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DNA Viruses of veterinary importance

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Objectives of this course

- ❖ At the end of this course students should be able to:
 - Describe the properties of DNA viruses
 - Categorize/ classify DNA Virus families
 - Explain replication of DNA viruses
 - Explain pathogenesis mechanisms of DNA viruses in animals
 - List and explain common DNA viral animal diseases and their control and prevention strategies



Families and Genera of Viruses Infecting Vertebrates

DNA

dsDNA **Group I**



Asfarviridae



Poxviridae
Chordopoxvirinae



Iridoviridae
Ranavirus
Lymphocystivirus
Megalocytivirus

dsDNA (RT) **Group VII**



Hepadnaviridae



Herpesviridae



Polyomaviridae



Papillomaviridae



Adenoviridae

ssDNA **Group II**



Circoviridae



Anellovirus



Parvoviridae
Parvovirinae

Poxviridae

- ❖ Large DNA viruses that are capable of infecting both invertebrates and vertebrates
- ❖ Common ability to induce characteristic “pox” (pockmark) lesions in the skin of affected animals
- ❖ Most poxvirus virions are pleomorphic
- ❖ 220–450 nm X 140–260 nm in size
- ❖ Most are enveloped that contains cellular lipids and several virus-encoded proteins



Poxviridae

- ❖ A single molecule of linear double-stranded DNA
- ❖ Genome size from 130 kbp (parapoxviruses) to 280 kbp (fowlpox virus) = encodes abt 200 proteins
- ❖ Replication of poxviruses occurs predominantly, if not exclusively, in the cytoplasm
- ❖ Encodes many enzymes for nucleotide synthesis e.g. DNA polymerase, DNA ligase, RNA polymerase = independent from the nucleus



ICTV Classification of *Poxviridae*

- ✓ The family *Poxviridae* is subdivided into two subfamilies:
 - Subfamily *Chordopoxvirinae*
 - Subfamily *Entomopoxvirinae*



Subfamily: Chordopoxvirinae

1. Genus: *Orthopoxvirus*

- Cowpox virus
- Camel pox virus
- Rabbit pox virus
- Monkey pox virus
- Variola (smallpox) virus
- Vaccinia virus
- Mousepox virus

3. Genus: *Suipoxvirus*

- Swinepox virus

2. Genus: *Capripoxvirus*

- Sheep pox virus
- Goat pox virus
- Lumpy skin disease virus

4. Genus: *Avipoxvirus*

- fowl pox virus
- Canarypox virus

5. Genus: *Parapoxvirus*:

- Orf virus (contagious pustular dermatitis virus)
- Pseudocowpox virus
- Bovine papular stomatitis virus
- Parapoxvirus of red deer



Subfamily: Entomopoxvirinae

Genus *Alphaentomopoxvirus*

Betaentomopoxvirus

Gammaentomopoxvirus



Family: *Poxviridae*

(2 Subfamilies) ← →

Subfamily: *Chordopoxvirinae*

(10 Genera) ← →

- ⊕ Genus: *Avipoxvirus* (10 Species)
- ⊕ Genus: *Capripoxvirus* (3 Species)
- ⊕ Genus: *Cervidpoxvirus* (1 Species)
- ⊕ Genus: *Crocodylidpoxvirus* (1 Species)
- ⊕ Genus: *Leporipoxvirus* (4 Species)
- ⊕ Genus: *Molluscipoxvirus* (1 Species)
- ⊕ Genus: *Orthopoxvirus* (10 Species)
- ⊕ Genus: *Parapoxvirus* (4 Species)
- ⊕ Genus: *Suipoxvirus* (1 Species)
- ⊕ Genus: Unassigned (1 Species)
- ⊕ Genus: *Yatapoxvirus* (2 Species)

Subfamily: *Entomopoxvirinae*

(3 Genera) ← →



☐ Genus: *Avipoxvirus*

Species: *Canarypox virus*

★ Species: *Fowlpox virus*

Species: *Juncopox virus*

Species: *Mynahpox virus*

Species: *Pigeonpox virus*

Species: *Psittacinepox virus*

Species: *Quailpox virus*

Species: *Sparrowpox virus*

Species: *Starlingpox virus*

Species: *Turkeypox virus*

☐ Genus: *Capripoxvirus*

Species: *Goatpox virus*

Species: *Lumpy skin disease virus*

★ Species: *Sheeppox virus*

☐ Genus: *Parapoxvirus*

Species: *Bovine papular stomatitis virus*

★ Species: *Orf virus*

Species: *Parapoxvirus of red deer in New Zealand*

Species: *Pseudocowpox virus*

☐ Genus: *Orthopoxvirus*

Species: *Camelpox virus*

Species: *Cowpox virus*

Species: *Ectromelia virus*

Species: *Monkeypox virus*

Species: *Raccoonpox virus*

Species: *Skunkpox virus*

Species: *Taterapox virus*

★ Species: *Vaccinia virus*

Species: *Variola virus*

Species: *Volepox virus*



Replication Cycle of *poxviruses*

- ❖ Replication and assembly occur in discrete sites within the cytoplasm (called viroplasm or viral factories)
- ❖ Attachment of the viral proteins to host mediates endocytosis of the virus into the host cell.
- ❖ Fusion with the plasma membrane to release the core into the host cytoplasm.
- ❖ Early phase: early genes are transcribed in the cytoplasm by viral RNA polymerase.
- ❖ Core is completely uncoated as early expression ends, viral genome is now free in the cytoplasm.



Replication Cycle of *poxviruses*

- ❖ Intermediate phase: Intermediate genes are expressed, triggering genomic DNA replication
- ❖ Late phase: Late genes are expressed to producing all structural proteins.
- ❖ Assembly of progeny virions starts in [cytoplasmic viral factories](#), producing an spherical immature particle. This virus particle matures into brick-shaped intracellular mature virion (IMV).
- ❖ IMV virion can be released upon [cell lysis](#), or can acquire a second double membrane from trans-Golgi and [bud](#) as external enveloped virion (EEV).



