



Tikrit University
College of Veterinary Medicine

Lect. 9-Virology

Subject name: DNA viruses families:
Herpesviridae and Poxviridae

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Lecturers link

I. Herpesviridae:

□ Structure characters:

1. Herpesvirus virions are enveloped with icosahedral symmetry and include a core, capsid, and tegument :
2. The tegument are proteins that occupy the space between the capsid and the nuclear envelope. The structure suggests play a role in viral transport.
3. All herpesviruses have genomes of linear, double-stranded DNA (dsDNA).
4. Replicate in nucleus, with intranuclear inclusion bodies.
5. They has an external diameter of approximately 150-200 nm in diameter, T=16 icosahedral symmetry
6. Latency is a common outcome of infection with these viruses.

Viral latency refers to the ability of certain viruses to remain dormant within the host cell, sometimes establishing lifelong hidden infections. During latency, the virus exists in a resting state without producing more virus particles and typically does not cause noticeable symptoms

7. This family contains more than 100 viruses which cause different diseases in human, birds, mammals, fish, amphibian & reptiles.
8. They are easily inactivated and do not survive well outside the body.
9. Transmission requires close contact, particularly mucosal contact (licking and nuzzling, as between mother and offspring or between neonates). Fig.1

❑ Icosahedral symmetry

Icosahedral symmetry refers to a specific type of symmetry exhibited by geometric structures known as icosahedra. An icosahedron is a polyhedron with 20 equilateral triangular faces, 12 vertices, and 30 edges.

In terms of symmetry, an icosahedron possesses rotational symmetry, meaning it can be rotated by certain angles and still appear the same. The icosahedron exhibits the highest degree of rotational symmetry among the regular polyhedra.

The rotational symmetry of an icosahedron is characterized by a 5-fold rotational axis passing through the center of each face. This means that the icosahedron can be rotated by 72 degrees (360 degrees divided by 5) around any of these axes and still look identical. In total, there are 12 such rotational axes in an icosahedron.

In addition to rotational symmetry, an icosahedron also exhibits other symmetrical properties. For example, it possesses reflectional symmetry, which means it can be divided into two halves with a mirror plane passing through its center. This mirror plane bisects opposite edges and opposite vertices of the icosahedron.

observed in various other natural and man-made structures, such as certain viruses, crystals, and even soccer balls (which are often modeled after truncated icosahedra).

