, five of nine patients with inflammatory bowel disease healed within 2 months of surgery, while the rest were very slow to heal, if at all.[95] Other series have shown very poor responses to surgery. [97] Pyoderma gangrenosum recurs in up to 70% of patients.[93,108]

Miscellaneous Problems

Mucosal Implantation

During ostomy maturation, sutures placed from the intestinal mucosa through the skin may provide a tract for mucosal cells to implant into the skin. The discharge leads to severe peristomal skin irritation and pouch leakage. Thus, the importance of suturing the intestine to the subcutaneous layer is critical in preventing this complication. [112] Attempts at local treatment with silver nitrate or electrocautery often fail, as the mucosa regenerates quickly from the deeply lined suture tract. Surgical revision with excision of the tract or even relocation of the stoma may be necessary. The best treatment is prevention by using proper surgical technique.

Fungal Infections

Overgrowth of *Candida* species under the faceplate is common, as a moist, warm environment provides an ideal culture medium. The skin becomes pruritic and erythematous (Fig. 23.12). Pustules develop quickly and degenerate into small ulcers. This condition is often recognized early and is easily treated by the application of nystatin (Mycostatin) powder to the peristomal skin immediately prior to applying the faceplate.

FIGURE 23.12. Ileostomy with *Candida* infection of the surrounding skin.

Allergic Reactions

Contact dermatitis may be due to any substance that comes in direct contact with the skin.[113–115] Adhesives and tape including those on and around the faceplate are the usual culprits (Fig. 23.13). The visual distribution of the area of erythema will be a strong indicator of the etiology. Occasionally the plastic bag will adhere to the skin and incite inflammation. Eliminating the offending material and treatment with a topical steroid such as Kenalog in a cream or spray form will generally resolve the problem. Severe reactions may require antihistamines and oral steroids.[116]

FIGURE 23.13. Dermatitis and reaction to tape around a stoma.

High-Output Ostomy and Dehydration

High ileostomy output was the rule in the early postoperative period in the days when stomas were not primarily matured. This was because of the severe serositis that invariably developed on the exposed bowel serosa. This was known as *ileostomy dysfunction*.[22] Subsequent spontaneous or delayed maturation often also resulted in stenosis, which could contribute to high output because of partial obstruction. This is much less of a problem now with primary maturation, yet dehydration, especially in ileostomy patients, is still a common event.[23,117] This may be due to gastroenteritis, ongoing underlying disease such as Crohn's disease, partial obstruction due to stenosis, a tight ostomy outlet through the abdominal wall, or proximal location of the ostomy in the small bowel. Contributing factors include ileus, bacterial overgrowth, radiation enteritis, adhesions with partial obstruction, and intraabdominal infections. More proximal small intestinal stomas are at an increased risk of dehydration due to high-volume output. This is a common problem in patients with short bowel syndrome due to ischemia or Crohn's disease.[118–120] Patients undergoing an ileal pouch procedure may have a proximal loop ileostomy. Since the distal ileum is fixed in the pelvis and the mesentery may be pulled straight down with little slack, it may be difficult to get a loop of distal ileum to reach the skin. Therefore, a more proximal ileal loop may need to be used, which may result in an ileostomy with high output.[121]

Treatment involves addressing the underlying condition such as Crohn's disease, strictures, or bacterial overgrowth. Oral rehydration solutions, dietary manipulation, antimotility agents, fiber supplementation, bile-acid binding agents (cholestyramine), somatostatin analogues (octreotide), and even narcotics may be used to reduce the ileostomy diarrhea. Surgical management of Crohn's disease or strictures may be necessary, though the best option is closure of temporary ostomies whenever possible.[122–126]

Stomal Polyps and Carcinoma

Mucosal or mucocutaneous stomal polyps are rare and often due to lymphoid hyperplasia (Fig. 23.14). Adenomatous polyps may be found on or in the stoma, particularly in polyposis patients. Pseudopolyps are found in patients with inflammatory bowel disease.

Carcinoma of an ostomy is exceedingly rare. Most articles describe single cases. Adenocarcinoma may develop at a colostomy as a primary tumor, as a metachronous lesion, or as a manifestation of carcinomatosis and disseminated disease.[127–132] Carcinoma at an ileostomy may develop for similar reasons, as well as in patients with familial polyposis.[133] Squamous cell or basal cell carcinomas at an ostomy are even more rare. Patients with Crohn's disease may have a slightly higher risk, although it is difficult to quantify because of the very low overall incidence.[134,135]

FIGURE 23.14. Lymphoid hyperplasia in a patient with an ileostomy.

Treatment involves proper staging to determine if the recurrence is solitary or part of a disseminated process. Physiologically fit patients with an isolated recurrence are candidates for surgical resection with wide excision of the stoma, adjacent abdominal wall and mesentery, and relocation of the stoma. Nonoperative management with optimal medical care is appropriate for patients with widely disseminated metastases or those unable to physiologically tolerate a major surgical procedure.

Conclusion

Although permanent ostomies are becoming less common, they are still occasionally necessary. Temporary ostomies including loop ileostomies and colostomies, divided ostomies, and Hartmann procedures are still used quite often. The construction, care, and closure of stomas are of major concern for the surgeon, and despite substantial advances in enterostomal therapy, stomal complications are common. Appropriate preoperative preparation and postoperative support are necessary for all patients undergoing ostomy surgery. Early referrals to an enterostomal therapy nurse and the visitors' program of the local ostomy association are helpful.

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Reoperative Pelvic Surgery for Late Bowel Obstruction (After 30 Days)

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Whereas the focus of much of the literature is on early return of postoperative bowel function and methods to minimize early bowel obstruction, late bowel obstruction continues to be a major source of morbidity. In general, postoperative bowel obstruction can be divided into two broad categories: early and late. Early postoperative bowel obstruction is defined as onset of symptoms within 30 days of surgery. The majority of early postoperative bowel obstructions are due to adhesions—up to 90% in some series[1]—with the remaining possible etiologies including ileus, phlegmon, intraabdominal abscess, Crohn's disease, hernia, volvulus, intussusception, and malignancy.[1,2] Late obstructions are those presenting at any point later than 30 days following surgery. The management of late bowel obstruction remains a significant burden to health care costs. In 1994, according to Beck and colleagues,[3] there were 303,836 hospitalizations during which adhesiolysis was performed, accounting for 846,415 inpatient days and an estimated $1.3 billion in expenditures. In addition, reoperative pelvic surgery in the setting of late bowel obstruction can prove to be significantly challenging, both in diagnosing the underlying etiology and even more so with subsequent surgical management. To safely and effectively manage these patients, one must have an extensive understanding of the various conditions that may result in late bowel obstruction. This chapter provides a systematic approach, including salient diagnostic and operative strategies to improve the surgical outcomes, while rendering as little morbidity and mortality as possible when confronted with this difficult clinical situation.

Differential Diagnosis and Diagnostic Workup

The differential diagnosis in postsurgical patients with late bowel obstructions encompasses many different and widely varying conditions. Differentiating between those that are benign causes versus malignant in origin may help initially in patient counseling, obtaining proper diagnostic studies, and determining overall prognosis. Benign etiologies may include adhesions, endometriosis, incarcerated hernias, inflammatory bowel disease, infectious sources, strictures, and radiation-induced obstruction. Similarly, severe electrolyte abnormalities such as hypokalemia and hypomagnasemia may cause acute obstructive-like symptoms from an ileus rather than mechanical means. Malignant obstruction may result from intrinsic bowel processes such as recurrence of previous cancer, development of a new primary tumor, or extrinsic luminal conditions such as those triggered by diffuse carcinomatosis from metastatic spread of disease.

A thorough history and physical examination can help distinguish some of the benign causes of obstruction. For example, the history in a patient with Crohn's disease or prior radiation therapy can provide just as many clues as to the etiology of the obstruction, such as possible stricture, as an obvious hernia detected on physical examination. Although the most common cause of intestinal obstruction in the United States in patients with prior abdominal surgery is postoperative adhesions, the surgeon should perform the same evaluation as when examining those with a virgin abdomen. Regardless of the underlying cause, the majority of obstructed patients will present with nausea, vomiting, crampy abdominal pain and even occasional weight loss. As patients often present with concomitant dehydration and electrolyte abnormalities, admission with appropriate fluid resuscitation and correction of electrolyte abnormalities should occur while the workup is in progress.

In patients with malignancy, the diagnostic workup can be more difficult, as concomitant factors often confuse and even obscure the underlying cause. Whereas the etiology of their obstruction may be as simple as adhesive disease, this might also represent radiation enteritis from prior therapy, local recurrence of malignancy, anastomotic stricture,

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carcinomatosis, or metastatic disease.[4] General history and physical examination remain paramount, as does the need for ongoing resuscitation. However, the evaluation of a patient with history of prior cancer should also include tumor markers (when appropriate) and diagnostic imaging including computed tomography (CT) scan, CT/positron emission tomography (PET), or magnetic resonance imaging (MRI). Colonoscopy provides a useful diagnostic tool not only in the patient with prior gastrointestinal malignancy, but also to exclude a new primary tumor, and it can occasionally aid in the diagnosis of extrinsic processes impinging on the bowel. If there is an anastomotic stricture or new lesion present, biopsies should be obtained at the time of colonoscopy to help distinguish between a malignant and a benign process. This is especially important in patients with underlying inflammatory bowel disease, where it is often very difficult to differentiate malignant from benign strictures on a strictly clinical basis; yet malignancy may be present in up to 7% of colonic strictures.[5] According to Ketcham et al.,[6] one of every four patients with cancer who present and are explored for intestinal obstruction will have either a new primary cancer or nonneoplastic disease as the source of obstruction. Therefore, it can be hazardous to assume a patient with history of cancer has recurrent or metastatic disease as the etiology of the bowel obstruction; this highlights the need for a thorough workup prior to proceeding to the operating room, should the patient's clinical state allow.

Unless there are true indications for urgent operative intervention, the majority of these patients will be admitted for nasogastric decompression, intravenous fluid resuscitation, correction of any electrolyte abnormalities, and serial abdominal examinations. Plain film radiographs may confirm dilated small bowel loops with stair-stepping air-fluid levels, but usually do not assist with defining the underlying etiology. Despite the frequent use of plain abdominal radiographs, numerous studies report their poor sensitivity in diagnosis of small bowel obstruction, ranging from 13% for low-grade obstruction to only 50% to 60% for high-grade obstructions.[7–9]

According to Megibow et al.,[8] CT is the optimal radiologic test for patients with a history of abdominal malignancy and clinical symptoms suggestive of bowel obstruction. In their group of patients with a clinical diagnosis of bowel obstruction, they found CT scans to have an overall sensitivity of 94% and specificity of 96%, and the cause of obstruction was correctly diagnosed in 73% of patients. In this same group of patients, the diagnosis of small bowel obstruction by category of disease included adhesions, primary and metastatic neoplasm, Crohn's disease, hernia, diverticulitis, intussusception, gallstone ileus, and appendicitis—thus emphasizing the wide variety of causes. Yet, CT scan was nearly 100% accurate in specifying the etiology in all categories except Crohn's disease. In addition, CT also gives anatomic information outside of the bowel wall itself that may help with accurate diagnosis. Caution should be used in giving oral contrast for the patient with high-grade partial or complete obstruction, and in general, should be avoided.

When the degree of severity of an obstruction is factored into the overall accuracy of CT scan in diagnosing small bowel obstruction, the sensitivity varies from 48% for low-grade to 81% to 94% for high-grade small bowel obstruction.[7,8,10] Based on criteria described by Fukuya et al.,[7] Megibow et al.,[8] and Maglinte et al.,[10] when no mass or apparent cause is noted at the transition point from dilated to nondilated small bowel, then CT has accuracy rates of up to 73% in predicting adhesions as the etiology of obstruction.[8] If large bowel obstruction is suspected, CT may still play a role providing additional information; however, contrast enemas are often useful adjuncts to evaluate the degree of patency and mucosal abnormalities, and to rule out recurrence or volvulus.

