Lect.8.
DNA Viruses Families
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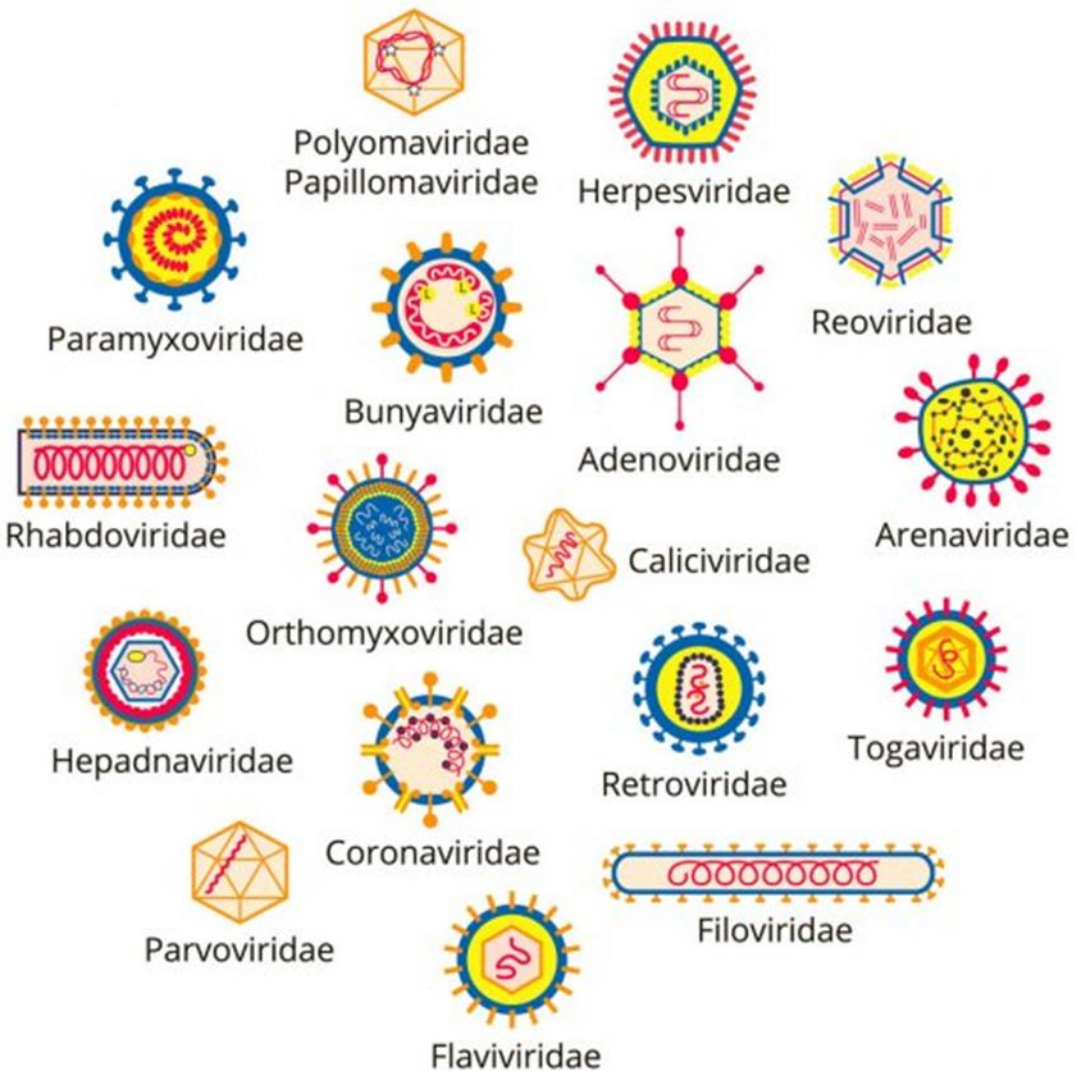


This lecture deals with:

II. DNA Viruses families:

- **Herpesviridae**
- **Poxviridae**
- **Parvoviridae**
- **Papillomaviridae**

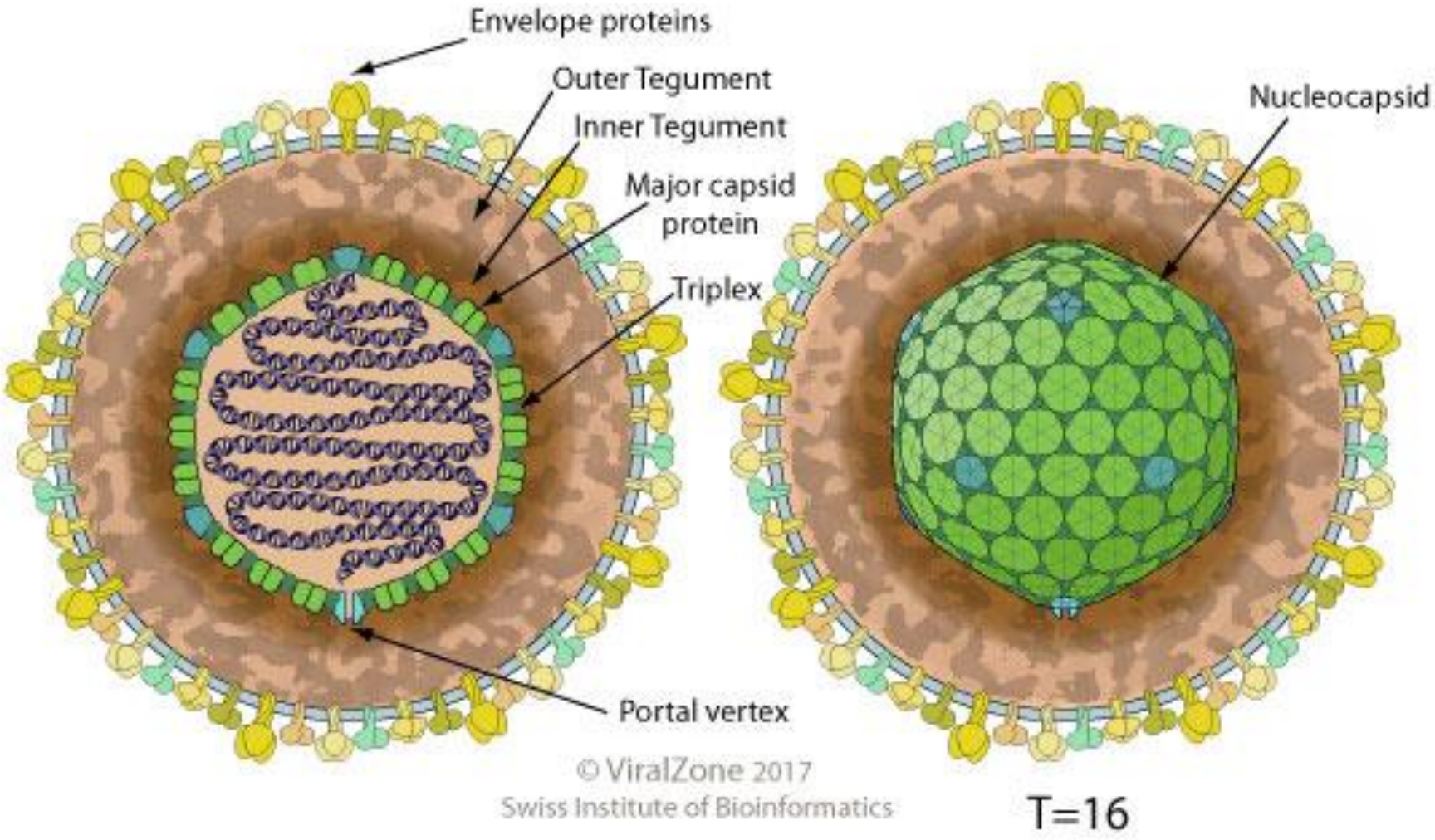
I. Herpesviridae:

General characters:

1. **Herpesvirus virions are enveloped with icosahedral symmetry and include a core, capsid, and tegument :**

Unique to herpesviruses, tegument is a structure that occupies the space between the nucleocapsid and the envelope and contains many virus encoded proteins called tegument proteins. the structure suggests play a role in viral transport

1. **All herpesviruses have genomes of linear, double-stranded DNA (dsDNA).**
2. **Replicate in nucleus, with intranuclear inclusion bodies.**
3. **They has an external diameter of approximately 125 nm diameter.**
4. **Latency is a common outcome of infection with these viruses.**
5. **This family contains more than 100 viruses which cause different diseases in human, birds, mammals, fish, amphibian &reptiles.**
6. **They are easily inactivated and do not survive well outside the body.**
7. **Transmission requires close contact, particularly mucosal contact (eg, coitus or licking and nuzzling, as between mother and offspring or between neonates). Fig.1**



Enveloped, spherical to pleomorphic, 150-200 nm in diameter, T=16 icosahedral symmetry. The capsid consists of 162 capsomers and is surrounded by an amorphous tegument. Glycoproteins complexes are embedded in the lipid envelope

Inclusion Bodies

Inclusion bodies are aggregates of virus particles or virus-induced proteins or special structures characteristic of infection by viruses either in the cytoplasm or the nucleus of the host cell (or both) during the multiplication of some viruses.

Inclusion bodies are intracellular abnormalities, commonly new structures, which arise as a direct result of virus infection which may be recognized by light microscopy following fixation and staining (Fig.2)

Depending on the virus, inclusion bodies may be intranuclear or intracytoplasmic, single or multiple, large or small, round or irregular in shape, and acidophilic (pink, stained by eosin) or basophilic (blue, stained by hematoxylin).

Inclusion bodies are diverse in nature:

1. some inclusions are accumulations of viral components For example, the intracytoplasmic inclusions in cells infected with rabies virus, known as Negri bodies, are actually masses of viral nucleocapsids.

2. Other inclusions are composed of crystalline aggregates of virions; for example, adenovirus inclusions in the nucleus.