Pathogenesis of *poxviruses*

- ❖ Large DNA viruses that are capable of infecting both vertebrates and invertebrates
- ❖ Poxviruses are resistant to ambient temperatures and can survive for many months or years in dried scabs
- ❖ Poxviruses are transmitted between animals by skin abrasions, aerosol and mechanical transmission by arthropods
- ❖ Highly epitheliotropic: causing cutaneous and systemic disease in birds and wild and domestic mammals



Pathogenesis of *poxviruses*

- ❖ Many are host specific, but orthopoxviruses infect a wide range of hosts
- ❖ After cutaneous introduction or inhalation-the virus gains access to the systemic circulation through the lymphatics.
- ❖ Multiplication of the virus at the skin wound may lead to direct access to the blood and primary viremia.
- ❖ Secondary viremia disseminates the virus back to the skin and other organs.



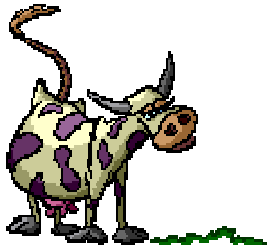
Common Diseases caused by Poxvirus

- ❖ Cowpox
- ❖ Camel pox
- ❖ Sheep and goat pox
- ❖ Lumpy skin disease
- ❖ Fowl pox
- ❖ ORF



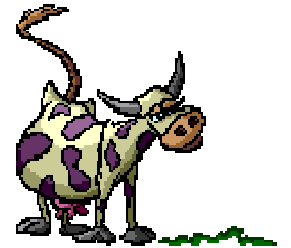
LSD, (a) Acute (b) After 2 months





Cowpox virus

Nomenclature



Family: Poxviridae

Subfamily: Chordopoxvirinae

Genus: Orthopoxviruses

Species: Cowpox virus

Epidemiology

- ❖ Cowpox virus has been found in developing countries, Europe and in adjacent parts of the former Soviet Union and has traditionally occurred via contact with infected teats of milking COWS
- ❖ The reservoir hosts of cowpox virus are rodents from which it can spread occasionally to cats, cows, humans, and zoo animals.
- ❖ Cowpox is a zoonosis, meaning it is transmitted from a vertebrate animal to a human.



Clinical findings

- ❖ Currently, infection with cowpox virus is more commonly seen among domestic cats, from which it is occasionally transmitted to humans.
- ❖ In human produces localized, pustular lesions that are painful.
- ❖ virus infection in domestic cats is often a more severe disease than in cattle or humans.
- ❖ Lesions are on head or a forelimb in cat.
- ❖ In cattle Lesions on the teats
- ❖ the contagious parts of the udder of cows and is spread through herds by the process of milking.

Camel pox

❖ Camelpox virus is very host Specific and does not infect other animals.

➤ Severe generalized

➤ Skin lesions

➤ Case fatality 25%



❖ Transmission is by either direct contact between infected and susceptible animals or indirect infection via a contaminated environment.

Sheep and goat pox

- ❖ All breeds of domestic and wild sheep and goats, although most strains cause more severe clinical disease in only one species



Sheep and goat pox

❖ Clinical signs

- rise in rectal temperature to above 40°C
- macules develop in 2-5 days
- small circumscribed areas of hyperaemia
- papules develop from macules-hard swellings of between 0.5 and 1 cm in diameter
- Papules may be covered by fluid-filled vesicles

Sheep and goat pox

❖ Lesions

- Skin lesions: congestion, haemorrhage, oedema, vasculitis, necrosis.
- Lymph nodes draining infected areas: enlargement (up to eight times normal size)
- lymphoid proliferation
- Pox lesions: on mucous membranes of the eyes, mouth, nose, pharynx, epiglottis, trachea, on the rumenal and abomasal mucosae, and on the muzzle, nares, in the vulva, prepuce, testicles, udder, and teats. Lesions may coalesce in severe cases



Lumpy Skin Disease (LSD) Virus

- ❖ Family Poxviridae
- ❖ Genus Capripoxvirus
- ❖ Closely related to sheep and goat pox
- ❖ Transmission
 - Primary route: biting insects
 - Minor route: direct contact
 - Cutaneous lesions, saliva, nasal discharge, milk,
 - semen may contain the virus
 - No carrier state



Lumpy Skin Disease (LSD) Virus

❖ Clinical signs

- Incubation period: 2 to 5 weeks
- Inapparent to severe infection
- Young calves most susceptible
- Nodule development
- Decreased milk yield
- Raised, circular, firm, coalescing nodules
 - Common on head, neck, udder, perineum, legs



Clinical signs

- Secondary bacterial infections
- Rhinitis, conjunctivitis
- Lameness
- Abortion and sterility

Fowl pox



- ❖ Fowl pox occurs mainly in two forms:
- ❖ Most commonly it is a cutaneous infection of epithelial tissues of the non-feathered portions of the skin characterized by the formation of wart-like nodules on the comb, wattles, oral commissures, eyelids, feet and legs
- ❖ alternatively it appears as an infection of the mucus membranes of the mouth, nose and eyes giving rise to diphtheritic pseudomembranes in the mouth, pharynx and larynx.

Fowl pox

- ❖ Strains: There are 4 main strains of the virus, namely; fowl pox, turkey pox, pigeon pox, and canary pox.
- ❖ Infection by biting
- ❖ Involvement of the skin around the nares may cause nasal discharge, and lesions on the eyelids can cause excessive lacrimation and predispose poultry to secondary bacterial infections.
- ❖ In uncomplicated cases, healing occurs within 3 weeks

ORF(rough) contagious pustular dermatitis

- ❖ Orf is an exanthemous disease caused by a *parapox virus* and occurring primarily in sheep and goats
- ❖ Symptoms
 - papules and pustules on the lips and muzzle
 - less commonly in the mouth of young lambs and on the eyelids, feet, and teats of ewes.
 - The lesions progress to thick crusts which may bleed.
 - Orf in the mouths of lambs may prevent suckling and cause weight loss
 - infect the udder of the mother ewe, mastitis.
 - Extensive lesions on the feet lead to lameness



Asfarviridae

- ❖ Asfar = African swine fever and related viruses
- ❖ African swine fever virus in the family *Asfarviridae* is the cause of African swine fever, an important disease that remains a serious threat to swine industries throughout the world
 - Enveloped, ~200 nm in diameter
 - Large viruses with highly complex genomes of linear ds DNA (170–190 kbp in size)
 - The only known DNA arbovirus and is transmitted by soft ticks of the genus *Ornithodoros*