Although CT remains the workhorse imaging modality, MRI can be very useful when distinguishing postoperative or radiation-induced fibrosis from recurrent malignancy. On T2-weighted images, recurrent malignancy normally appears as a medium- to high-intensity signal, in contrast to a fibrous reaction, which shows a low-intensity signal.[11] Dicle and colleagues,[12] however, disagree with this data, stating that the use of routine contrast-enhanced MRI cannot discriminate between benign and malignant lesions, and they recommend *dynamic* MRI. They describe several benign lesions such as radiation-induced inflammation, granulation tissue, hygrogmas, and hematomas as having a high intensity on T2 imaging, and certain malignancies such as desmoplastic or hypovascular tumors might have intermediate intensity, giving a false-negative result. Due to examples such as these, they determined that standard contrast-enhanced MRI was inferior to dynamic MRI, although the two modalities were not directly compared. Dynamic contrast-enhanced MRI acquires a sequence of images using gradient echo during a bolus of contrast and allows one to observe changes in tissue perfusion over time. This modality differs from the standard "static" contrast-enhanced MRI, which acquires images before and then after a bolus of contrast has been given. When Dicle et al. prospectively evaluated the accuracy of dynamic contrast-enhanced MRI to differentiate between recurrent rectal carcinoma and benign scarring, they found a sensitivity of 83%, specificity of 92%, and accuracy of 89% using this technique. Yet, these differences in opinion may simply reflect the experience of the radiologist along with the quality of examination.

Muller-Schimpfle and colleagues[13] also reported on the use of dynamic MRI using pharmacokinetic mapping to assist in diagnosis of recurrent rectal cancer versus benign findings, reporting a sensitivity of 91% to 100%, specificity of 29% to 43%, and accuracy of 71% to 75%. Regardless of the imaging findings, however, if recurrent malignancy is suspected, tissue should be obtained for histologic analysis. This can be done by either endoscopic or image-guided means (ultrasound or CT-guided). Even in patients who have undergone an abdominoperineal resection and have a pelvic/presacral abnormality, prior to CT-guided biopsy a transvaginal ultrasound (females) can be used to evaluate the presacral and pelvic area.[14]

When standard imaging fails to delineate normal postoperative changes from possible recurrent disease, and the suspicion for malignancy remains high because of elevated tumor markers, there are additional adjuncts that can assist with diagnosis. These include PET scan and PET/CT scan. Multiple studies have shown PET scan to be very accurate in the staging of primary and recurrent colorectal cancer with sensitivities of 93% to 100% in tumor detection and accuracy of up to 85% when PET is combined with CT.[15,16] Despite these seemingly terrific results, there are several limitations of PET scan alone, including inability to detect small volume disease <1 cm, confounding findings in pelvis due to urinary activity, false-positive results in patients with inflammatory processes (due to fluorodeoxyglucose [FDG] uptake in leukocytes and macrophages), and inaccurate anatomic localization (when PET is used alone).[16,17] Dual PET/CT scanners, which fuse together the anatomic abnormalities seen on CT scan with the functional information gained by PET scan, have alleviated some of these concerns. Cohade and colleagues[15] directly compared PET and PET/CT imaging in patients with colorectal cancer and found a significant increase in lesion localization and characterization along with an increased accuracy in staging colorectal cancer—78% with PET up to 98% with CT/PET. In a recent study from Japan, PET/CT fusion was shown to have diagnostic superiority in accurately detecting recurrent colorectal cancer.[18] In this study, PET, CT, and PET/CT images were each separately evaluated with the primary outcome as the ability to detect recurrence, metastasis, or both. They found the sensitivity of detecting recurrent lesions to be 93% using PET/CT versus 63% for CT alone and 71% for PET alone ($p < .01$).[18] With ever-evolving technology and improved imaging, the standard treatment in the near future may have all patients presenting with the possibility of a new or recurrent malignancy undergoing PET/CT.

Preoperative Considerations

Prior to embarking on an operative procedure that may be both daunting for surgeon and patient alike, there are some important points to consider that may play a role in both patient counseling and preparation.

Distorted Anatomy and Loss of Normal Tissue Planes

Although well known, it is often understated how the basic anatomy of the pelvis plays such a major role in the complex nature of these patients. The bony pelvis is a fixed cavity that contains multiple different organ systems including gastrointestinal, urologic, and gynecologic organs as well as vital vascular and nervous structures, all in close proximity to one another. Especially for those surgeons not accustomed to operating in the pelvis, yet even for seasoned pelvic warriors, a thorough knowledge of normal anatomy is absolutely necessary when dealing with reoperative pelvic surgery. To navigate safely in a reoperative field, one should not only understand where things should normally lie, but also be aware of and predict possible changes in anatomic structures following initial surgical exploration. Depending on the prior surgery, one may encounter distorted fascial planes, thick adhesions, or walled-off fluid collections—all of which make identification of normal anatomy quite difficult. There may be loops of small bowel fixed to the bony pelvis or entangled and intertwined among themselves, creating a Gordian knot–like configuration, so that the surgeon must weigh the risk of creating multiple enterotomies during mobilization versus that of causing short bowel syndrome with extensive resection. It is important to understand that one may also encounter normal anatomy but in ectopic positions; for example, the ureters may be located in a more medial position after mobilization of the sigmoid and rectum. Also prior to embarking on any reoperative procedure, a thorough review of the prior operative report(s) may demonstrate details that will allow surgeons to prepare in advance for things they may encounter. Knowledge of any prior postoperative complications such as anastomotic leaks, pelvic abscesses, or prior postoperative radiation therapy is also important, as all of these will increase the likelihood of adhesive disease, distorted fascial planes, and difficult surgery.

Potential Pitfalls and Complications

The timing of reoperative pelvic surgery is important, with the optimal window for reexploration anywhere from 3 to 6 months—a period marked by less vascular and easier to manage adhesions. If the patient has a prior history of pelvic sepsis or radiation therapy, the ideal interval for reembarking on elective surgery may be even longer, from 6 months to 1 year. Enterotomies are only one possible complication encountered during reoperative pelvic surgery. Because of these adhesions and distorted anatomy, reoperative surgery often entails long operative times. Therefore, it is important to ensure the patient will tolerate general anesthesia for this length of time. With this in mind, if the patient's clinical condition will allow, all patients should undergo preoperative workup and optimization from a cardiovascular and general medical standpoint. Also important in postoperative recovery and healing is nutrition. This can be a major issue in a patient with recurrent malignancy, especially a cachectic patient. Although nutrition can often be a difficult parameter to improve upon, especially when dealing with bowel obstruction, parenteral nutrition should be considered preoperatively in the setting of severely malnourished patients and postoperatively if the length of nothing per oral status will be greater than 1 week.

The Veterans Affairs TPN (total parenteral nutrition) Cooperative Study group evaluated TPN in surgical patients and found more infectious complications in surgical patients given TPN in the setting of normal or mildly malnourished state. The only benefit seen was in those patients severely malnourished, defined as either a serum albumin less than 2.7,[19] or a Nutrition Risk Index (NRI) of less than 83.5 {NRI = 1.519 × the serum albumin level [in grams per liter] + 0.417 × [current weight/usual weight] × 100}.[19,20] According to Braga and colleagues,[21] the best approach to malnourished cancer patients is to feed enterally with formulas that have been supplemented with arginine, omega-3 fatty acids, and glutamine, which all help modulate immune and inflammatory responses and provide overall improved intestinal function. They found a 10% versus 27% rate of complication in the supplemented group when compared to controls ($p < .05$). In the severely malnourished, as defined above, the rate of complications dropped from 39% to 14% with the addition of immuno-supplements.[21] These data concur with the present-day belief that the best approach to feeding is enteral, when possible, and formulas rich in arginine, glutamine, and omega-3 fatty acids may provide additional benefit to severely malnourished patients with cancer.

Preoperative Adjuncts

As stated before, important to a successful operative intervention is the surgeon's having a thorough knowledge of prior surgeries and postoperative courses. Obtaining previous operative reports and hospital summaries can be quite helpful when preparing for operative intervention. Knowing whether the patient has had difficulty with anesthesia or experienced a prior perioperative complication such as pulmonary embolism or myocardial infarction will allow the surgeon to identify those at risk and provide optimal preparation before embarking upon a difficult surgery. Evaluation by internal medicine, cardiology, or pulmonology services ahead of time may also prevent future perioperative complications.

In patients with a history of abdominal malignancies, tumor markers may assist the surgeon in preoperative planning and counseling. For instance, an elevated carcinoembryonic antigen (CEA) or CA-125 may suggest malignancy and place this diagnosis higher on the differential diagnosis and prompt additional preoperative testing, such as PET/CT to further characterize the etiology of the obstruction. When patients have a prior history of colorectal carcinoma, preoperative CEA should be obtained and, if possible, correlated with previous levels. According to Libutti and associates,[22] 70% of all patients with recurrent disease have elevation in their CEA levels. Sixty to ninety percent of those patients who present with increased CEA and no detectable disease on preoperative CT imaging have recurrent disease at laparotomy. In addition, in 75% of cases of recurrent colorectal cancer, the CEA level rises prior to clinical evidence of recurrence.[23] Thus CEA may provide one marker useful for earlier detection of recurrence. Yet, it is important to remember that while CEA is a valuable marker for recurrent or metastatic disease, it has not been shown to correlate readily with overall prognosis or survival.[24]

In addition to the diagnostic workup, the surgeon should also plan ahead to minimize morbidity in the operating room. Ureteral stents are felt to be invaluable by many surgeons when operating in a hostile abdomen or pelvis. Although they have not been shown to prevent injury, they are very helpful when trying to identify the ureters in a reoperative field, thus decreasing operative times, and identifying any injuries intraoperatively. Bothwell et al.[25] performed a 5-year retrospective review of patients undergoing sigmoid or rectosigmoid colon resections in an attempt to evaluate the role of prophylactic ureteral catheter placement. Of 561 patients, 16.4% had ureteral catheters requested by the operative surgeon and the remaining 83.6% had no catheter placed. Although this was not limited specifically to reoperative surgery, the authors found no difference between the groups, with only two patients from each cohort sustaining a ureteral injury. Not surprisingly, they also found additional costs for ureteral catheter placement to exceed $2000 per operation, thus calling into question the routine placement. They did, however, conclude that placement of ureteral stents should be reserved for those at high risk for iatrogenic ureteral injury—specifically, complicated diverticulitis with perforation or fistula formation, previous pelvic surgery or irradiation, and large invasive rectosigmoid malignancies. We agree with their assessment and routinely place bilateral stents for repeat pelvic exploration, while recognizing the potential for rare injury from placement, as well as the increased cost.

Operative Technique

Positioning of the patient is crucial to a successful outcome. Our preference is to have access to the perineum; therefore, we routinely place patients in low lithotomy position with the arms tucked along the patient's side with palms facing inward. Nerve damage is the second most common complication represented in the American Society of Anesthesiologists (ASA) Closed Claims Database, with ulnar neuropathies being the most common followed by brachial plexus injuries.[26] To avoid ulnar nerve injury, the elbows and hands must be appropriately padded. In similar fashion, placing a thin gel pad beneath the sacrum will assist in avoidance of decubitus formation during prolonged cases. Low lithotomy position allows the surgeon access to the perineum and maintains all available management and therapeutic options, such as proctoscopy or colonoscopy, while providing the required access for a more radical dissection to be completed if the need arises. Having access to the vagina can prove invaluable when discerning pelvic anatomy in the setting of dense adhesions. Dilators or other long blunt instruments can be placed transvaginally to help identify the vaginal cuff or move the uterus out of the way. We also prefer patient placement on a beanbag to allow for steep positioning adjustments to aid in visualization.

Exposure is paramount in visualizing anatomy and proceeding safely through the exploration. There are several retrospective studies looking at the safety of laparoscopy in the setting of acute small bowel obstruction. Most recently, Khaikin et al.[27] showed that laparoscopy can be successful in 55% of patients with acute adhesive small bowel obstruction, despite a 32% conversion rate to open laparotomy. The numbers of previous operations, episodes of small bowel obstruction, duration of symptoms before admission, ASA score, and body mass index (BMI) did not affect the need for conversion. The authors reported considerably less complications and no mortality in the laparoscopic group compared to one mortality and various complications in the laparotomy group. Despite their reported success, the surgeon needs to be aware of the potential for dense adhesions limiting the exposure and safe dissection with laparoscopy and increasing the risk of inadvertent bowel or vascular injury with access, especially in the patient with late bowel obstruction. In one of the largest series, the rate of intestinal perforation during laparoscopy was 15.6% and, although not statistically significant, the rate of peritonitis from unrecognized or secondary perforation was 8.5% in the nonconverted group versus 2.7% in the converted group.[28] Therefore, extra emphasis should be placed not only on safe dissection, but also on proper evaluation of any possible enterotomies, including converting to laparotomy when indicated.