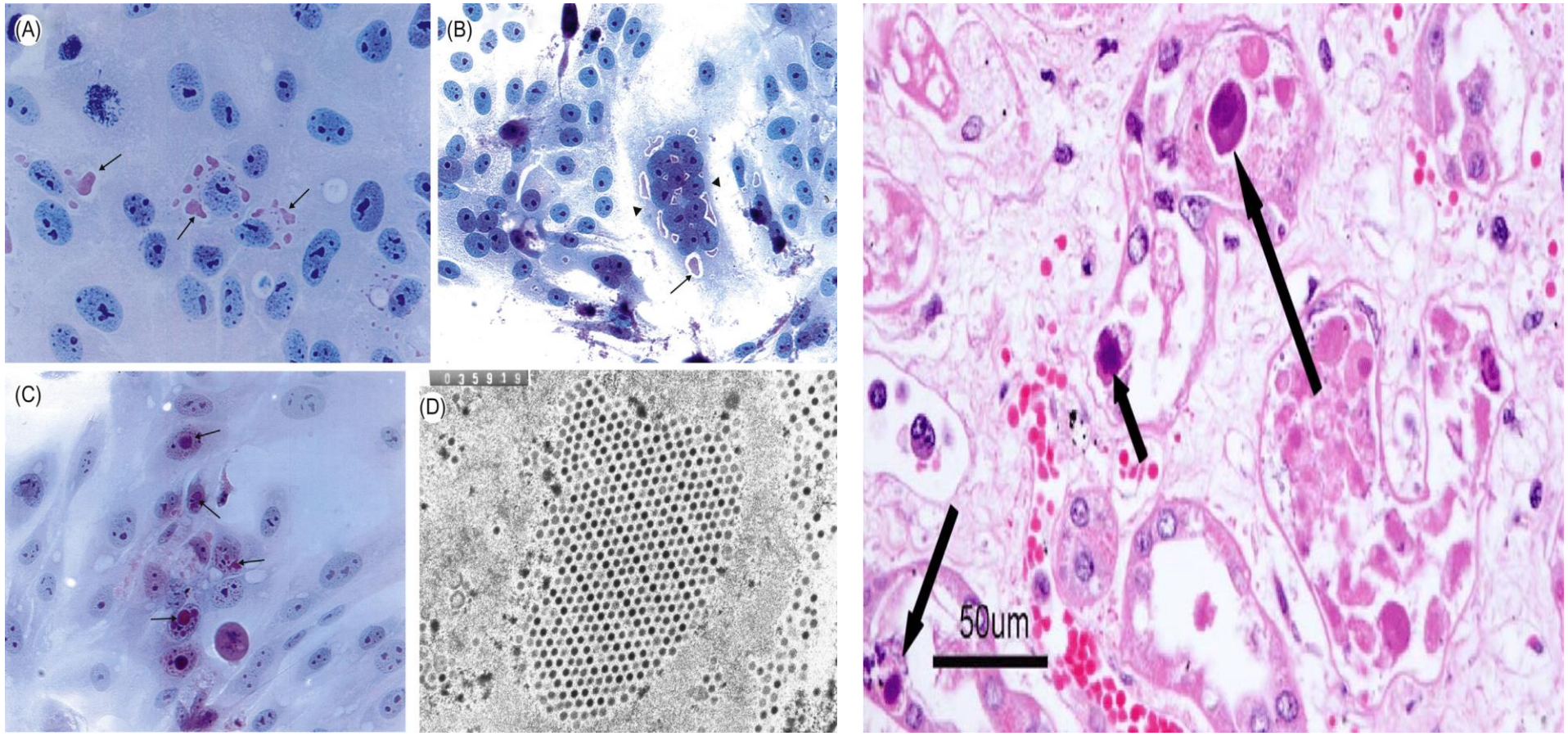


Figure.2 : Typical inclusions and abnormal cell morphology in virus-infected cells. (A) Reovirus inclusions (arrows) in infected Vero cells. (B) Canine distemper virus inclusions (arrows) and syncytium (arrowheads) in infected Vero cells. (C) Bovine adenovirus 5 intranuclear inclusions (arrows) in primary 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 Alpha herpesviruses : 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.
Transmission:-<u>secretions from the eye nose and reproductive organs</u>.
Signs relating to respiratory disease :
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 , conjunctivitis – runny eyes, drop in milk production
Signs relating to reproductive disease:
Abortion

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:

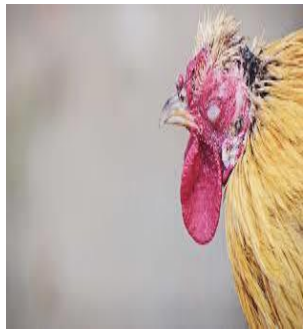
1. **Cutaneous form: Swollen feather follicles (bumps) on the skin that can form crusty scabs .**
2. **Neural form: Characterized by one, all, or none of the following symptoms:**