Asfarviridae

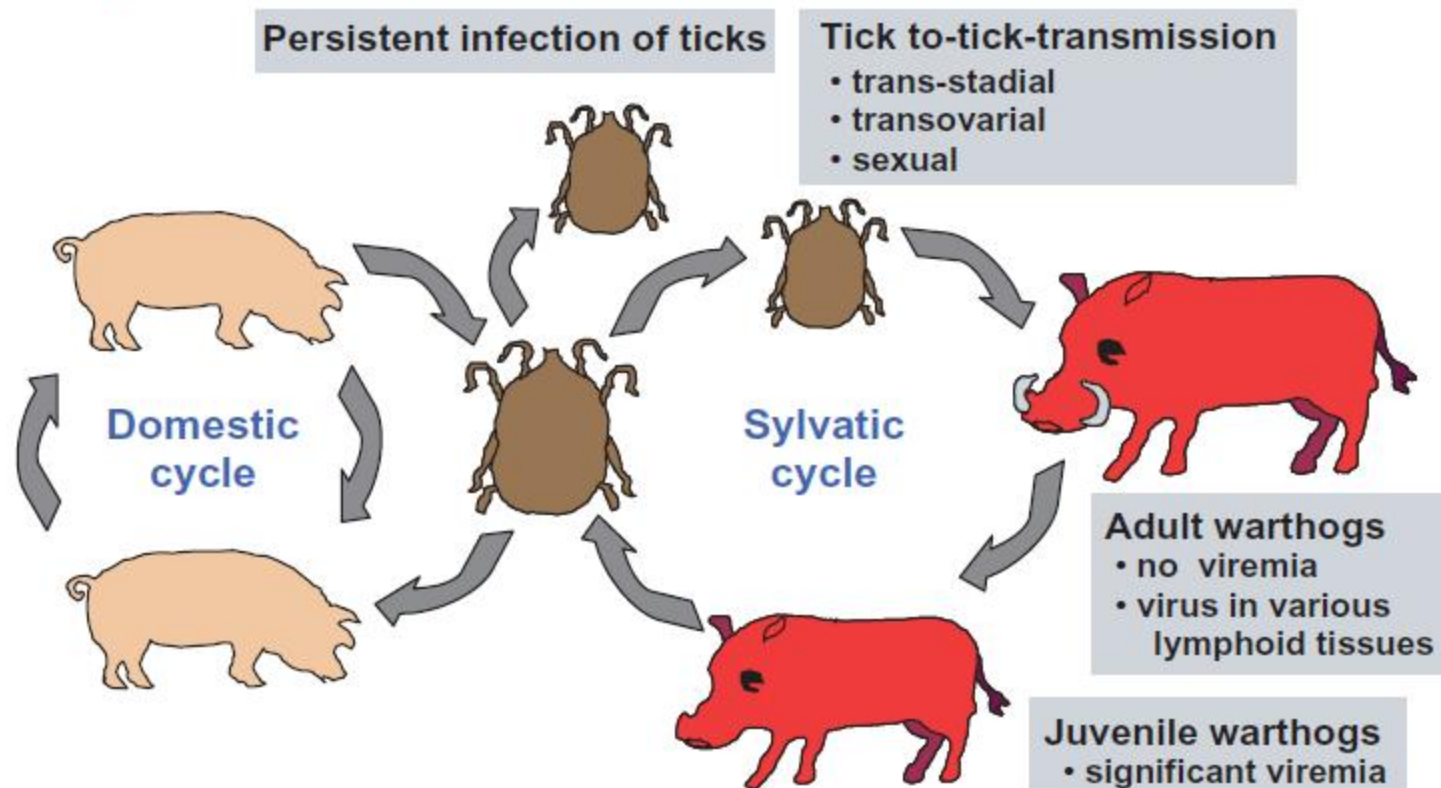
- ❖ ASFV is thermolabile and sensitive to lipid solvents
- ❖ However, the virus is very resistant to a wide range of pH and survives for months and even years in refrigerated meat
- ❖ Replication occurs primarily in the cytoplasm, although the nucleus is needed for viral DNA synthesis and viral DNA is present in the nucleus soon after infection