Bhoyrul et al.[28] analyzed all the reported complications from trocar insertion during 1993 to 1996 and divided them into three categories: major vascular injury, visceral injury, and abdominal wall hematoma. Major vascular injury from either trocars or Veress needles occurred in from 0.1% to 0.22%, with the iliac vessels being the most common vessel injured. Although advocated by some, the authors found that safety-shielded and direct-view trocars do not prevent major vascular injury. More importantly, stabilization of the abdominal wall with towel clamps while inserting the trocar or using an open Hasson technique (especially in the patient with a known aortic aneurysm, pregnant uterus, or any mass close to the anterior abdominal mass) may lead to decreased iatrogenic injury. Several factors have been identified as predictors of conversion to open exploration and include duration of surgery greater than 120 minutes ($p = .001$) and diameter of the small bowel greater than 4 cm.[29] When bowel necrosis or malignancy is encountered, then conversion to laparotomy is suggested, especially for those less experienced with advanced laparoscopic techniques.[29] Most often a generous midline incision is then required and may need to be extended all the way to the pubis. A self-retaining retractor should be utilized in order gain maximal exposure and free up the hands of the surgeon and assistant. The pelvis is often very narrow, especially in males, and proper lighting may be difficult with the standard overhead lights. Head lamps and lighted retractors, when available, can be quite helpful.

Defining anatomy and delineating safe tissue planes are often the most difficult parts of reoperative surgery. As stated, inadvertent enterotomies with spillage of enteric contents add to operative morbidity and increase the risk of postoperative enterocutaneous fistula formation, wound complications, and sepsis. To avoid such complications, one should attempt to enter the peritoneal cavity in virgin territory—away from prior scars. When the previous incision extends from the xiphoid process to the pubis and there is no easily accessed entrance point, embarking through the scar in the upper portion of the midline incision tends to be a safer avenue into the peritoneal cavity. Rather than having dilated loops of small bowel lying beneath the incision, the liver or stomach is more likely encountered, lessening the risk of inadvertent enterotomies. Although transverse and chevron incisions have been advocated and have purported advantages, such as decreased pain, they do risk taking away a potential site for future stomas, especially in patients who often require multiple abdominal operations such as for Crohn's disease. Adhesiolysis can often require a significant amount of operative time; therefore, it is important to rely on the basics of surgical technique: work from defined anatomy, maintain a broad front with tension/countertension, and maintain meticulous hemostasis during dissection. Depending on one's comfort level and training, adhesions can be divided by several different means: electrocautery, or sharply with scissors or a scalpel. Regardless of the decision to perform an open or laparoscopic approach, it is often easier to begin with decompressed bowel and progress toward the dilated proximal bowel. Finally, any enterotomy should be repaired in a transverse fashion so as not to narrow the bowel.

Specific Situations and Management

Malignant Bowel Obstruction from Local Recurrence or Carcinomatosis

Although malignant bowel obstruction secondary to recurrent cancer or carcinomatosis is often a sign of end-stage disease and typically portends a very poor survival, patients have been shown to benefit from operative intervention. Lau and Lorentz[30] reviewed a small group of patients who had advanced, unresectable colorectal cancer causing malignant bowel obstruction. All of these patients were nonresponsive to conservative therapy and all underwent exploratory surgery to relieve their obstruction. In their series, the most common palliative procedure was intestinal bypass, with 63% of patients having return of bowel function after surgery and 57% of patients able to be discharged home after surgical palliation. They found a morbidity and mortality rate of 27% and 17%, respectively. Morbidity ranged from minor wound infections to abdominal sepsis from anastomotic leaks, myocardial infarction, aspiration, and pneumonia. Mortality occurred in one of each of these categories except wound infection. Despite the risks, given their overall trend towards successful outcomes, the authors advocate surgery in all but the terminally ill.

Miller et al.[31] compared operative to nonoperative therapy in patients with small bowel obstruction secondary to malignant disease. They found a 15% higher reobstruction rate in the nonoperative group and a much quicker time to reobstruction with conservative nonoperative therapy (10 weeks vs. 63 weeks; $p < .05$). In their series, predictors of poor outcome included shock, ascites, and palpable abdominal mass. They concluded that patients receive benefits in both survival and quality of life when operative therapy is chosen for malignant bowel obstruction. They suggest an algorithm such that patients with ascites, abdominal mass, and shock undergo percutaneous endoscopic gastrostomy (PEG) with or without intravenous nutritional support along with pain control. Patients with none of the stated risk factors should undergo a 5-day trial of conservative therapy with nasogastric tube decompression and discharge to home if resolution occurs. For the nonresponders operative intervention is recommended.[31]

Several retrospective studies have looked at patients who present with carcinomatosis and malignant bowel obstruction to determine the best diagnostic and

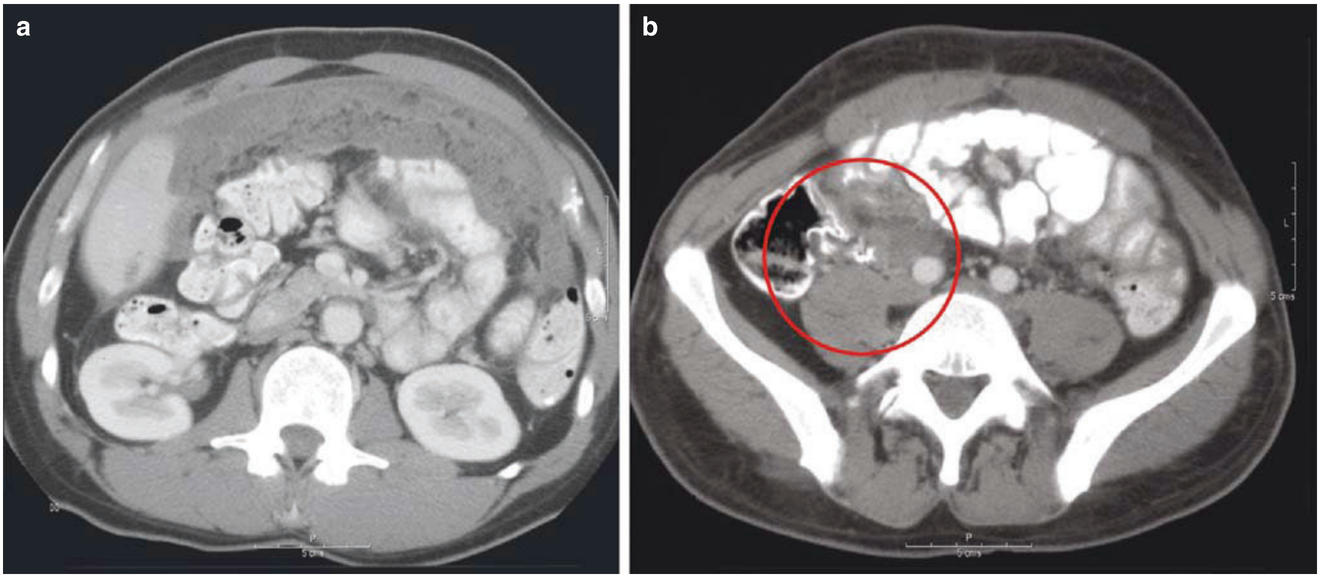

FIGURE 24.1. Extensive carcinomatosis. (**A**) Omental caking from colorectal carcinoma. (**B**) Carcinomatosis at the terminal ileum as depicted by the *red circle*.

therapeutic approach. Blair et al.[32] identified two independent predictors of palliative surgery failure: level of obstruction and presence of ascites. When obstructions involved the small bowel, the hazard ration was 6.4 (p = .009) towards failure, and ascites correlated with a hazard ratio of 5.2 (p = .03). Others have shown that the underlying condition can play a role in the failure of embarking on palliative surgery. Carcinomatosis from ovarian cancer has been shown to have inferior results from palliative surgery when there is a palpable mass, >3 L of ascites, multiple sites of intestinal obstruction, and a preoperative weight loss of >9 kg.[33] When pursuing surgical exploration, it is important to keep in mind all of the different options, including bowel resections with anastomoses, intestinal bypass, creation of stoma, lysis of adhesions, placement of gastrostomy or jejunostomy tubes, or any combination of these. Unfortunately, there are times that the carcinomatosis is so extensive (Fig. 24.1) that the only option is to open and close in order to avoid extensive iatrogenic injury.

Reversal of Hartmann's/Stoma Closure

Reversal of a Hartmann's procedure carries with it significant morbidity, including anastomotic leak, intraabdominal abscess, and postoperative ileus, as well as significant risk of mortality—up to 28% in some series—that is likely higher than most may recall.[34] In attempt to lessen the risk of morbidity, the timing of Hartmann's reversal has been a much debated topic in the literature, although the majority of studies describe completing a Hartmann's reversal procedure within 3 to 6 months.[34] Keck et al.[35] compared early with late (defined as less than or greater than 15 weeks, respectively) Hartmann's reversal. Although they did show a higher mean adhesion density grade and more frequent injury to the small bowel in the early group, they found no difference in the rate of mortality, morbidity, or anastomotic leak rates between the two groups. They describe three separate areas of operative difficulty that one encounters during reversal of a Hartmann's procedure, the first being lysis of adhesions, followed by identification and mobilization of the rectal stump, and finally performing the colorectal anastomosis. Common suggestions to assist in identification of the rectal stump include placement of long, nonabsorbable sutures or creation of a mucous fistula at the time of creation of the Hartmann's pouch, or passage of an anal dilator at the time of reoperation. Keck et al. described using a lighted sigmoidoscope through the rectal stump, especially when delineating the rectum from the vagina. Shellito[36] recommends placement of ureteral catheters to aid in the identification of the ureters and proceed with a safe dissection of the rectal stump. In either case, proper identification of the pertinent structures, in what is often a "socked in" pelvis, by whatever means available will potentially lessen operative time and result in a safe reanastomosis.

Closure of a stoma is associated with significant morbidity and has been found to have complication rates of 10% to 30%.[36,37] Wound infections are the most common, ranging from 1% to 25% in colostomy closures and 0.5% to 6% when taking down an ileostomy. Leak, fistula, or intraabdominal abscess, occur in 2% to 15% and 0% to 10% in colostomy and ileostomy takedowns, respectively.[36] Similar to reversal of a Hartmann's, the recommended time interval to takedown of a stoma is 3 months, allowing for patients' full recovery from their prior surgery and progression of intraabdominal adhesions from an inflammatory and hypervascular phase to a much less dense type of adhesion.[36]

Gynecologic Malignancy

Bowel obstruction is one of the most common complications associated with gynecologic malignancy[38] and occurs most commonly in patients with ovarian cancer

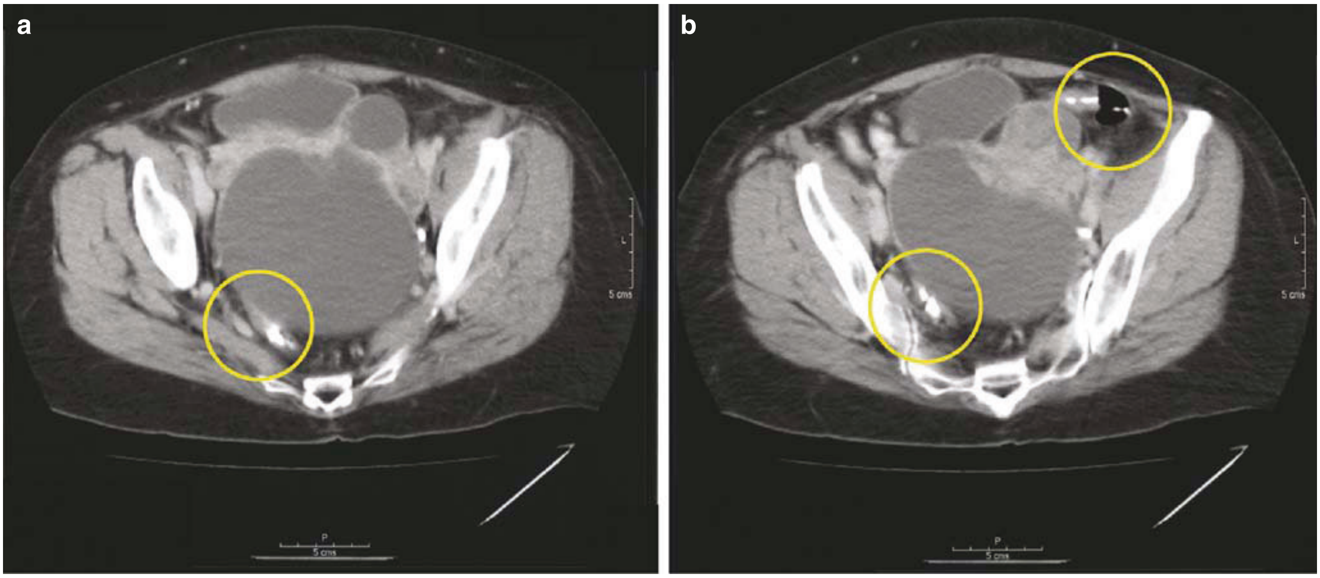

FIGURE 24.2. (**A** and **B**) Advanced ovarian carcinoma with external compression on both the rectum and sigmoid colon, as depicted in the enclosed *yellow circles*.