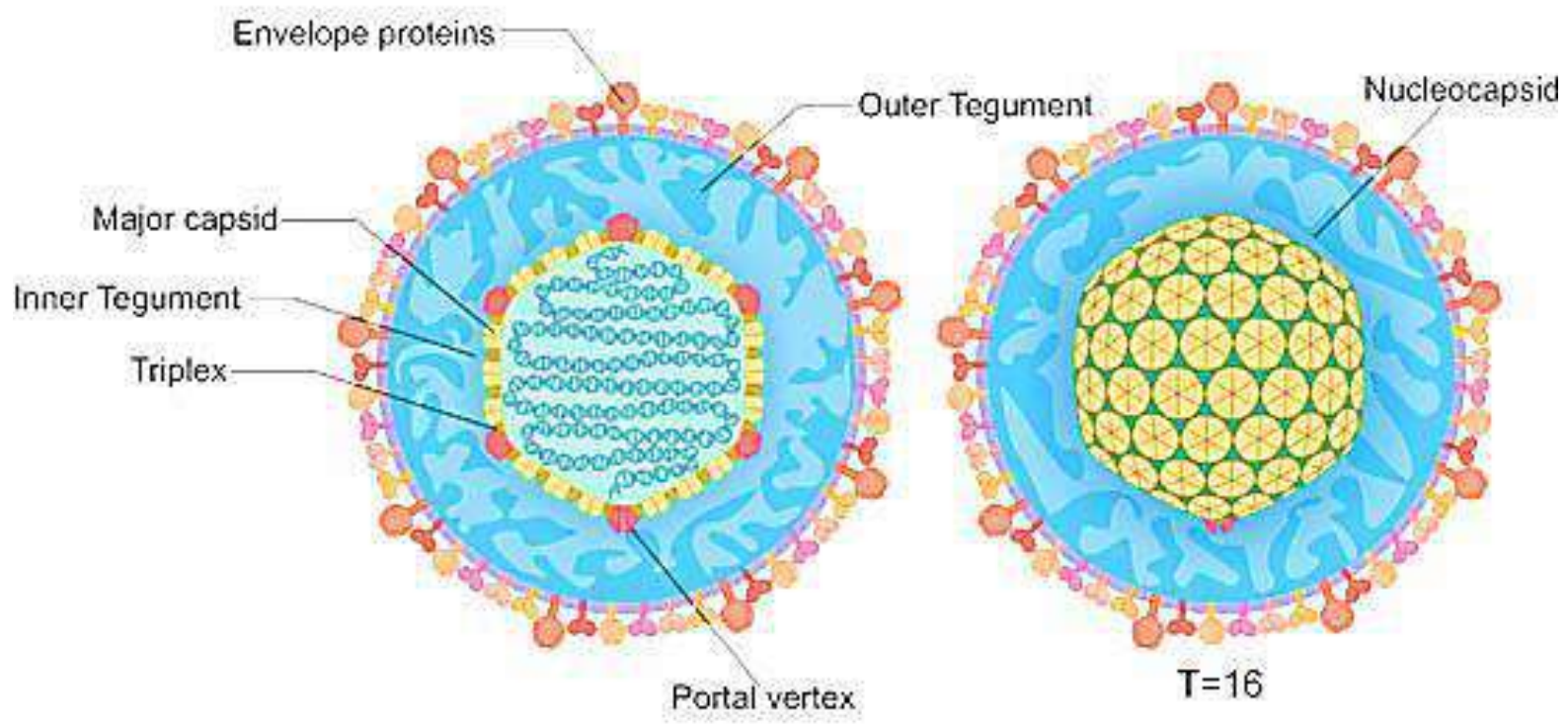


Figure 1. The structure of herpesviruses

❑ Inclusion bodies

Inclusion bodies are distinct structures that can be found within cells. They are often composed of aggregated proteins or other substances and are typically observed under a microscope. Inclusion bodies can form as a result of various cellular processes and are associated with several diseases and conditions.

Inclusion bodies can be classified into different types based on their composition and location within cells. Some examples of inclusion bodies include:

- ❑ **Viral inclusion bodies: Certain viral infections can lead to the formation of inclusion bodies within infected cells. These inclusion bodies often contain viral particles or viral proteins. Negri bodies are primarily observed in the neurons of the central nervous system in rabies virus infection and intranuclear inclusions in herpes simplex virus infection.**
- ❑ Nuclear inclusion bodies: These inclusion bodies are located within the nucleus of cells and can be associated with viral infections, such as Cowdry type A bodies seen in herpes virus infections.
- ❑ Cytoplasmic inclusion bodies these inclusion bodies are located in the cytoplasm of cells and can be observed in various conditions. Examples include Mallory bodies in alcoholic liver disease and Lewy bodies in Parkinson's disease.