Family: *Asfarviridae*

Genus: *Asfivirus*

★ Species: *African swine fever virus*

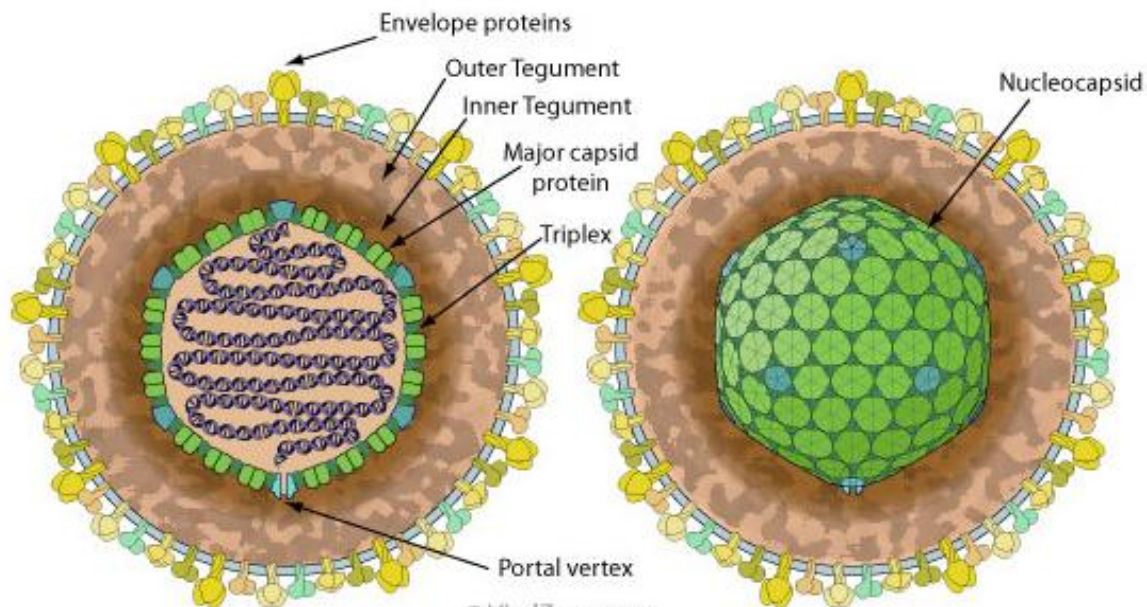
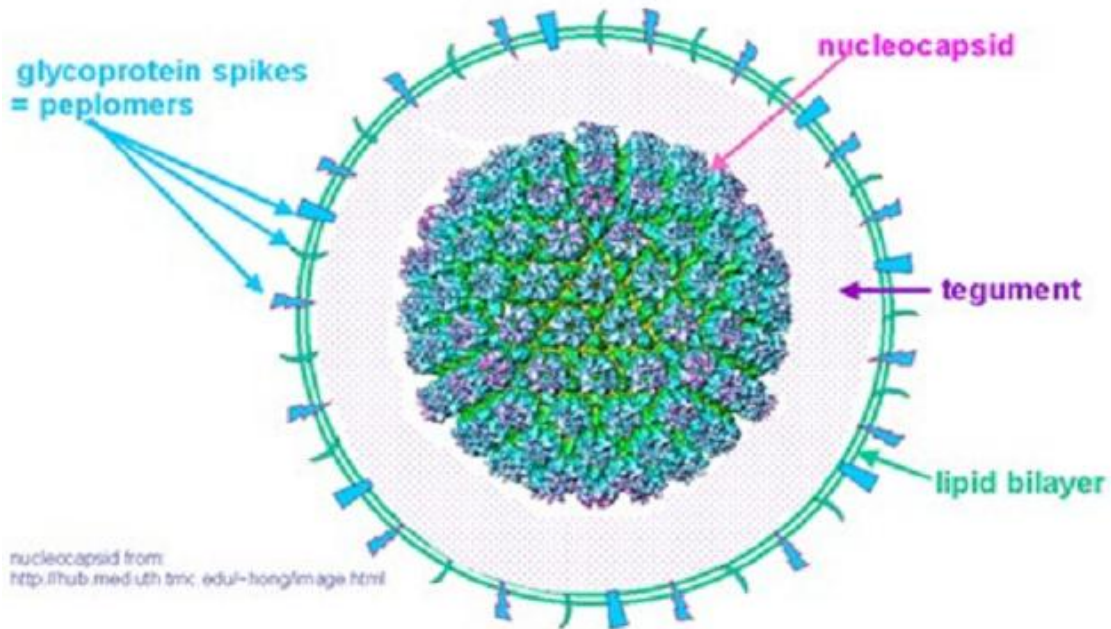


Herpesviridae

- ❖ Herpesviruses have been found in insects, fish, reptiles, amphibians, and mollusks as well as in virtually every species of bird and mammal that has been investigated
- ❖ It is likely that every vertebrate species is infected with several herpesvirus species
- ❖ Herpesvirus infections typically produce severe disease only in neonates, fetuses, immunocompromised individuals
- ❖ The family name is derived from the Greek word herpein ("to creep"), referring to spreading cutaneous lesions, usually involving blisters



HERPESVIRUSES



Herpesviridae

- ❖ An important aspect of herpesvirus pathogenesis is *latency*
- ❖ Latency is defined as persistent life-long infection of a host with restricted but recurrent virus replication
- ❖ Recurrent virus replication can lead to shedding, transmission, and the maintenance of detectable antiviral immune responses.
- ❖ Therefore, latent infections in clinically normal hosts provide a potentially undiagnosed reservoir for virus transmission



[-] Family: *Herpesviridae*

(3 Subfamilies) ←

⊕ Subfamily: *Alphaherpesvirinae* (5 Genera)

⊕ Subfamily: *Betaherpesvirinae* (4 Genera)

⊕ Subfamily: *Gammaherpesvirinae* (4 Genera)

⊕ Subfamily: Unassigned

Subfamily: *Betaherpesvirinae*

(4 Genera) ←

[-] Genus: *Cytomegalovirus*

(8 Species)

Species: *Aotine herpesvirus 1*

Species: *Cebine herpesvirus 1*

Species: *Cercopithecine herpesvirus 5*

★ Species: *Human herpesvirus 5*

Species: *Macacine herpesvirus 3*

Species: *Panine herpesvirus 2*

Species: *Papiine herpesvirus 3*

Species: *Saimiriine herpesvirus 4*



Herpesviridae

❖ Virus properties:

- Have linear, dsDNA genome, 125–290 kbp in size
- Virions are enveloped ~120–250 nm in diameter
- Replication occurs in the nucleus
- Infection results in characteristic eosinophilic intranuclear inclusion bodies

❖ Important diseases:

- Marek's Disease
- Malignant Catarrhal Fever
- Mammillitis/Pseudo-Lumpy Skin Disease Virus
- Infectious Bovine Rhinotracheitis & Infectious Pustular Vulvovaginitis Viruses



Corneal opacity caused by malignant catarrhal fever



Marek's disease

- ❖ Highly contagious neoplastic disease in chicken
- ❖ Named after Jozsef Marek, a Hungarian veterinarian
- ❖ Caused by MDV /*Gallid alphaherpesvirus 2*
- ❖ **Characterized by:**
 - ✓ presence of T cell lymphoma
 - ✓ infiltration of nerves and organs by lymphocytes



Marek's disease

- ❖ Resistance: They are strictly cell associated virus and can be preserved at -60C.
- ❖ Infectivity is retained at pH range 5.5 to 8.4
- ❖ Serotypes /strains: There are three serotypes
 - Serotype 1 (Gallid Herpesvirus 2)- contains all pathogenic strains. The strains are oncogenic.
 - Serotype 2 (Gallid Herpesvirus 3)- avirulent and non-oncogenic strains.
 - Serotype 3 (Meleagrid Herpesvirus 1)- avirulent virus of turkeys.