(5–50%).[39,40] Rubin and colleagues[41] looked retrospectively at all patients over a 3-year period who underwent intestinal surgery at the Memorial Sloan-Kettering Cancer Center to evaluate and define the frequency, distribution by site of disease, indications, and outcome of intestinal surgery in patients with gynecologic cancer. In their series, the most frequent indication for surgical intervention was intestinal obstruction (small bowel, 47.3%; colon, 39.2%; mixed, 13.5%). The majority of patients had ovarian carcinoma (58%), followed by cervical cancer (17.6%) and endometrial cancer (14.9%). The underlying pathophysiology was due to both diffuse carcinomatosis causing external compression on the surface of the bowel, and intestinal dysmotility from the carcinomatosis (Fig. 24.2).

Emphasizing the difficulty with these patients, most of them have previously failed multiple therapies and ultimately require palliative surgery when chronically malnourished, septic, or under semiurgent conditions.[39,40] Although operative intervention may be required, it is important to counsel the patient about its potential risks. Palliative surgery, in general, is associated with significant morbidity, up to 50% in the literature,[37] with the most frequent complications being enterocutaneous fistulas, sepsis, anastomosis dehiscence, and deep vein thrombosis.[38] Multiple authors have tried to define parameters to help determine which patients will likely benefit from palliative surgical intervention. The consensus remains that surgery should be reserved only for those patients in good general condition with a life expectancy of greater than 8 weeks. Negative predictors of successful surgical outcome include a large amount of ascites (greater than 2 L), rapidly accumulating ascites (21% vs. 78% survival at 60 days),[39] prior radiation, multiple bowel obstructions, carcinomatosis, palpable masses, and short interval from time of diagnosis to obstruction.[38] When encountering any of these factors during evaluation, unfortunately, gastrostomy tube placement and hospice care may be the more difficult but more appropriate course.

Conclusion

Late bowel obstruction remains a difficult entity not only for the patient but surgeon alike. Due to the wide variety of underlying causes, surgeons need to have a systematic approach when confronted with this challenging clinical entity. A thorough review of past history and prior surgical details and outcomes can aid in determining the required diagnostic and operative strategies to improve the surgical outcomes, while rendering as little morbidity and mortality as possible.

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25

Reoperations for Bleeding

David E. Beck

Uncontrollable bleeding is one of the most fearsome complications any surgeon may face.[1] Bleeding may present as the patient's initial problem, or a familiar procedure can rapidly deteriorate into a struggle for survival. Careful preparation and a logical, reasoned approach to hemorrhage are essential to successful management. This chapter discusses the evaluation and management of the patient presenting with bleeding, usually from a gastrointestinal source, and the management of perioperative bleeding.

Gastrointestinal Bleeding

Lower gastrointestinal hemorrhage refers to a spectrum of intestinal bleeding that arises distal to the ligament of Treitz. It may range from occult bleeding or occasional spotting of blood to massive lower intestinal hemorrhage. Massive intestinal hemorrhage typically produces hemodynamic compromise or symptomatic anemia (e.g., hematocrit <30%, transfusion requirements (three to five units of blood/blood products, or more), or orthostasis requiring resuscitation).[2]

Lower intestinal hemorrhage presents several challenges.[3] First, the condition may arise from bleeding throughout the gastrointestinal tract. Second, intermittent bleeding precludes a prompt identification of the site of hemorrhage. Third, patients may require surgery without a specific preplanned site of resection, which has been associated with considerable morbidity and mortality and a high incidence of persistent bleeding. Finally, there is no consensus about diagnostic and therapeutic pathways.

Lower gastrointestinal bleeding presents with varying degrees of hemorrhage ranging from the passage of 100 to 250 mL of blood, possibly a few clots and mucus, to copious bleeding with major, self-limited hemorrhage, to massive and continuous hemorrhage associated with hypovolemia. Hemorrhage may present as melena, which suggests bleeding from a more proximal source in the colon or small intestine, or hematochezia, which suggests left colonic, rectal, or anal sources. Upper gastrointestinal hemorrhage may present with the rectal bleeding due to blood's cathartic effect and rapid intestinal transit. It is estimated that upper sources present as lower gastrointestinal bleeding in 10% to 15% of cases.[2,4] Comorbidities often complicate the management of gastrointestinal (GI) bleeding and must be considered in the diagnostic and therapeutic phases of the care plan.

History and physical examination do not predict patient needs or clinical outcome, and diagnostic studies often are invasive procedures with limited sensitivities and specificities. Patients on anticoagulants or antiplatelet agents for underlying cardiovascular conditions present increased challenges when they experience lower gastrointestinal massive hemorrhage.

Etiologies

Common causes of lower gastrointestinal hemorrhage include colonic diverticula, angiodysplasia, ischemic colitis, and inflammatory bowel disease. Hemorrhage also stems from intestinal tumors or malignancies. Unusual causes include nonsteroidal antiinflammatory drugs (NSAIDs), related nonspecific colitis, Meckel's diverticulum, and anorectal diseases.

Initial Assessment, Resuscitation, and Stabilization

Patients with massive lower gastrointestinal hemorrhage demonstrate pallor, fatigue, angina, tachypnea, cardiac palpitations, postural hypotension, and syncope, which define the significance of hemorrhage and the urgency of clinical attention. Initial resuscitation involves placement of large-bore catheters for vascular access, hemodynamic monitoring (cardiac rhythm), and placement of a urinary catheter. Placement of a nasogastric tube screens for the presence of prepyloric, upper gastric sources of bleeding.[5] The goal of resuscitation is to restore volume and replete red blood cell deficiencies to maintain oxygen delivery. In addition, any coagulopathies must be corrected. Appropriate laboratory studies include a complete blood count, serum electrolytes, a coagulation profile, and a type and cross-match for blood components.

The diagnostic evaluation begins with a digital anorectal examination and anoscopy. A rigid proctosigmoidoscopy allows the examiner to evacuate the rectum of blood and clots. A complete mucosal assessment of this segment serves to exclude internal hemorrhoids, anorectal solitary ulcers, neoplasms, and colitis. Identification of a bleeding source often allows therapy to control the hemorrhage, and

R.P. Billingham et al. (eds.), *Reoperative Pelvic Surgery*, DOI 10.1007/b14187_25,

this preoperative evaluation aids in intraoperative management if a primary rectal anastomosis is necessary.

After stabilization, the diagnostic evaluation proceeds with three options: radionuclide imaging (nuclear scintigraphy), colonoscopy, and angiography. Colonoscopy and angiography offer therapeutic intervention while nuclear scanning is purely diagnostic. Decisions on the order of testing depend on clinical judgment, local expertise, and the severity or ongoing nature of the hemorrhage.

Patients can be subdivided into three general clinical categories based on the history, physical, and initial laboratory data: (1) minor and self-limited, (2) major and self-limited, or (3) major and ongoing. Major ongoing hemorrhage requires prompt intervention with angiography or surgery. Minor, self-limited may undergo a colonic lavage and colonoscopy within 24 hours. The management of major, self-limited hemorrhage creates the most controversy. Patients with this type of hemorrhage need a diagnostic test to determine if they require prompt therapy or observation.

Radionuclide Imaging

Radionuclide imaging (Fig. 25.1) detects the slowest bleeding rates (0.1–0.5 mL/min). While this technique is more sensitive than angiography, nuclear scanning cannot reliably localize the site of hemorrhage.[6] Two general techniques are used for nuclear imaging, technetium (Tc) sulfur colloid scans and ^{99m}Tc pertechnetate-tagged red blood cells (RBCs). Sulfur colloid scans have a short half–life and detect very low rates of hemorrhage (0.1 mL/min). It is effective to detect brisk hemorrhage but cannot detect sporadic bleeding. The more commonly preferred agent for lower gastrointestinal hemorrhage radionuclide scanning is the pertechnetate-tagged RBC scans. The tagged RBC scans may cover a period of hours and allow for reimaging within 24 hours. Nuclear scintigraphy has variable results, suggesting that scan timing, technical skills, and experience may increase accuracy. Current reports suggest accuracies ranging from 24% to 91%.[7] Radionucleotide scanning is best for patients with major, self-limited hemorrhage.[7]

Experience reported by the Ochsner Clinic suggests the timing of the blush predicts the success of angiography.[8,9] If the nuclear scan demonstrates an immediately positive blush (within the first 2 minutes of scanning), it is highly predictive of a positive angiogram (60%) and the need for surgery (24%). Just as important, if the initial images did not demonstrate a blush, the study is highly predictive of a negative angiogram (93%) and the need for surgery falls to 7%. Thus a negative nuclear scan provides objective evidence that the patient is not actively bleeding and may be evaluated by colonoscopy.

Colonoscopy

Many authors believe that colonoscopy has the highest efficacy and should be the first study in patients with major bleeding that appears self-limited.[10] Whether colonoscopy should be undertaken emergently depends on the patient's stability. In patients with hypotension and ongoing hemorrhage, it is difficult to safely accomplish bowel preparation with lavage solutions, and the continued bleeding limits intraluminal visualization and the ability to utilize therapeutic options. In general, these patients require prompt attention with an angiogram or surgery.

In stable patients with self-limited hemorrhage, colonoscopy is the preferred diagnostic study. The need for bowel preparation is controversial. Colonoscopy without preparation can be described as "emergent," while administering a mechanical preparation and then performing colonoscopy within 24 hours of presentation is termed "urgent" colonoscopy. The rapid time preferred for mechanical cleansing usually mandates a lavage method.

Proponents of emergency colonoscopy have demonstrated high cecal intubation rates (95%) and a diagnostic accuracy of 72% to 86%.[11–13] However, many of the reported series described atypical etiologies for "massive hemorrhage" including ischemic colitis, inflammatory bowel disease, and cancer. The usual rate of bleeding in these conditions is more amenable to urgent colonoscopy (within 24 hours) rather than emergent colonoscopy. Higher bleeding rates are more common with diverticular or angiodysplastic sources.

The benefit of colonoscopy depends on its ability to provide a definitive localization of ongoing active bleeding and the potential for therapy. Many landmarks for colonoscopy may be obscured during hemorrhage. Because of the inability to appreciate all intraluminal landmarks and locate the segment that is bleeding, once the endoscopist highlights a bleeding source, the region of the intestine requires a tattoo to mark the site with India ink. In such patients, if the hemorrhage continues and fails medical management, the tattoo greatly assists the surgeon in localizing the hemorrhagic site.