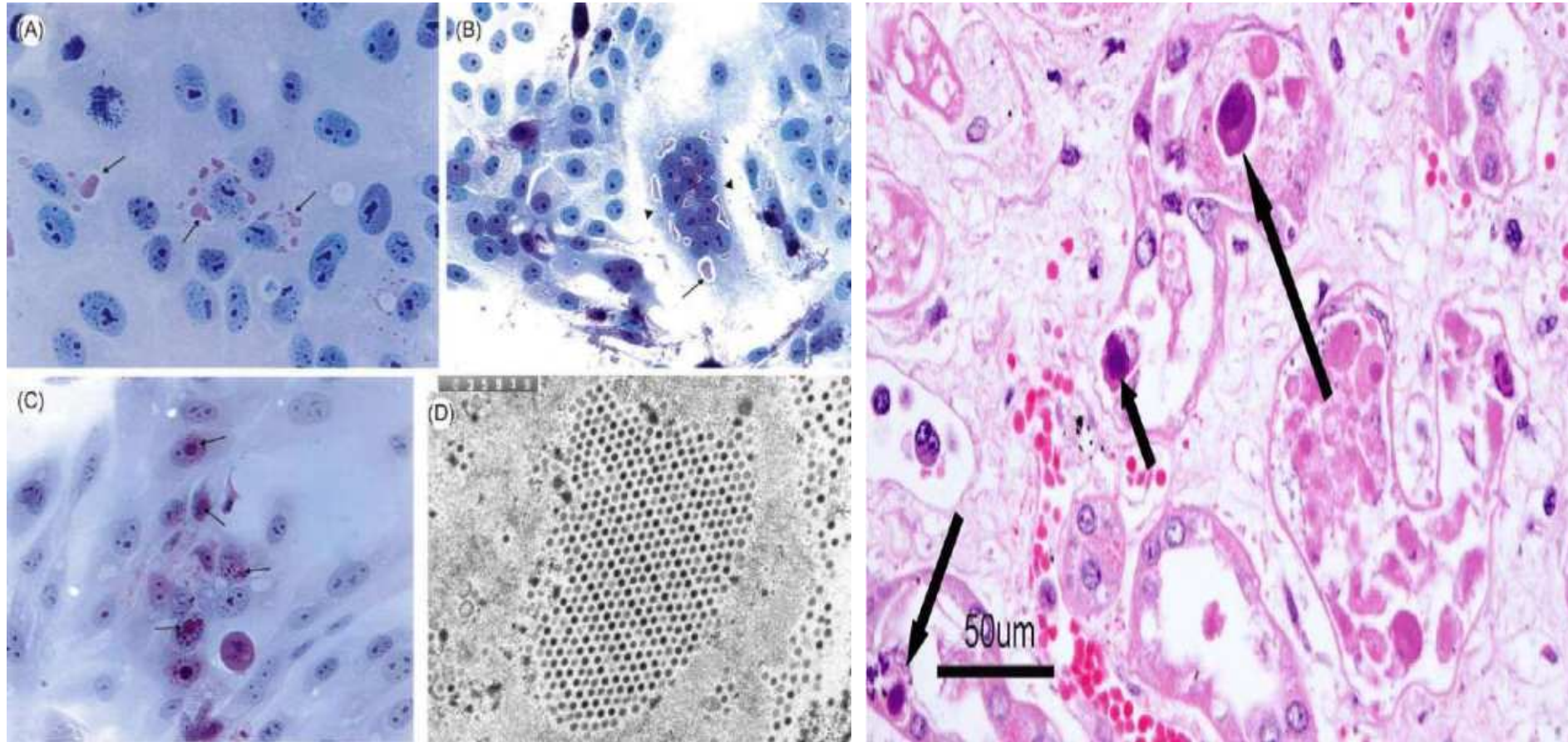


Figure.2 : Typical inclusions and abnormal cell morphology in virus-infected cells. (A) Reovirus inclusions (arrows) in infected Vero cells. (B) Canine distemper virus inclusions (arrows) and syncytium (arrowheads) in infected Vero cells. (C) Bovine adenovirus 5 intranuclear inclusions (arrows) in primary bovine kidney cells. (D) Transmission electron micrograph of an untyped adenovirus nuclear inclusion in A459 cells.

There are three subfamilies of veterinary importance:

Alpha herpesvirinae, Beta herpesvirinae, Gamma herpesvirinae which cause diseases of the respiratory, reproductive & nervous systems, in different animal species: e.g. Herpes infections of ruminants

Subfamily Alphaherpesvirinae:

- a. Bovine Alphaherpesviruses Bovine herpes virus cause (infectious bovine rhinotracheitis (IBR).
- b. Avian Alphaherpesviruses In poultry:
 - a. infectious laryngo-tracheitis (ILT).
 - Marek's disease.
 - Duck plaque.

❑ **Bovine Rhinotracheitis (IBR):-**

Infectious bovine rhinotracheitis (IBR) is a disease characterized by acute inflammation of the upper respiratory tract. There are two subtypes of bovine herpesvirus 1:bohv-1.1 and bohv-1.2

Bohv-1 infection can also sporadically cause abortion in cattle.

Bovine rhinotracheitis (IBR):-is a highly contagious, infectious disease that is caused by bovine herpesvirus-1 (BHV-1).

In addition to causing respiratory disease, this virus can cause conjunctivitis, abortions, encephalitis, and generalized systemic infections.

(Encephalitis is a condition characterized by inflammation of the active tissues of the brain. It can be caused by various factors)

Transmission:-secretions from the eye nose and reproductive organs.

Signs relating to respiratory disease

Infectious bovine rhinotracheitis (ibr)

Fever (as high as 42 c) ,depression ,loss of appetite ,reddening of the mucous membranes

Ulceration / reddening of the upper airway, nasal discharge – initially watery and later may become purulent قبيحة , conjunctivitis – runny eyes, drop in milk production

inflammation of the conjunctiva, the thin layer that covers the white part of the eye and the inside of the eyelids. similar to the common cold or flu.