Symptoms

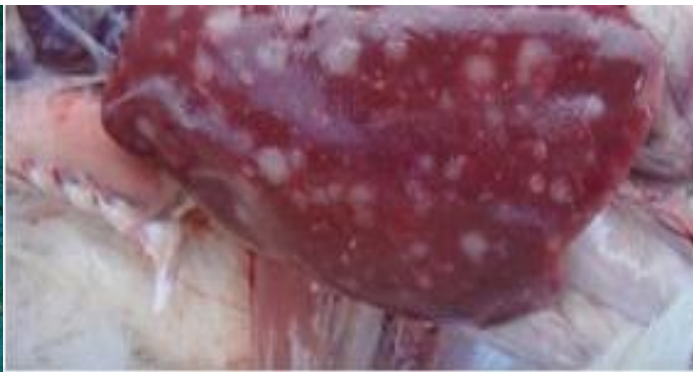
- ❖ Marek's disease occurs in two main forms, depending on which parts of the body are affected by the tumors.
 - Nervous form (Classical form – neural lymphomatosis)
 - Visceral form (Acute form)
- ❖ The symptoms and lesions of the eye are sometimes referred as ocular form (ocular lymphomatosis)



Marek's disease

❖ *Classical Marek's disease /neurolymphomatosis:*

- Asymmetric paralysis of limbs
- With vagus nerve involvement, difficulty breathing or dilation of the crop may occur
- lymphomatous infiltration/tumours in the skin, skeletal muscle, visceral organs (e.g. spleen, liver, kidneys, lungs, heart, proventriculus and adrenals)



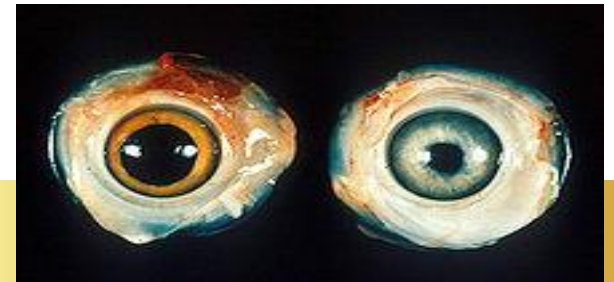
Marek's disease

❖ *Acute Marek's disease* (Visceral form)

- Epidemic in a previously uninfected/unvaccinated flock
- Causing depression, paralysis, and death in a large number of birds (up to 80%)
- The age of onset is much earlier than the classic form(4-8Wks)
...3-4 months in classical
- Infiltration into multiple organs/tissue is observed

❖ *Ocular lymphomatosis:*

- causes lymphocyte infiltration of the iris (making the iris turn grey), unequal size of the pupils, and blindness
- ✓ Left: normal chicken eye.
- ✓ Right: Eye of a chicken with Marek's disease



Transmission

- ✓ Chicks are infected very early in life, usually within the first few days,
- ✓ Get infected from virus in dust in their env't
- ✓ Virus multiplies in the bird's lymphoid tissues
- ✓ Infected birds shed this virus in feather dust (dander)
- ✓ Birds which survive will shed the virus for life and present a risk to others in the flock
- ✓ Because of this risk, it's generally advised that you should cull any affected birds



Transmission

- ✓ The virus is very resistant in the environment
- ✓ It can survive for at least a year in feather dander and dust in the hen house
- ✓ Source of infection for the next generation
- ✓ It is crucial that an environment be thoroughly disinfected using a potent yet poultry friendly product
- ✓ It can occur at any age, but it's most often diagnosed between 12 and 24 weeks
- ✓ Stress factors can trigger the disease