The endoscopist has many therapeutic options to control the bleeding, including thermal agents such as heater probes, bipolar coagulation, and laser therapy. Injection therapy primarily uses topical and intramucosal epinephrine. Mechanical therapy includes endoscopically applied clips (Fig. 25.2).[2,5]

Angiography

Angiography aids as a diagnostic and therapeutic option in the treatment of intestinal hemorrhage. Acute, major hemorrhage with ongoing bleeding requires emergent angiography, while patients with an early blush during nuclear scintigraphy may benefit from therapeutic angiography. Angiograms may also define a potential source for hemorrhage in occult and recurrent gastrointestinal hemorrhage. To appreciate an angiographic blush of contrast, the study requires a hemorrhage rate of at least 1 mL/min.[14] Positive yields with angiography range from 40% to 78%.[15–18] Appropriate patient selection increases yields and avoids excessive use of angiograms.

The angiographic blush may suggest a specific etiology, but this finding lacks the accuracy of colonoscopy. Highly accurate localization also provides for focused therapy. The hemorrhagic site may receive highly selective, intraarterial vasopressin infusion. This medication produces potent arterial contraction, which may reduce or halt the hemorrhage. Infusion rates of vasopressin being at concentrations of 0.2

FIGURE 25.1. Images from a ^{99m}Tc-labeled red blood cell gastrointestinal bleeding study demonstrating extravasation of contrast in sigmoid colon.

U/min and may progress to 0.4 U/min. The systemic effects and cardiac impact of vasopressin may limit maximizing the dosage. Vasopressin infusion controls bleeding in as many as 91% of patients. Unfortunately, bleeding may recur in as many as 50% of patients once the vasopressin is tapered.

Angiographic technology also allows for arterial embolization to control hemorrhage. Arterial embolization of larger vessels produces intestinal ischemia or infarction in approximately 20% of patients. Much safer superselective mesenteric angiography using microcatheters allows embolization of the intestinal vasa recta or vessels as small as 1 mm (Fig. 25.3). Arteriography also has complications, separate from the therapy delivered to the site of bleeding. These include arterial thrombosis, distant arterial emboli, and renal toxicity from the angiographic dye.

Successful embolization therapy provides immediate arrest of the bleeding. Embolization agents including

FIGURE 25.2. Clip applied to bleeding diverticular vessel.

Gelfoam pledgets, coils, and polyvinyl alcohol particles.[19,20] Success has been better in diverticular bleeds, which are usually fed by one vessel, than with angiodysplasias, which often have multiple feeding vessels.

Newer Diagnostic Methods

Advanced computed tomography (CT) using thinly sliced, fast image acquisition combined with three-dimensional software packages has revolutionized the imaging of the vascular tree.[21] Vessels smaller than "named" vessels can be visualized, and the use of CT angiography has been reported in chronic conditions such as mesenteric ischemia and inflammatory bowel disease.[21] Case reports and animal modeling suggest feasibility for gastrointestinal hemorrhage. Image acquisition synchronized with intravascular contrast may outline a site of contrast extravasation or blush defining intestinal hemangiomas, arteriovenous malformations, and angiodysplasias. The sensitivity and specificity of CT angiography in patients with gastrointestinal hemorrhage are unknown and require further research.

Magnetic resonance angiography (MRA) creates images using the bright signal from blood.[22] The three-dimensional images are reconstructed using computerized imaging to project a two-dimensional image that mimics a conventional angiogram. Further improvement is possible with contrast-enhanced MRA (CEMRA). Images using current techniques are not as specific or as refined as an angiogram, but may detect the extravasation of blood pooling in various segments of the intestine. In addition to localizing the site, the study may distinguish small intestine versus large intestine. These studies may prove advantageous when compared to nuclear scintigraphy.

Wireless capsular endoscopy is a diagnostic adjunct for patients with occult hemorrhage.[23–26] The first-generation capsules are 11×30 mm and easily swallowed and tolerated. The current system captures two images per second and transmits the images to a recording apparatus the patient wears. Transmitted images are later reviewed by the endoscopist.

Operative Therapy

Most sources of bleeding spontaneously resolve or are controlled with the current therapeutic interventions. Surgical therapy for intestinal bleeding is rare and associated with significant mortality. Patients who are hemodynamically unresponsive to the initial resuscitation require urgent surgery. In other patients the site of hemorrhage may be localized, yet the available therapeutic interventions fail to control the bleeding. Patient mortality increases with transfusion requirements. Bender et al.[27] noted a reduced mortality (7%) for patients requiring less than 10 units of blood, while the mortality increased to 27% for patients receiving an excess of 10 units. Therefore, patients with ongoing hemorrhage who require more than six to seven units of blood during the resuscitation should undergo surgical intervention.

Surgeons should tailor their operative approach based on the preoperative diagnostic evaluations. Surgery starts with a thorough examination of the entire intestine through a large midline open laparotomy incision. The first objective is location of intraluminal blood with the hope of segmentally isolating a possible source of bleeding.

After the initial visual inspection, the exploration begins in the stomach and duodenum and considers possible missed upper gastrointestinal sources. Next, the small intestine must undergo examination from the ligament of Treitz to the ileocecal valve. Palpation of the intestine may demonstrate such etiologies as a Meckel's diverticulum, ileitis, colitis, or a gastrointestinal stromal tumor (GIST). If the colon appears filled with blood and the small intestine remains spared, the surgeon may focus on colonic sources of bleeding. If the small bowel contains blood, then the operative team has a larger area of concern.

If no source appears obvious after the exploration phase, the surgeon may consider intestinal enteroscopy. The enteroscope or colonoscope exposes the luminal surface and transillumination the intestinal wall. Transillumination may identify vascular anomalies, small ulcers, or tumors. Endoscopic access to the intestine may require a transoral, transgastric, transcolonic, or transanal approach or a combination of these. Intraoperative endoscopy is a technically difficult endeavor. A team approach with two surgeons or the availability of an experienced endoscopist is important to identify the elusive lesions causing the hemorrhage.

Once the hemorrhage site is identified, an appropriate segmental resection can be performed. If no source of bleeding is confirmed, but appears to arise from the colon, the surgeon should perform a subtotal or total colectomy. Stable patients tolerate a primary ileosigmoid or ileorectal

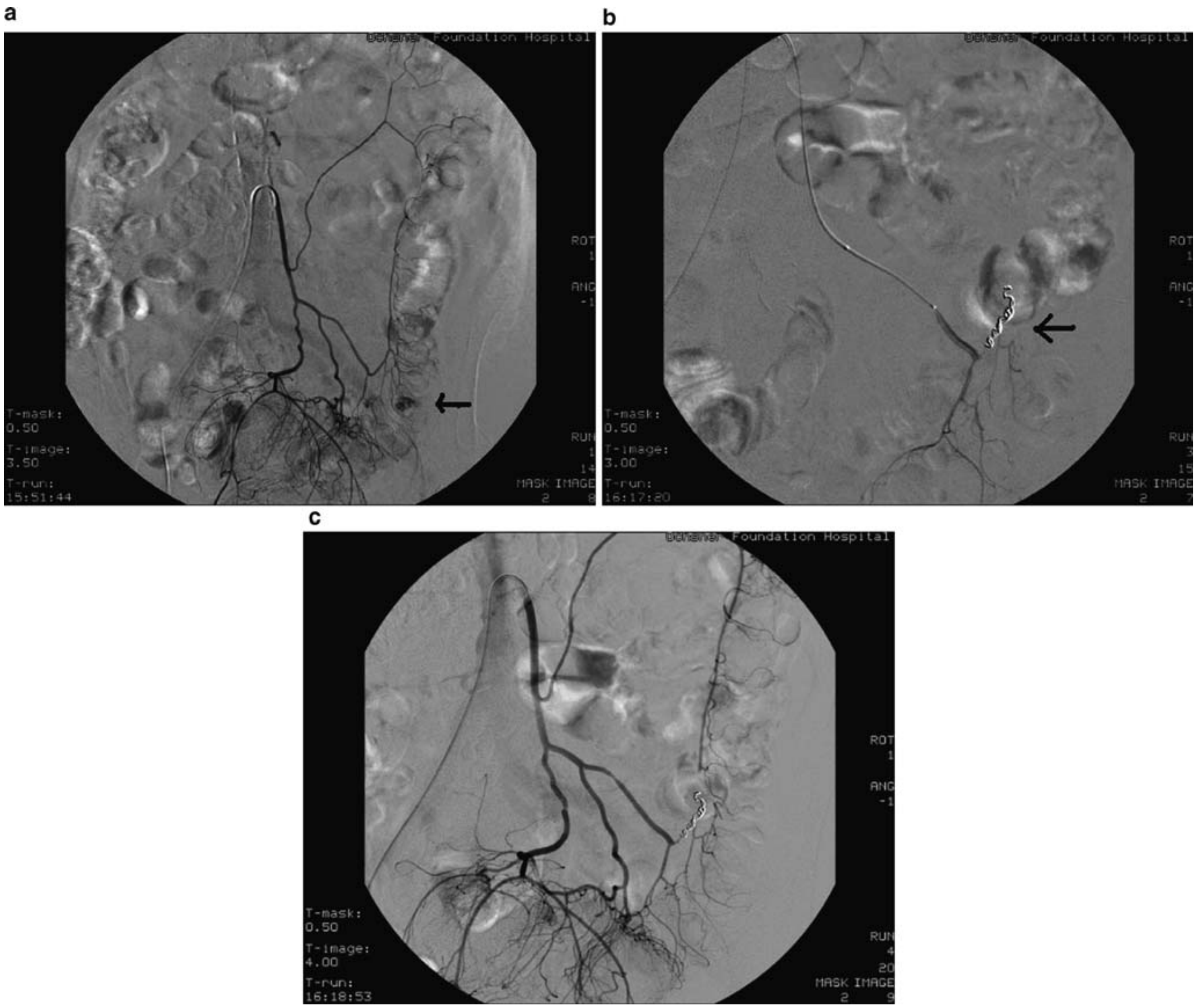

FIGURE 25.3. (**A**) Selective angiogram of inferior mesenteric artery demonstrating extravasation (hemorrhage) in sigmoid colon (*arrow*). (**B**) Angiogram with coil in distal feeding vessel with cessation of bleeding. (**C**) Delayed angiogram demonstrating collateral flow to colon and absence of hemorrhage.

anastomosis, while unstable patients are best served with an end ileostomy with closure of the rectal stump or a sigmoid mucous fistula.

Critical issues with operative management include delaying surgery until the hemorrhage reaches a critical point beyond 10 units of blood, an associated mortality rate between 10% and 35%, and recurrence bleeding rates of 10% due to imprecise localization of the bleeding.[28] Recurrence rates are higher (e.g., 20%) if a limited right or left colectomy is performed without precise localization of the hemorrhage.[29] A total colectomy offers the same mortality with a lower chance of recurrent or persistent hemorrhage.

The evaluation and management of lower gastrointestinal hemorrhage remains a challenge for surgeon. An algorithm summarizing the management is provided in Fig. 25.4.

Perioperative Hemorrhage

Perioperative hemorrhage is a consideration with any procedure. Appropriate preoperative preparation, intraoperative technique, and postoperative management are crucial to preventing perioperative bleeding problems and minimizing morbidity when it occurs.

Preoperative Preparation

A thorough preoperative history and physical examination yields important information about the likelihood of perioperative bleeding problems.[1] Prior hemorrhages after minor procedures such as a tooth extraction, easy bruising, or particularly heavy menses may indicate an underlying disorder of coagulation. A family history of hemorrhagic or thrombotic complications should also be elicited.

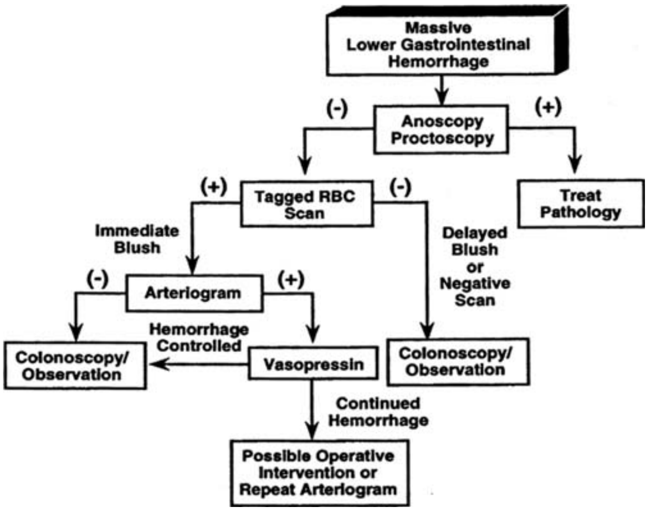

FIGURE 25.4. Algorithm for the management of lower gastrointestinal hemorrhage. (From Opelka et al.,[2] with permission of Springer Science + Business Media.)