Signs relating to reproductive disease : Abortion

Lesions



Nasal Discharge



Infectious bovine rhinotracheitis (IBR)

Marek's disease (MD)

Marek's disease (MD) is a common disease of backyard chickens

Marek disease is a highly contagious viral disease of poultry that is caused by a herpesvirus. Its characterized by T-cell lymphomas, peripheral nerve enlargement, immunosuppressive and is often described as a virally induced cancer. It is also MD primarily affects young birds (6-20 weeks) and mortality can be high.

The virus is very contagious and is spread through direct contact (bird-to-bird aerosols and secretions) and indirect contact (contaminated material). The virus concentrates in feather follicles and can also be shed in dander.

Marek's disease-causing virus particles can survive for months in chicken house dust and litter. It is very easy for the virus to be moved through contaminated shoes, clothing and equipment.

As with other herpesviruses, chickens may become persistently infected without showing any clinical signs.

Standard criteria used for diagnosis include history, clinical signs, gross necropsy, and histopathology. Although no treatment is available, current vaccines are highly protective.

There are three species of MDV:

1. Gallid herpes virus 2 (serotype 1).
2. Gallid herpesvirus 3 (serotype 2).
3. Meleagrid herpesvirus 1 (serotype 3, also called herpesvirus of turkeys, HVT).

Serotype 1 includes all the virulent poultry strains and some attenuated vaccine strains.

There are four forms of Marek's Disease:

1. **Cutaneous form**: Swollen feather follicles (bumps) on the skin that can form crusty scabs.

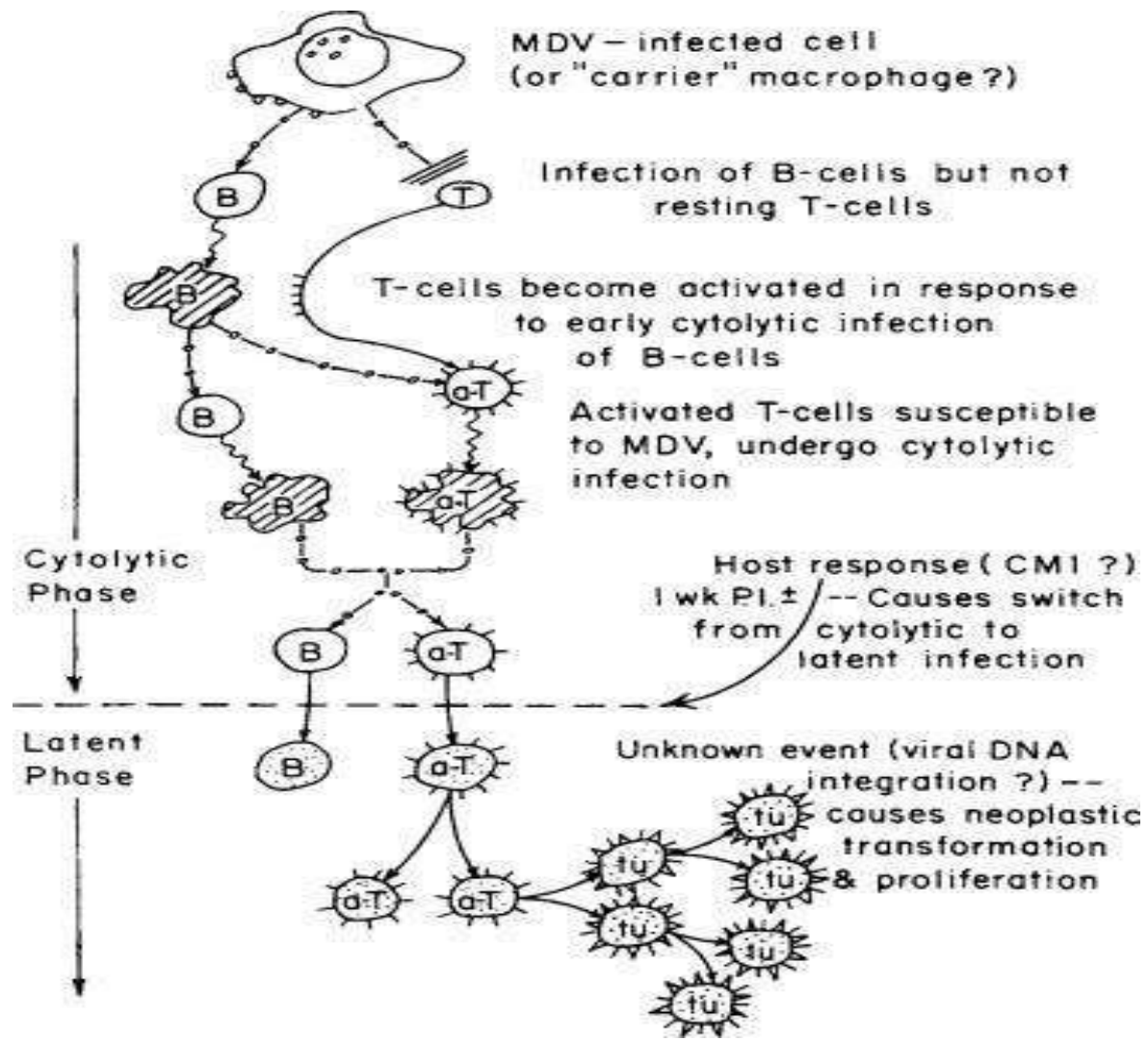
1. **Neural form**: Characterized by one, all, or none of the following symptoms:

- a) • Progressive paralysis, usually of the leg, a typical leg-paralysis affected bird will have one leg extended forward and one leg tucked under the bird. This is the result of infiltration of lymphocytes in the sciatic nerve.
- b) • Weight loss, labored breathing, diarrhea.
- c) • Starvation and death due to an inability to reach feed and water and/or trampling by other birds.

3. **Ocular form**: Gray eye color and misshapen iris due to infiltration of lymphocytes in the eye.

3. **Visceral Form**: Tumors in internal organs including heart, ovary, liver, kidney and lung.





II. Poxviridae:

Structure characters:

1. Most poxvirus virions are large, pleomorphic, (220-450 nm x 140-260 nm) with an irregular surface of projecting tubular or globular structures
2. Complex symmetry, typically brick-shaped.
3. Enveloped double-stranded DNA and replicate in cytoplasm.
4. Virions are stable at room temperature under dry conditions, but sensitive to heat, detergents, formaldehyde and oxidizing agents.
5. Skin lesions prominent feature.
6. Genetic recombination within genera results in extensive serological cross reaction and cross-protection.

Genera of Poxviridae:

a. Orthopoxvirus: Vaccinia, cow pox , variola virus(Smallpox) , Monkeypox virus.

the smallpox vaccine protects people from smallpox by helping their bodies develop immunity to smallpox. The vaccine is made from a virus called **vaccinia**, which is a poxvirus similar to smallpox, but less harmful. The smallpox vaccine contains live vaccinia virus, not a killed or weakened virus like many other vaccines. For that reason, people who are vaccinated must take protections when caring for the place on their arm where they were vaccinated, so they can prevent the vaccinia virus from spreading.

a. Parapoxvirus: Orf virus, Bovine papular stomatitis virus, pseudo complex.