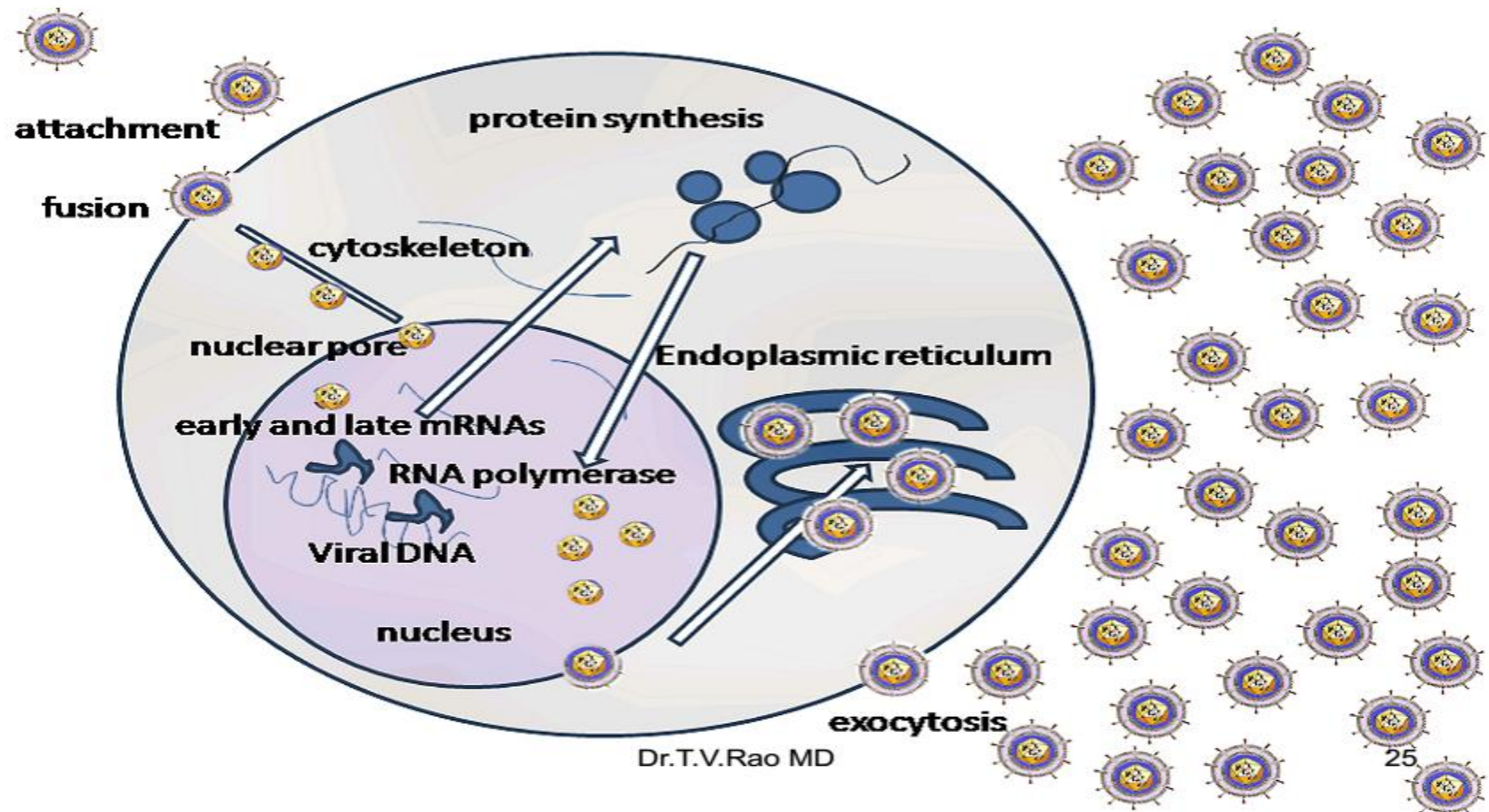
Control

- ❖ **Vaccination** of day-old chicks is an effective means of control
- ❖ Vaccines are also effective when administered to embryos at the **18th day of incubation**
- ❖ In ovo vaccination is now performed by automated technology
- ❖ Important to **maintain high hygienic and sanitary measures** by good management to avoid early exposure of young chickens



Replication

- Viruses replicate in the nucleus and mature by budding through the nuclear membrane, thus acquiring an envelope.



Pathogenesis

- ❖ A feature of all herpesvirus infections is lifelong persistent infection, usually in latent form.
- ❖ An important aspect of herpesvirus pathogenesis is latency
- ❖ Latency is defined as persistent life-long infection of a host with restricted but recurrent virus replication
- ❖ Excretion, especially in saliva or genital secretions, may occur continuously or intermittently and with or without episodes of recurrent clinical signs.
- ❖ Some member viruses of the subfamily Gammaherpesvirinae cause tumors



Pathogenesis

Entry by skin or mucous membranes



viral multiplication → sensory nerve



lysis of cells



vesicles



ulcers

↓
root ganglia

↓
latency

REACTIVATION

COLD
FEVER
SURGERY
UNKNOWN

Dr.T.V.Rao MD

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Adenoviridae

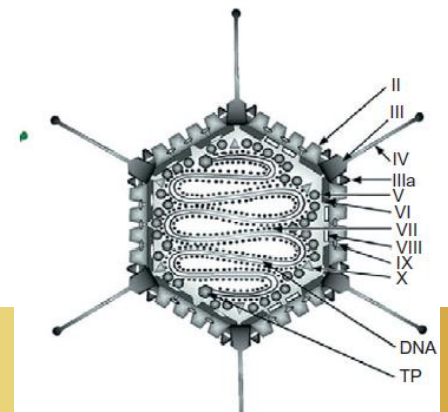
- ❖ In 1953, Wallace Rowe and colleagues, having observed that explant cultures of human adenoids degenerated spontaneously, isolated a new virus that they named *adenovirus*
- ❖ Most of adeno viruses produce subclinical infections in their respective hosts, with occasional upper respiratory disease, but canine and avian adenoviruses are especially associated with clinically important disease syndromes.



Adenoviridae

❖ Virus properties:

- Virions are non-enveloped, hexagonal in outline, with icosahedral symmetry, 70–90 nm in diameter
- one (genus *Mastadenovirus*) or two (genus *Aviadenovirus*) fibers (glycoprotein) projecting from each vertex of the capsid
- The genome consists of a single linear molecule of double-stranded DNA, 26–45 kbp in size



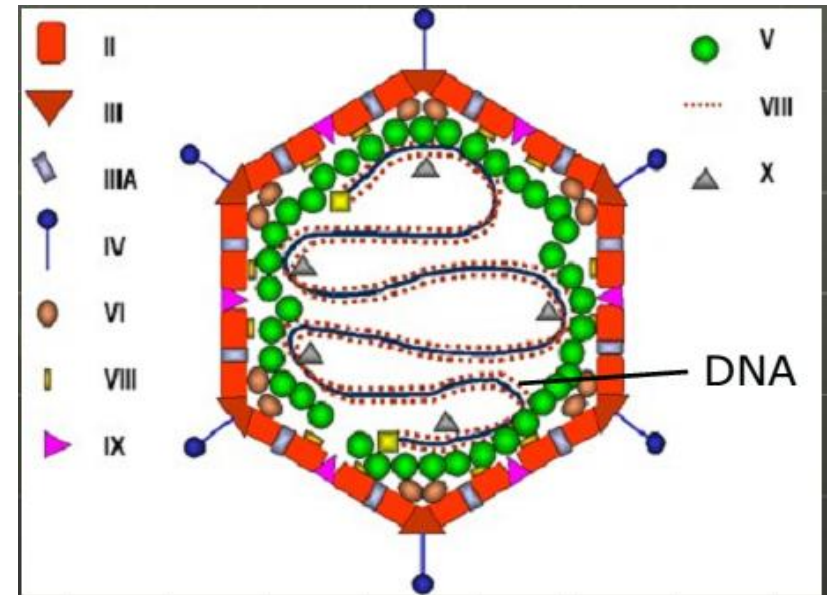
Adenoviridae

- ❖ Replicate in the nucleus where mRNA transcription, viral DNA replication, and assembly of virions occur
- ❖ Virions are released by cell lysis
- ❖ Intranuclear inclusion bodies are formed, containing large numbers of virions
- ❖ Viruses agglutinate red blood cells
- ❖ Some viruses are oncogenic in laboratory animals



Adenoviridae

- ❖ The capsid contains 252 capsomers arranged as icosahedrons with 20 triangular facets and 12 vertices
- ❖ 240 are called as hexons
- ❖ 12 are called as pentons.
- ❖ Adenoviruses are unusually stable to chemical and physical agents and to adverse pH conditions, thus allowing for prolonged survival outside of.