In general, routine laboratory screening of all patients in the absence of a history suggestive of bleeding problems adds unnecessary expense to the preoperative evaluation. In one study, prothrombin and partial thromboplastin times (PT/PTT) were normal in over 98% of patients without an antecedent bleeding history. Likewise, unsuspected thrombocytopenia is rare. For patients with a suspicious history, the standardized bleeding time is the single best test of the coagulation system; if it is normal, no further evaluation is indicated. Should it be prolonged, a search for the cause is needed.[30,31]

Underlying medical conditions may raise the risk of hemorrhage. In patients with renal failure, chronic uremia leads to platelet dysfunction through defects in platelet surface glycoprotein receptors, which causes impaired aggregation and adhesion. Heparin used for routine dialysis can persist and lead to troublesome bleeding.[32] Hepatic failure leads to prolongation of the prothrombin time due to decreased circulating levels of coagulation factors. In many patients, this will respond to supplemental vitamin K, but nonresponders require fresh-frozen plasma. Antibiotic bowel preparations may exacerbate prolongation of PT, as the gut flora is required for vitamin K production. Hypersplenism in the face of portal hypertension causes thrombocytopenia. In addition, portal hypertension causes new and often fragile portosystemic collaterals to form. These may occur at a recanalized umbilical vein or in the pelvis. Usually tiny retroperitoneal vessels supplying the ascending and descending colon may enlarge and form collaterals, making mobilization of the colon quite difficult if not done carefully.

Surgical patients may be on numerous medications that have implications for hemorrhagic complications. Aspirin irreversibly blocks cyclooxygenase, rendering the affected platelet nonfunctional for its remaining life span. Other NSAIDs such as ibuprofen and indomethacin have similar effects. The risk of perioperative bleeding from a single 325-mg daily dose of aspirin is small, but the risk

TABLE 25.1. Perioperative Recommendations for Anticoagulated Patients.

Indication	*Before surgery*	*After surgery*
Acute venous thromboembolism		
Month 1	IV heparin	IV heparin
Month 2 and 3	No change	IV heparin
Recurrent venous thromboembolism	No change	SC heparin
Acute arterial embolism		
Month 1	IV heparin	IV heparin
Mechanical heart valve	No change	No change
Nonvalvular arterial fibrillation	No change	SC heparin

IV heparin, intravenous heparin at therapeutic doses; SC heparin, subcutaneous unfractionated or low-molecular weight heparin.

Source: From Kearon and Hirsh,[35] with permission.

increases with increasing doses.[33] Plavix, Ticlid, and ReoPro are newer powerful antiplatelet agents that have been reported to cause serious bleeding problems intraoperatively. Plavix is dynamically bound to platelets, so transfused platelets are affected competitively.[34]

Current recommendations call for stopping all NSAIDs and antiplatelet agents for approximately 7 days prior to elective surgery. This poses little added thromboembolic risk for the average-risk patient. However, patients with recent stroke or myocardial infarction, as well as those with coronary stents, may be at significant risk if their antiplatelet therapy is stopped. Cardiology consultation for risk assessment is generally indicated. Should emergency surgery be necessary in patients on these medications, meticulous operative hemostasis is a must. Platelet replacement may be necessary even in the face of a normal platelet count.

Patients who are chronically anticoagulated on Coumadin require special consideration, balancing their thromboembolic risk with their bleeding risk. A recent review summarizes this complex topic succinctly. The recommendations most germane to elective colorectal surgery are complied in Table 25.1.[35] In the emergency setting, correction of coagulation with fresh-frozen plasma may be necessary. Vitamin K is typically not given, as it makes subsequent restoration of the proper anticoagulated state with Coumadin more difficult.

Intraoperative Considerations

At surgery, clamps, clips, suture ligation, cautery, and newer energy sources (e.g., ultrasonic scalpel [Harmonic scalpel, Ethicon Endo-Surgery, Inc., Cincinnati, OH; LigaSure, Tyco Healthcare, Princeton, NJ; EnSeal SurgRX, Redwood City, CA; etc.]) are essential to attain hemostasis from specific bleeding points.[36] Diffuse oozing may require the use of chemical agents. Sponges or pledgets of gelatin foam (Gelfoam), oxidized regenerated cellulose (Surgicel), or micronized collagen (Avitene) can be used to apply pressure against the wound surface and form a matrix for clot formation. Gelatin foam and cellulose pledgets soaked in bovine thrombin have intrinsic hemostatic function. Thrombin can also be sprayed onto surfaces in conjunction with cryoprecipitate to produce a hemostatic fibrin glue. Refractory bleeding may require temporary packing.

Splenic Injury

The intimate anatomic relationship of the spleen to the omentum and colon makes the spleen vulnerable to injury during colonic resection. The length of the ileocolic ligament is usually quite short and can be complex, with redundant folds. The omental attachments are also complex.[37] A thorough working knowledge of this region is paramount in avoiding injury.

Correct operative strategy is also crucial. The splenic flexure is often far under the left costal margin, making exposure difficult. If the incision initially chosen does not adequately expose this area, it must be extended. Good retraction is vital and the body wall should be lifted vertically, which may not be possible with most self-retaining retractors. The colon and omentum must be retracted gently, as most splenic injuries occur from avulsion due to overly vigorous attempts at exposure.

The splenic flexure must be mobilized to provide adequate bowel length for low colorectal anastomoses. For colonic lesions at the splenic flexure, an early decision relative to direct splenic invasion, which mandates an en bloc resection of the spleen, must be made. A partial resection, based on the hilar blood supply, may be adequate; however, a total splenectomy is often necessary.

Despite careful technique, splenic injury occasionally occurs.[38] A reasoned, stepwise approach to splenic salvage minimizes morbidity. Most injuries are apparent immediately through obvious hemorrhage, but delayed bleeding can occur. Capsular tears, caused by over vigorous retraction of the numerous splenic attachments, are the most common injury. Most can be controlled through a combination of electrocautery and topical hemostatic adjuncts such as microfibrillar collagen (e.g., Avitene, C.R. Bard, Murray Hill, NJ). Judicious use of packing and later reinspection are also useful. For larger injuries, a more aggressive approach is required to successfully save the spleen. The spleen must be fully mobilized to the midline by quickly and carefully dividing all lateral peritoneal attachments. Direct compression or temporary manual control of the splenic hilum stems the bleeding and allows for a more complete assessment. Large capsular avulsions may respond to argon beam coagulation or topical anticoagulants as described previously. Deeper injuries of the parenchyma or hilar vessel damage require careful dissection and ligation of theses fragile structures. The parenchyma is divided bluntly and individual vessels oversewn or clipped. Compressive through-and-through sutures may be necessary. Partial splenectomy can be performed for complex injuries.[39]

Should splenectomy be necessary, patients are subsequently at risk for life-threatening infections, most due to the encapsulated bacteria: *Streptococcus pneumoniae, Haemophilus influenzae,* and *Neisseria meningitidis.* Postoperative immunization should be accomplished prior to discharge for pneumococcus and *H. influenzae*; routine meningococcal immunization is not recommended for most patients.[40] However, immunization should be deferred for 6 months after chemotherapy, and these patients should be covered with penicillin prophylaxis during this interval. In addition to the infective risk, stage III colon cancer patients who undergo unexpected splenectomy may have a worse prognosis than matched controls.[41]

Pelvic Hemorrhage

The narrow confines and complex three-dimensional anatomy make pelvic surgery difficult and prone to potentially disastrous bleeding complications from injuries to vessels on the pelvic sidewalls, sacrum, or genitourinary structures. Fibrosis and inflammation from tumor, infection, or radiation may distort anatomy and increase the potential for hemorrhage. Portal hypertension causes enlargement of numerous pelvic retroperitoneal collaterals that are at particular risk for injury and bleeding.

The pelvic sidewalls are covered by the endopelvic fascia, which covers the internal iliac veins. Should dissection proceed outside this layer, these vessels may be injured. Radiation and fibrosis are particularly damaging in this area. Hemorrhage from the iliac veins is brisk and difficult to control, as these vessels are large and thin-walled. Careful suture ligation should be attempted, but at the risk of causing further tears. Temporary inflow occlusion of the iliac arteries may aid in direct control, but bilateral hypogastric ligation should be avoided, as pelvic necrosis may ensue. Prolonged packing of the pelvis with laparotomy pads over plastic sheeting is sometimes necessary,[42] allowing for resuscitation in the intensive care unit (ICU) with correction of any acquired clotting defects. On the patient's return to the operating room in 24 to 36 hours, most bleeding will have stopped. Angiographic embolization is occasionally useful for the rare case of arterial hemorrhage.

Presacral hemorrhage is perhaps the most feared intraoperative complication of rectal mobilization and resection. The endopelvic fascia of variable thickness covers the thin-walled, high-pressure anterior venous plexus of the sacrum. In approximately 15% of patients, a large basivertebral vein connects this anterior plexus to the internal vertebral system, further increasing the likelihood of exsanguinating hemorrhage if injury occurs.[43,44] Prevention of this potentially devastating problem is paramount. Sharp dissection in the avascular plane between the mesorectum and the presacral fascia following the curve of the sacrum facilitates safe rectal mobilization. Should bleeding occur, initial manual compression allows the operative team to prepare. The anesthesiologist should be made aware that massive and rapid hemorrhage is possible. Consideration should be given to collecting blood from the field for processing and autotransfusion (Cell Saver, Haemonetics Corp., Braintree, MA), although open bowel may preclude this option. Initial, brief attempts at suture or clip ligation are indicated, especially for smaller surface vessels. Laparoscopic instruments such as clip appliers or hernia staplers are useful given their additional length. However, these attempts may prove futile, especially for vessels that are lacerated flush with the anterior bony table of the sacrum. In this instance, control can be obtained by insertion of titanium thumbtacks directly into the sacrum where the vessel exits, effectively occluding these difficult vessels.[41] For the thumbtacks to work, they must be inserted into the sacral bone. Thus they will not work if the bleeding occurs off the midline or the sacral bone is not of sufficient density to hold the tacks. Also, more than one thumbtack may be required to stop the bleeding. Fibrin glue has also been used successfully for slow but persistent oozing after application of these tacks.

An additional measure is to suture with pledgets or "weld" a piece of rectus muscle to the presacral surface. The mechanical pressure of the muscle occludes the vessels, and the exposed muscle fibers have an autologous hemostatic effect. This technique involves harvesting a small piece of rectus abdominis muscle, which is held in place with a forceps to occlude the bleeding site. Electrocautery adjusted to the highest setting is then applied to the forceps to "weld" closed the bleeding point.[45] Should all these measures fail, tight pelvic packing or balloon tamponade may be necessary as a last resort.[46] For both sidewall and sacral bleeding, rapid completion of the planned resection will aid exposure. The decision to proceed with anastomosis following massive hemorrhage must be made carefully, considering the patient's overall condition, as well as local factors.

Bleeding from the posterior vaginal wall, while rarely massive, can be quite frustrating. Obliteration of the rectovaginal septum may occur after radiation or infection, making identification of the proper plane difficult to impossible. Injection of the septum with saline or dilute epinephrine facilitates this dissection. Bleeding can usually be controlled with suture ligation after adequate exposure is obtained. Similar problems can occur in males on the prostate. Care must be taken to avoid urethral injury when controlling hemorrhage in this region.