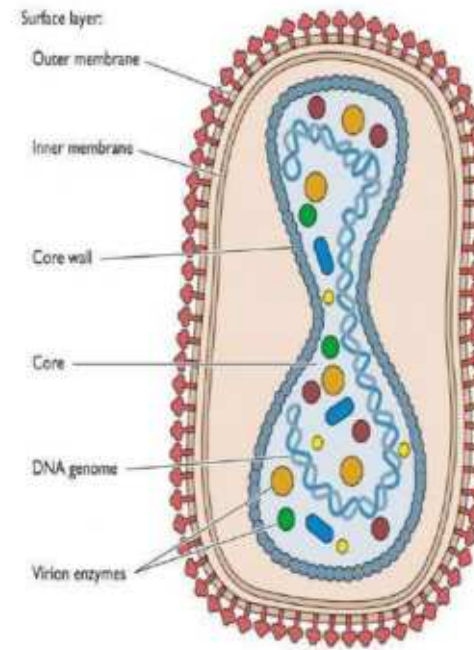
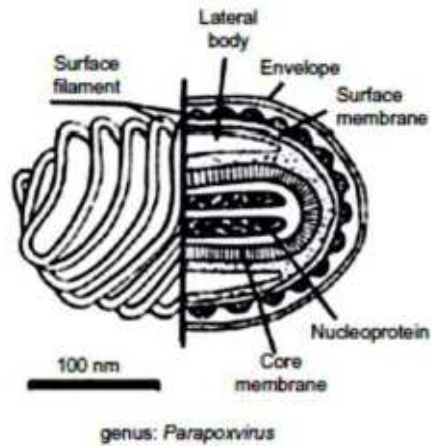
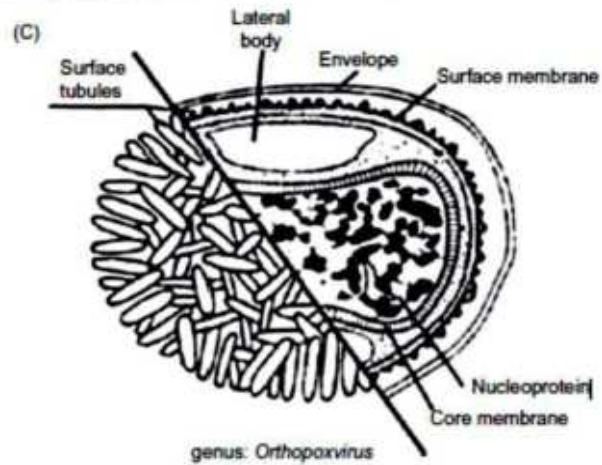
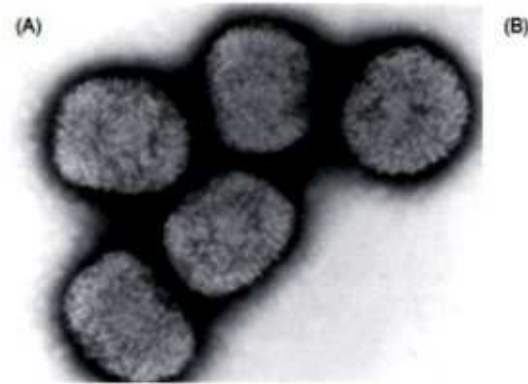
b. Capripox virus : goat pox, sheep pox, lumpy skin disease virus.

c. Avipoxvirus: Fowl pox virus, pigeon pox, Turkey pox.

d. Suipox virus: Swinepox virus.

e. Leporipox virus: Myxoma virus. (Rabbit)

f. Entomopox virus: infect insects.



Poxviridae : (A) Negatively stained vaccinia virus virions showing surface tubules characteristic of member viruses of all genera except the genus Parapoxvirus. (B) Negatively stained orf virus showing characteristic surface tubules of the member viruses of the genus. Parapoxvirus. (C, left) Schematic diagram, genus Orthopoxvirus (and all other vertebrate poxvirus genera except the genus Parapoxvirus). (C, right)

1. Orthopoxvirus : Vaccinia virus, cowpox virus , variola virus(Smallpox), Monkeypox virus,
Despite the name, the reservoir hosts of cowpox virus are rodents, from which the virus occasionally spreads to domestic cats, cows, humans, and zoo animals. The virus produces lesions on the teats and the contiguous parts of the udder of cows and is spread through herds by the process of milking.

2. Capripox virus : Sheep pox, Goat pox, lumpy skin diseases virus
Sheep pox and goat pox are the most important of all pox diseases of domestic animals, causing high mortality in young animals and significant economic loss.



Clinical symptoms characteristic for goat pox like lesions of the skin (A–E), nasal (C,D), and ocular discharge (E). (Wolff *et al.*, 2020)

Transmission of **Capripox virus**

1. Virus particles are shed from skin lesions and in ocular and nasal discharges during the acute stages of the disease. During an outbreak, the virus is probably transmitted between sheep by respiratory droplets.
2. There is also evidence that mechanical transmission by biting arthropods, such as stable flies, may be important.
3. Infection occurs through skin abrasions or by aerosol.

Clinical signs

1. Incubation period of about one week,
2. Infected animals develop fever,
3. Edema of the eyelids, conjunctivitis and nasal discharge. Within a few days
4. Macules which rapidly develop into papules appear on the skin and external mucous membranes.
5. Scabs form over necrotic papules.