Adenoviridae

- ❖ This family contains three genera
- ❖ *Mastadenovirus*, comprising viruses that infect only mammalian species
- ❖ *Aviadenovirus*, comprising viruses that infect only birds
- ❖ *Atadenovirus* that includes viruses that infect a broad host range, including snakes, lizards, ducks, geese, chickens, possums, and ruminants



Adenoviridae

❖ Genus: Mastadenovirus

- human adenoviruses 1-49.
- equine adenoviruses 1 and 2.
- canine adenovirus 1 (infectious canine hepatitis virus),
- canine adenovirus 2 (canine adenoviruses have also caused epidemics in foxes, bears, wolves, coyotes, and skunks),
- bovine adenoviruses 1, 2, 3, and 10, and ovine adenovirus 3

❖ Genus: Aviadenovirus

- hemorrhagic enteritis virus (fowl, turkeys)
- marble spleen disease virus (fowl)

❖ Genus (proposed): Atadenovirus

- ovine adenovirus 287
- bovine adenoviruses 4, 5, 6, 7, and 8, and egg drop syndrome virus



[-] Family: *Adenoviridae* (5 Genera) ←

+ Genus: *Atadenovirus* (5 Species)

+ Genus: *Aviadenovirus* (8 Species)

+ Genus: *Ichtadenovirus* (1 Species)

+ Genus: *Mastadenovirus* (25 Species)

+ Genus: *Siadenovirus* (5 Species)

[-] Genus: *Mastadenovirus* (25 Species) ←

Species: *Bat mastadenovirus A*

Species: *Bat mastadenovirus B*

Species: *Bovine mastadenovirus A*

Species: *Bovine mastadenovirus B*

Species: *Bovine mastadenovirus C*

Species: *Canine mastadenovirus A*

Species: *Equine mastadenovirus A*

Species: *Equine mastadenovirus B*

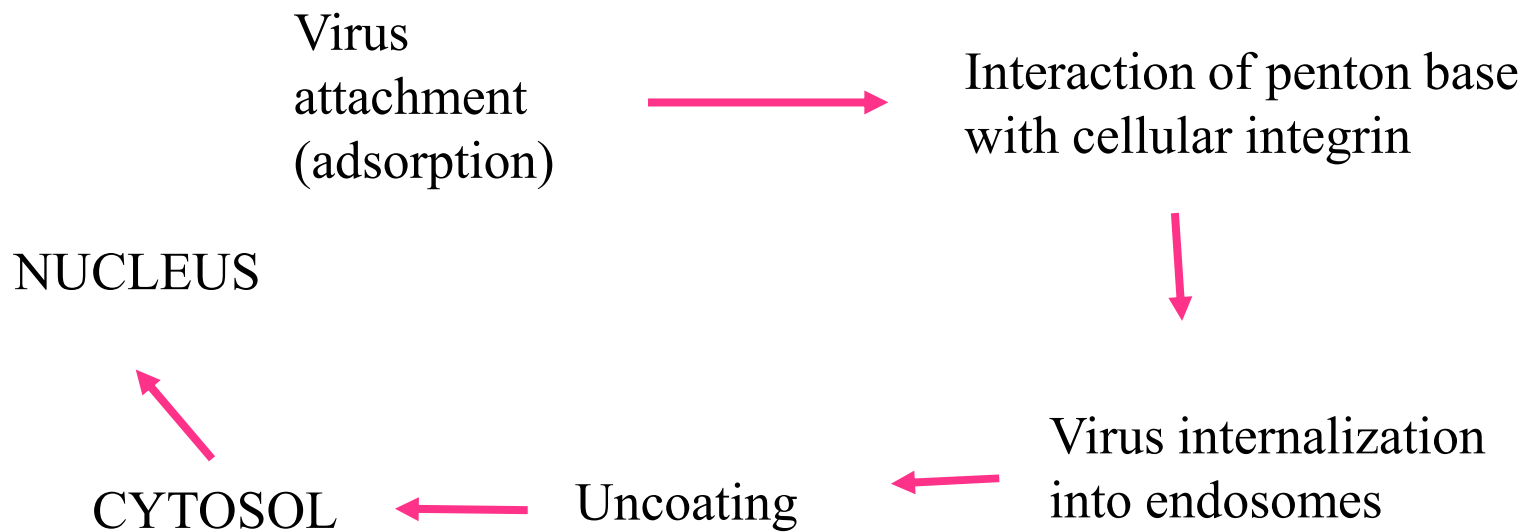
Species: *Human mastadenovirus A*

Species: *Human mastadenovirus B*



Replication

- ❖ Induce the host cell to enter the S phase of the cell cycle-create conditions conducive to viral replication



Pathogenesis

- ❖ Adenovirus cause infections in
 - Respiratory tract
 - Eye, Urinary bladder, and Intestines
- ❖ Some of the adenoviruses of humans, cattle, and chickens cause tumors when inoculated into newborn hamsters and have been used in experimental studies on oncogenesis, but none causes tumors in its natural host.
- ❖ Important disease: Infectious Canine Hepatitis, Canine Infectious Tracheobronchitis (Kennel Cough), Equine Adenovirus Infections



Infectious Canine Hepatitis: Rubarth's diseases

- ❖ Etiologic Agent: Canine adenovirus 1
- ❖ Host: Family Canidae (domestic & wild) & Ursidae (bears)
- ❖ Distribution: worldwide
- ❖ Transmission: mainly ingestion of urine, feces, or saliva, also conjunctival or aerosol routes
- ❖ Pathogenesis: initial infection in tonsillar crypts & Peyer's patches.
- ❖ Clinical Feature: viremia leading to hemorrhages & necrosis of target organs (liver, kidneys, spleen, lungs), mostly asymptomatic, can lead to Corneal Edema (blue eye), Glomerulonephritis, Encephalitis (foxes)



Canine Infectious Tracheobronchitis: Kennel Cough

- ❖ Etiologic Agent: Canine adenovirus 2 (also canine parainfluenza virus 2, Bordetella bronchiseptica, Mycoplasma cynos)
- ❖ Host: Canines
- ❖ Distribution: worldwide
- ❖ Transmission: highly contagious via aerosolized microdroplets.
- ❖ Pathogenesis: self-limiting (2wks) upper respiratory disease.
- ❖ Clinical Feature: nonproductive cough



Equine Adenovirus Infections

- ❖ Etiologic Agent: Equine adenovirus 1
- ❖ Host: horses, mostly Arabians due to T&B cell immunodeficiency
- ❖ Distribution: worldwide
- ❖ Transmission: aerosol
- ❖ Pathogenesis: fatal, horses susceptible to a wide range of pathogens as maternal antibodies wane (usually within 3 months).
- ❖ Clinical Feature: bronchiolitis and pneumonia.