Laparoscopic Surgery

The same basic techniques of hemorrhage prevention and control—exposure, identification, ligation, and packing—apply equally to laparoscopic and open surgery, but are more difficult to apply in the minimally invasive setting. Adequate exposure and careful colonic mobilization allows for accurate vessel identification. Vessel division is most efficiently accomplished centrally, where narrower pedicles can be developed through avascular areas. Once identified, precise ligation can be accomplished by clips, electrocautery, looped suture, or by several newer techniques; the ultrasonic scalpel, bipolar electrocautery, LigaSure, and EnSeal have the advantage of causing very little tissue damage beyond the instrument. Endoscopic vascular staples can also be used to ligate and divide the pedicles in a single step. Significant hemorrhage mandates conversion to an open procedure if it cannot be promptly controlled. Rates of conversion for bleeding vary among series, ranging from 2% to 10%.[47,48]

Bleeding can also occur from misadventures of trocar placement. Injuries to the major abdominal vessels are fortunately rare and completely avoidable with proper technique. Hemorrhage from the inferior epigastric vessels is more common. Placement of trocars with direct visualization of the interior abdominal wall will help avoid injury. Minor bleeding often stops with the pressure applied by the cannula itself. Brisk bleeding requires definitive control. Sutures on straight needles can be placed under direct vision through the trocar incision and then brought back up and tied, effectively ligating the vessels. Alternatively, a Foley catheter is introduced through the wound, inflated, and brought up against the abdominal wall snugly and held in place with a large clamp. Should these maneuvers fail, the wound must be opened and the vessel ligated directly. Failure to control these bleeds promptly may lead to a postoperative rectus sheath hematoma that requires surgical evacuation.[49]

Anastomotic Hemorrhage

The bowel ends brought together to form colonic anastomoses are typically well vascularized, with variable amounts of bleeding. Only spurting vessels should be controlled with careful ligation or the judicious use of electrocautery. All techniques of creating anastomoses, whether sewn or stapled, are hemostatic to some extent, making hemorrhage rare. Should bleeding be evident immediately after anastomosis, it is controlled with sutures or cautery. Care is needed with cautery, as it may arc to staples, causing occult bowel wall injury that may lead to anastomotic leaks.

Anastomotic hemorrhage in the postoperative period is more troublesome. The patient should be evaluated and treated as any with gastrointestinal bleeding, with resuscitation and correction of clotting disorders, followed by a search for the source. Pelvic anastomoses may be reachable via the rigid proctoscope. If active bleeding is seen, control with cautery or epinephrine injection can be attempted. More proximal bleeding requires colonoscopy, which adds the risk of disrupting the fresh anastomosis. Angiographic control with selective embolization or regional vasopressin infusion may render the area ischemic, trading bleeding for a leak. Reexploration and suture control or resection and reanastomosis may be necessary for ongoing hemorrhage.

Anorectal Procedures

Intraoperative bleeding during most anorectal cases is little more than a nuisance, easily controlled with the appropriate use of electrocautery or suture ligatures. Proper exposure, aided by lighted anal retractors and adequate suction, is imperative. Patients with portal hypertension pose a particular challenge in anorectal surgery, as they may have coagulation defects and enlarged, fragile rectal varices.

Postoperative hemorrhage following anorectal procedures, especially hemorrhoidectomy, occurs in 0.8% to 2.5% of cases.[50,51] This may be immediately noted if intraoperative hemostasis is not adequate, or may happen days later as ligatures dissolve or pedicles necrose. In one study, 37% of patients with significant hemorrhage were on some form of anticoagulant therapy.[52] Minor bleeding can be managed by patient reassurance, or at the bedside with packing, application of silver nitrate, or cautery. Brisk hemorrhage is best handled by an expeditious return to the operating theater, where adequate suction, lighting, and instrumentation, as well as anesthesia support are available. Delayed or persistent hemorrhage from an anorectal procedure must be differentiated from bleeding due to a more proximal source.

Postoperative Care

The patient who has sustained a significant intraoperative hemorrhage will be under considerable physiologic stress in the immediate postoperative period. Strong consideration should be given to resuscitation in the intensive care unit. The patient must be kept warm, both during and after surgery, with the use of warm air blankets, heat lamps, and countercurrent fluid warmers. Like all enzymatic processes, the activity of the clotting cascade decreases as the temperature falls. Hypothermia also increases fibrinolytic activity and worsens platelet number and aggregation.[52] Transfusion therapy tailored to specific deficits should also be warmed.

In high-risk patients, perioperative cardiac ischemia may be difficult to detect; routine evaluation with serial electrocardiograms and cardiac enzymes is warranted, even in the absence of symptoms or hemodynamic instability. Beta blockade or underlying conditions will attenuate the typical responses to shock. Ventilatory support may be necessary.

Postoperative Hemorrhage

Postoperative hemorrhage is a dangerous complication that, if mismanaged, can result in significant morbidity and mortality. The abdomen and pelvis represent large potential spaces for fluid accumulation. Inattention to hemostasis before closure may allow bleeding from a small arterial or venous source to cause exsanguination. Intraabdominal hematomas may contribute to abscess formation.

Postoperative hemorrhage may be easy to recognize if drains are placed before closure, although the lack of output can also be misleading because drains often fail to function in the presence of active hemorrhage because of blood clot obstruction. The primary physiologic compensation for acute blood loss occurs through the sympathetic autonomic nervous system. Adrenergic signals augment venous return by constricting small veins and venules and preserve blood flow to critical organs by constricting arterioles that serve tissues that are able to withstand warm ischemia (skin, fat, and muscle). The conservation of salt and water by the kidney is also stimulated by adrenergic nerves and intrinsic renal mechanisms.

Mild acute blood loss is characterized by cutaneous vasoconstriction and sweat gland output (producing cool, clammy skin) and decreased capillary refill of >2 seconds. Tachycardia and orthostatic hypotension occur. Greater degrees of blood loss cause oliguria, mental status changes, and overt hypotension. Coexisting medical conditions may mask these clinical signs. For example, a hypertensive patient with acute blood loss may have a *normal* blood pressure with significant blood loss if the baseline pressure was elevated. It is important to note that acute hemorrhage does not immediately reduce the hematocrit level. Serial hematocrit measurements, however, show a precipitous decline after fluid resuscitation and confirm the diagnosis of hemorrhage.

Treatment includes immediate isotonic crystalloid fluid infusion through large-bore peripheral or central vein catheters and obtaining blood for cross-matching. Blood should be given if the patient remains hemodynamically unstable after infusion of 30 mL/kg of crystalloid solution. The adequacy of volume replacement is assessed by means of urinary output (0.5–1 mL/kg/h) and central venous pressure measurements. Blood should be transfused to keep the hematocrit level >0.30 in patients with coexisting cardiopulmonary disease. Healthier patients can tolerate a much lower hematocrit level (e.g., 0.20–0.24). The possibility of gastrointestinal hemorrhage should always be considered in the differential diagnosis, and placement of a nasogastric tube should be considered and rectal examination performed. A patient with a clear chest radiograph and no evidence of external or gastrointestinal bleeding after laparotomy most likely has bleeding into the peritoneum or retroperitoneum.

Every patient with major postoperative blood loss should be evaluated for medical hemostasis. Blood should be tested for platelet count, PT, and PTT. If test results are abnormal, analysis of fibrinogen and fibrin degradation product may be useful to identify a cause of the failure of medical hemostasis. The differential diagnosis includes liver failure, vitamin K deficiency, a congenital factor deficiency not recognized before surgery, disseminated intravascular coagulation, fibrinolysis, or a reaction to blood transfusion. Unless the patient's condition is markedly unstable, medical management to correct coagulopathies should precede repeat surgery.

Patients with hemodynamic instability and a falling hematocrit level despite fluid resuscitation and normal clotting mechanisms need to undergo careful exploratory surgery to restore hemostasis. Most bleeding in postoperative patients abates, however, without surgical intervention. The decision of whether to perform repeat surgery in a hemodynamically stable patient with evidence of potential ongoing bleeding requires experienced clinical judgment.

Abdominal compartment syndrome has recently been recognized as a source of considerable morbidity in the critically ill surgical patient. Bowel edema following massive transfusion and resuscitation causes an increase in intraabdominal pressure. This leads to respiratory embarrassment due to upward pressure on the diaphragm, anuria from renal parenchyma compression, and hypotension from decreased venous return.[53] Bladder pressure serves as an adequate surrogate for intraabdominal pressure. By connecting a needle and pressure tubing to a continuous column of fluid in the urinary catheter, bladder pressure can be measured and trends followed. Consideration should be given to emergent laparotomy, decompression, and temporary silastic closure in patients with the clinical problems associated with abdominal compartment syndrome, especially if bladder pressures exceed 30 mm Hg.[54]

Recurrent postoperative hemorrhage can be a vexing problem. Patients with an ongoing transfusion requirement need rapid correction of coagulation defects and close assessment by an experienced surgeon. Inability to correct the coagulation parameters is often seen with persistent hemorrhage, as the clotting factors are consumed as the shed blood clots. The decision to reoperate is sometimes difficult, but must be made in a timely fashion.

Conclusion

Hemorrhage can be a frightening occurrence. Gastrointestinal bleeding is best managed with a logical, reasoned approach. Proper preoperative assessment, attention to meticulous technique, and a reasoned, stepwise approach should problems arise all will aid the surgeon in avoiding and rapidly correcting perioperative bleeding problems.

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26

Reoperative Surgery for Constipation or Dysmotility

Tracy L. Hull

Constipation implies different symptoms when patients present to their health care provider. Even among health care providers, understanding the exact problem and how to proceed can be vastly different. In an attempt to standardize the definition, a panel of experts met in Rome, Italy, and the *Rome criteria* were established. These consist of two or more of the following symptoms for greater than 3 months: straining more than 25% of the time with stooling; hard stools more than 25% of the time; incomplete evacuation more than 25% of the time; or two or fewer bowel movements per week.[1] These criteria are not perfect, but provide a starting point for evaluation of these patients when they come to the office.

Always Start Over with the History

Even though the topic for this chapter is reoperative surgery for constipation, it is important to start over and consider the exact symptoms and what has previously been done (even if the evaluator was the initial surgeon or health care provider) prior to planning further treatment. Hence, this process begins with a thorough history. Exactly what the patient means by the term *constipation* is important to determine. Since patients may use incorrect terminology, frequently asking questions about their precise symptoms is helpful. This may require rewording of questions to provide the clinician with the opportunity to determine exactly what the patient means. Maneuvers that help or hinder fecal evacuation may prove crucial when trying to decide the treatment plan and should be noted. This also includes medications that patients ingest (both prescribed and over-the-counter), their diet and activity level, and other chronic diseases. It is not uncommon to uncover medications or a chronic disease that would contribute significantly to constipation.

Constipation-prone irritable bowel syndrome (IBS) is almost never treated with a surgical intervention. There are also Rome criteria to define IBS,[2] but essentially they are chronic abdominal pain relieved by defecation and associated with a change in stool consistency or frequency. Unfortunately, distinguishing IBS from non-IBS constipation may be difficult. Nonetheless, looking for these symptoms is important and questioning patients about them when a surgical intervention has failed may influence treatment.

Investigation of previous treatments may require obtaining outside records. Relying on what the patient understood was done may lead to decisions based on inaccurate or incomplete information. Ensuring that the patient had blood work completed that revealed a normal calcium level and thyroid functions is important. It is particularly important to obtain and study past surgical reports. Even if the current clinician was the initial surgeon, refreshing the memory may uncover points that could be improved or changed.

In women, genitourinary symptoms or surgery may be associated with constipation. Questions dealing with anterior pelvic procedures or symptoms may uncover information that will alter treatment. Combined surgical treatment of the anterior and posterior pelvis may not be as common when dealing with constipation as other pelvic floor issues, but it is still important to note these symptoms before treatment interventions.

Occasionally constipation is found in families, so a family history of bowel issues is sought. Likewise, a social history may give clues to habits and life changes that may influence constipation.

Physical Examination

The physical exam focuses on the abdomen and perineum. When looking at the abdomen, features to note include surgical scars, distention, masses, and hernias. During the perineal exam, the vagina is inspected for prolapse of the vagina itself, a rectocele, or an enterocele (which occasionally can be noted). On digital anorectal exam feeling the puborectalis during straining may detect an abnormal contraction that may be occurring also during defecation. Rectoceles, masses, perineal descent, and infolding of the rectum with strain are also sought.