Lumpy skin Disease virus (within genus Capripoxvirus):

Lumpy skin disease affects cattle breeds, characterized by fever, followed shortly by the development of nodular lesions in the skin that subsequently undergo necrosis.

Clinical signs

1. The incubation period is up to 14 days.
2. Persistent fever accompanied by lacrimation(refers to the secretion of tears), nasal discharge and a drop in milk yield.
3. Superficial lymph nodes(Superficial lymph nodes are lymph nodes that are located near the surface of the body) become enlarged and there is oedema of the limbs and dependent tissues.
4. Skin nodules develop particularly on the head, neck, udder and perineum.
5. Nodules also develop on the mucous membranes of the mouth and nasal
6. Some skin lesions may develop into a central plug of necrotic tissue(المكونات المركزية للأنسجة الميتة)which sloughs producing a deep ulcer.
7. Secondary bacterial infection or myiasis can exacerbate the condition. Myiasis is a medical condition that refers to the infestation of fly larvae (maggots) in human or animal tissue.Flies can transmit their larvae to humans through various means, such as depositing eggs on or near wounds or sores, or through ingestion of contaminated food
8. Recovery may take several months.
9. Pregnant cows may abortion .



(A) Acute lumpy skin disease in cattle. (B) Animal approximately 2 months after infection with lumpy skin disease virus.

Diseases caused by members of the genus avipoxvirus

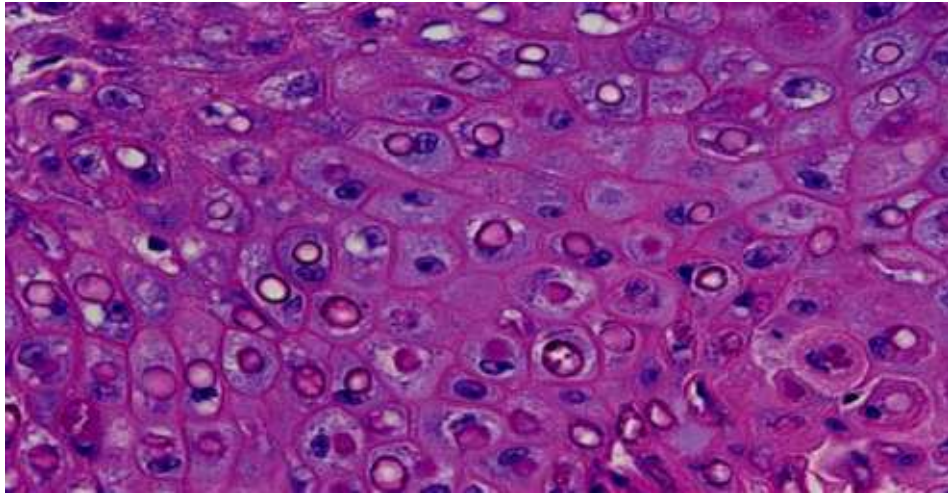
□ Fowlpox and Other Avian Poxvirus Diseases

Fowlpox is a disease of chickens and turkeys caused by a DNA virus of the genus Avipoxvirus of the family Poxviridae. Its distribution is world-wide. It is slow-spreading and characterised by the formation of proliferative lesions and scabs on the skin, and diphtheritic lesions in the upper parts of the digestive and respiratory tracts.

Fowlpox causes a transient drop in egg production and a reduced growth rate in young birds. The fowl pox virus is highly infectious for chickens and turkeys, rarely so for pigeons, and not at all for ducks and canaries, but turkey pox virus is virulent for ducks.

There are two forms of fowl pox, probably associated with different routes of infection.

1. **the cutaneous form : The most common, which probably results from infection by biting arthropods, is characterized by small papules on the comb, wattles, and around the beak; lesions occasionally develop on the legs and feet and around the cloaca. the mortality rate is usually low and affected birds are more likely to recover than those with the diphtheritic form**
2. **diphtheritic form or The second form of fowl pox is probably due to droplet infection and involves infection of the mucous membranes of the mouth, pharynx, larynx, and sometimes the trachea. This is often referred to as the diphtheritic form of fowlpox because the lesions result in a necrotic pseudo-membrane, which can cause death by asphyxiation.**



Avian poxvirus disease. (A) Avian pox affecting the oral cavity and stomach. (B) Histological appearance of avian pox disease; epidermal hyperplasia with characteristic eosinophilic (red) intracytoplasmic inclusion bodies