Papillomaviridae and Polyomaviridae

- They are taxonomically and biologically distinct, but they share striking similarities in their genome organization, virion structure, and mechanisms of replication, cell cycle regulation, and tumor induction
- Papovavirus [the name derived from papilloma, polyoma, vacuolating (Simian vacuolating virus 40 (SV40)]
- Virions are nonenveloped, spherical in outline, with icosahedral symmetry



Papillomaviridae and Polyomaviridae

Virus properties:

- Non-enveloped, spherical, 55 nm(*Papillomaviridae*) or 45 nm (*Polyomaviridae*) in diameter, with icosahedral symmetry
- Single molecule circular double-stranded DNA genomes, 6.8–8.4 kbp (*Papillomaviridae*) or 5 kbp (*Polyomaviridae*) in size
- Resistant to diverse environmental insults: infectivity survives lipid solvents and detergents, low pH, and high temperatures
- Replicated in the nucleus



Papillomaviridae and Polyomaviridae

- Genus: Polyomavirus (murine polyomavirus)
 - mouse polyoma virus
 - SV40 virus (both of which have been useful models for the study of viral oncogenesis).
- Genus: Papillomavirus
 - human papillomaviruses (more than 70 types; cause of warts; particular types are associated with cancer of the cervix, anus, and pharynx).
 - bovine papillomaviruses (cause of cutaneous papillomas in cattle
 - canine oral papillomatosis virus
 - rabbit papillomavirus



Parvoviridae

- ❖ Requirement for cells that are passing through mitotic S phase in order to replicate their DNA
- ❖ The relative availability of mitotically active cells in specific tissues during differentiation in early life confers an age-dependent susceptibility to several parvovirus-induced diseases
- ❖ Thus certain parvovirus infections are most severe in fetuses (after transplacental infection) and neonates



Parvoviridae

❖ Classification: Two subfamilies:

➤ *Densovirinae*: viruses of insects

➤ *Parvovirinae*: contains viruses of vertebrates

✓ Five genera in the *Parvovirinae* subfamily:

✓ *Parvovirus*

✓ *Erythrovirus*

✓ *Dependovirus*

✓ *Amdovirus*

✓ *Bocavirus*



Parvoviridae

- ❖ Genus: Parvovirus (minute virus of mice)
 - Feline panleukopenia virus,
 - Canine parvovirus 1, 2a, and 2b,
 - Bovine parvovirus,
 - Goose parvovirus,
 - Porcine parvovirus,
 - Murine parvovirus
- ❖ Genus: Erythrovirus (human parvovirus B19)
- ❖ Genus: Dependovirus (adeno-associated virus 2): Insects



Parvoviridae

Virus Properties:

- ❖ They are non-enveloped, 25 nm in diameter & have icosahedral symmetry
- ❖ The genome consists of a single molecule of linear, ss DNA, ~4.5–5.5 kb in size
- ❖ Replication occurs in the nucleus of dividing cells; infection leads to large intranuclear inclusion bodies
- ❖ Viruses are very stable, resisting 60°C for 60 minutes and pH 3 to 9
- ❖ Most viruses hemagglutinate red blood cells



TABLE 12.1 Manifestations of Parvovirus Diseases in Animals^a

Virus	Disease
Feline panleukopenia virus	Generalized disease in kittens, with panleukopenia, enteritis; cerebellar hypoplasia
Canine parvovirus 1 (minute virus of canines)	Minimal
Canine parvovirus 2 (subtypes 2a, 2b, 2c)	Generalized disease in puppies; enteritis, myocarditis (rarely), lymphopenia
Porcine parvovirus	Stillbirth, abortion, fetal death, mummification, infertility.
Mink enteritis virus	Leukopenia, enteritis
Aleutian mink disease virus	Chronic immune complex disease, encephalopathy. Interstitial pneumonia in neonates
Mouse parvoviruses, minute virus of mice, rat parvoviruses, H-1 virus of rats	Subclinical or persistent infection; congenital fetal malformations; hemorrhagic syndrome in rats
Goose parvovirus	Hepatitis, myocarditis, myositis
Duck parvovirus	Hepatitis, myocarditis, myositis

^a Parvoviruses have also been detected in a variety of animal species, frequently in the absence of obvious clinical disease.



Canine Parvovirus infection

- ❖ The virus is very stable in the environment, able to withstand wide pH ranges and high temperatures.
- ❖ It is resistant to a number of common disinfectants and may survive for several months in contaminated areas.
- ❖ The virus agglutinates porcine or Rhesus monkey RBC
- ❖ Hosts affected: Dogs are mainly affected by this infection.
- ❖ Distribution: The infection is worldwide in distribution



Canine Parvovirus infection

- ❖ Transmission: The virus is transmitted from direct contact with infected dogs.
- ❖ Indirect transmission, e.g., from fecal-contaminated fomites, is also an important source of infection.
- ❖ The virus is shed in the feces of infected dogs for up to 3 wk after infection.
- ❖ Recovered dogs may serve as carriers and shed the virus periodically.



Canine Parvovirus infection

- ❖ Incubation period: 3-8 days.
- ❖ Mortality varies from 16-35%.
- ❖ Gastroenteritis is most common in pups 6-20 week old.
- ❖ Gastrointestinal form mostly seen in young male dogs of less than 1 year old.
- ❖ Myocarditis is observed in young pups, especially in the early neonatal period.



Circoviridae

- ❖ Includes viruses with circular single-stranded DNA genomes
- ❖ Together with members of the family *Parvoviridae*, *Circoviridae* are the smallest known DNA viruses of vertebrates
- ❖ Includes important pathogens of birds and swine
- ❖ Virions are small (20–25 nm), non-enveloped, spherical in outline, with icosahedral symmetry



Circoviridae

- ❖ The genome consists of a single molecule of circular (covalently closed ends) single-stranded ambisense (genus *Circovirus*) or positive-sense (genus *Gyrovirus*) DNA, 1.7–2.3 kb in size
- ❖ Replication takes place in the nucleus of cycling cells, producing large intranuclear inclusion bodies
- ❖ **Disease:**
- ❖ Chicken infectious anemia



Hepadnaviridae

- ❖ Name of family comes from hepa-DNA-virus
- ❖ ‘Hepar’ means liver
- ❖ As it is Group VII virus, replication involves an RNA intermediate
- ❖ Encodes for an enzyme having reverse transcriptase activity
- ❖ E.g. *Hepatitis B virus*

Duck hepatitis B virus



I
thank
you