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Further Testing

Further testing depends on the symptoms and tentative treatment plan. If there is any question regarding a colon lesion, a colonoscopy or barium enema is performed. Other testing depends on the overall perception as to where the constipation is originating from. Trying to divide the area of problem into the colonic segment or the pelvic segment will guide further testing. If patients mainly feel that the stool does not move through the colon or they seem to go weeks without defecation, the colon is suspected. Patients who feel the stool comes down into the pelvis and they just cannot expel it may have a problem in the distal colon or rectum. Sometimes differentiating between the two is impossible and testing to look at the entire colon is carried out.

A colonic transit study is used to assess the movement of radiopaque markers through the large intestine. Introduced in 1969,[3] there currently are several schedules of ingesting the markers and then obtaining abdominal x-rays. A popular scheme involves having the patient stop all laxatives and ingesting 24 markers 2 days later. While taking only a high-fiber diet and no laxatives, an abdominal x-ray is taken 5 days after marker ingestion. Eighty percent of the marker should have been passed by then. Noting the distribution of retained markers has been used to perform segmental colonic resection.[4] Radioscintigraphy also has been used to look at colonic transit including segmental dysfunction, gastric emptying, and small bowel transit.[5,6] This modality is not available in all centers.

Defecating proctograms evaluate the rectal emptying. When contrast is given orally, per vagina, and into the sigmoid, additional information as it pertains to outlet obstruction can be obtained. Intussusception, rectoceles, enteroceles, sigmoidoceles, and failure of the rectum to empty are all looked for. Additionally, paradoxical pelvic pressures can also be noted.[7] A positive finding in any of these areas may influence treatment.

Anal physiology testing gives information concerning the rectum and pelvic floor. Evaluation of rectal compliance can be performed and this combined with the ability to evacuate a balloon that has been placed in the rectum provides information about the rectum and coordination with the pelvic floor. Further examination of the pelvic floor can be done looking for a lack of relaxation of the pelvic floor with straining (paradoxical puborectalis contraction). The rectal anal inhibitory reflex is important to note. If absent (in adults), Hirschsprung's disease warrants further consideration.

Conservative Treatment

Medications to improve stooling, enemas, diet and exercise, and biofeedback are all entertained. Even if they failed before in a previous intervention, they may now allow for improvement in symptoms.

Surgical Treatment

Slow Transit Constipation

Disabling constipation requiring colonic resection is seen almost exclusively in women.[8] It is important to assess recurrent constipation, abdominal pain, fecal incontinence, and severe diarrhea when evaluating failure of any treatment.[4] Persistent constipation after colectomy and ileorectal anastomosis ranges from 2% to 32%.[9–11] Since initial function may be satisfactory, long-term follow-up is essential.[12] Scrupulous adherence to only choosing patients with documented slow transit constipation on radiopaque marker studies or radioisotope studies may be the most important factor for success.[9]

Fear of diarrhea and fecal incontinence has led some surgeons to perform a partial colectomy with an ileosigmoid anastomosis or cecorectal anastomosis.[13–15] DeGraaf et al.[4] looked closely at marker progression and advised partial left-sided colectomy when transit in the right colon appeared normal. Recurrent constipation was found in three of 18 patients. Additionally, 14% had fecal incontinence/severe diarrhea, 33% had abdominal pain, and 67% were satisfied with their surgery (Table 26.1).

To be considered successful, fecal incontinence or severe diarrhea are symptoms that should not develop after surgery. Patients having four or five bowels movements daily were found to be generally satisfied.[9] The threshold when patient satisfaction decreases due to stool frequency is not clear. However, frequent stools or fecal incontinence can lead to disabling symptoms. Some patients request a stoma to improve their quality of life.

About 50% of patients continue to experience abdominal pain after resection.[9,13] Therefore, careful preoperative

TABLE 26.1. Results of Total Colectomy for Constipation and Partial Colectomy.

References	*Number*	*Follow-up*	*Constipation (%)*	*Abdominal pain (%)*	*Fecal incontinence (%)*	*Satisfied (%)*
DeGraaf[4] total colectomy	24	Mean 46 months (12–80)	29	62	25	62
DeGraaf[4] partial colectomy	18	Mean 46 months (12–80)	17	33	14	67
Preston[8]	16		25	50	37	81
Lubowski[9]	59	Median 42 months (3–81)	2	52	11	90
Zutshi[11]	35	Median 11 years (5–18 years)	9	21	40	77
Vasilevsky[13]	52		11			79

counseling is essential, providing clear realistic expectations regarding postoperative symptoms.

When considering reoperation for colonic disease, the initial operation is evaluated. Reports supporting various segmental excisions of the colon for delayed transit have been advocated as mentioned above. If these fail and reevaluation demonstrates colonic delay, an abdominal colectomy with ileorectal anastomosis is the initial consideration. The small bowel or stomach may have delayed motility problems, and this should be considered and evaluated. This can be done by following the transit of a radiolabeled meal. The normal transit of the small bowel is 90 to 120 minutes.[16] The anal sphincters need to be evaluated since the stool consistency may be loose along with the possibility of multiple stools daily. Patients with weak sphincters may have disabling fecal incontinence and a stoma may be a better choice. When performing reoperation after an open colonic resection, ureteric stents and a long block of operating room time is essential, since there may be considerable adhesions from the previous surgery. If the initial surgery was done laparoscopically, adhesions would be expected to be substantially less, but the surgeon is always prepared for significant adhesions and the possibility of needing to open the abdomen.

When a full colectomy with ileorectal anastomosis fails to improve constipation, this may signal problems associated with rectal emptying. Puborectalis relaxation and evaluation of rectal evacuation is needed. A proctectomy and pelvic pouch is a consideration, but there is essentially no good studies written about the efficacy of this procedure in these types of patients. Sometimes an ileostomy is the best choice, and if the small bowel does not contract properly, this may also not improve patients but it is worth consideration.

Obstructed Outlet Defecation

When the rectum is the primary problem involved with defecation, the surgical options have been fewer. Certainly for Hirschsprung's disease discovered beyond childhood, surgical intervention is chosen. Since the segment of aganglionic rectum is usually short, resection of the rectum with a mucosectomy and coloanal anastomosis is an excellent option. Care must be taken to ensure that the proximal margin anastomosed at the neodentate line contains ganglion cells.

Repair of a rectocele has been done via the transvaginal, transanal, or transperineal approach. Since many women have a rectocele, it is important to operate only on symptomatic rectoceles. Deciding when a rectocele is symptomatic is sometimes difficult.[17–19] When a patient describes improved defecation by placing fingers in the vagina or around the anus to provide counterpressure and assist defecation, then the rectocele is felt to by symptomatic. It is in this group of patients that surgical correction of the rectocele is felt to be most successful.

For patients who appear to demonstrate obstructed defecation on the defecating proctogram related to a sigmoidocele or enterocele, surgical correction of these problems is done. For a sigmoidocele, a sigmoid resection and colorectal anastomosis is performed. Closure of the inlet of the enterocele is done if that is the culprit.

For rectal dysfunction, biofeedback has been the mainstay of treatment. For patients who fail an acceptable trial of biofeedback, surgical options do exist. Proctectomy with coloanal anastomosis (CAA) has been done with varying results. However, if a proctectomy and CAA is done and fails, consideration of a pelvic pouch is usually not entertained due to the technical difficulty of a reoperation in the patient's pelvis. For those who fail, colostomy or ileostomy has been advocated.

With the popularization of the stapled transanal resectal resection (STARR), patients who seem to have difficulty expelling stool may benefit.[20,21] It is unclear if this is truly a rectocele repair. While significant improvement is seen in many patients, the exact patient who benefits remains unclear.

Sacral neuromodulation has been used in some European centers for rectal evacuation dysfunction. Short-term results are promising.[22] Even in patients with slow transit constipation, improvement has been reported.[23] Unfortunately, sacral neuromodulation is only approved in the United States for urinary incontinence. However, there is anticipation that this treatment option will be generally available in the future for many pelvic floor dysfunction issues. Certainly, when a stoma is contemplated, if available, this treatment can be considered due to the low morbidity.

For patients who continue to experience outlet constipation, a stoma may be the best alternative to improve their quality of life. If the colon works satisfactorily, a colostomy is performed. If the motility of the colon is questionable, an ileostomy is chosen.

Conclusion

Constipation that requires surgical intervention is a frustrating problem. It is always difficult to remove a portion of bowel that looks normal, even though it may not function properly. Perhaps in the future as knowledge is gained, a device that stimulates the bowel at the point where it does not properly propel stool will be available. This may involve an implanted pacemaker that is connected to the bowel via electrodes perhaps sewn onto the serosal surface.

For now, when patients do not improve after the initial treatment and surgery or repeat surgery is contemplated for constipation, think about the symptom complex (Fig. 26.1). It is important to make sure the symptoms seem to correlate with the bowel that will be surgically altered. If surgery has failed, then start again with a fresh history and physical exam. Further testing may be indicated. For most colonic issues, the first step is to make sure a total abdominal colectomy and ileorectal anastomosis was previously performed. If not all of the colon was removed, then a complete colectomy with ileorectal anastomosis is done. If this fails, consideration is given for a completion proctectomy and pelvic pouch, but certainly an ileostomy may be the preferred surgery. A loop ileostomy can always be performed, and if successful at improving symptoms, further

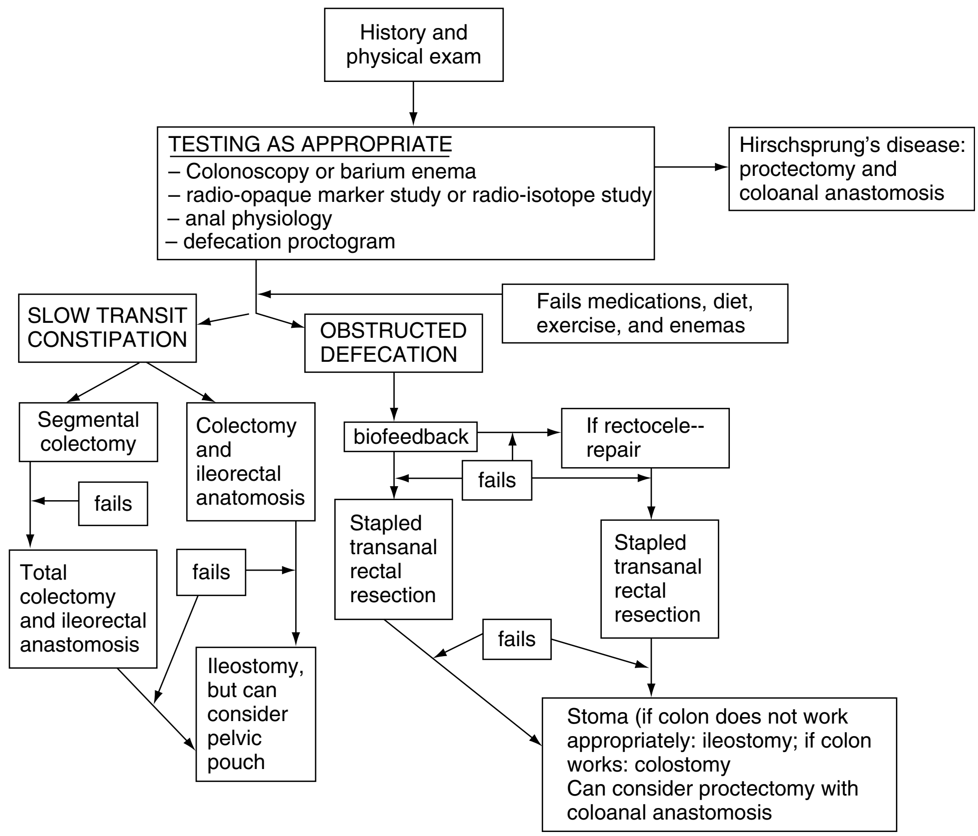

FIGURE 26.1 An algorithm to use when considering recurrent surgery for constipation.

resectional surgery can be seriously entertained. Since dysmotility may be a global problem for the patient, the transit through the stomach and small intestine should be taken into account.

Rectal dysfunction is more difficult. When a rectocele fails, a STARR can be considered (provided that there is no mesh and the tissue at the level where the staple line needs to be placed has sufficient bulk). Even though proctectomy with coloanal anastomosis or a pelvic pouch may be considered, most will ultimately require an ileostomy or colostomy.

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