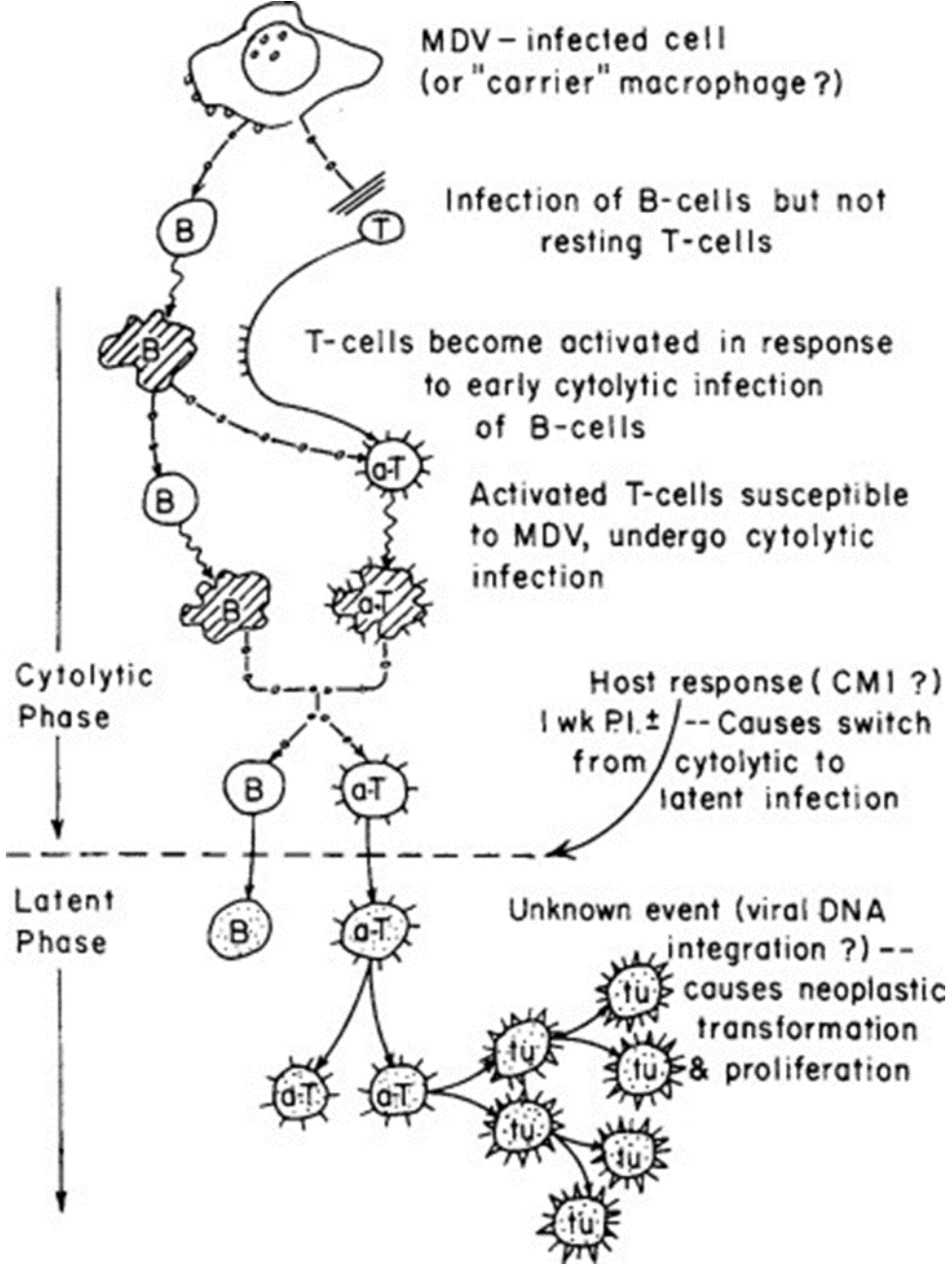
a) **• Progressive paralysis, usually of the leg, a typical leg-paralysis affected bird will have one leg extended forward and one leg tucked under the bird. This is the result of infiltration of lymphocytes in the sciatic nerve.**

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




MDV – infected cell
(or "carrier" macrophage ?)
Infection of B-cells but not
resting T-cells
T-cells become activated in response
to early cytolytic infection
of B-cells
Activated T-cells susceptible
to MDV, undergo cytolytic
infection
Cytolytic
Phase
Host response (CMI ?)
1 wk P.I. ± -- Causes switch
from cytolytic to
latent infection
Latent
Phase
Unknown event (viral DNA
integration ?) --
causes neoplastic
transformation
& proliferation
B
T
a-T
tu

How is Marek’s Disease spread?

Marek’s is highly contagious and spreads through bird-to-bird contact, by contact with contaminated soil, clothes, shoes, equipment and dander. Chickens are commonly exposed to Marek’s by contact with residual dust and dander in previously infected houses, by aerosol (air) contamination from a nearby house, or by virus particles carried by personnel and equipment.

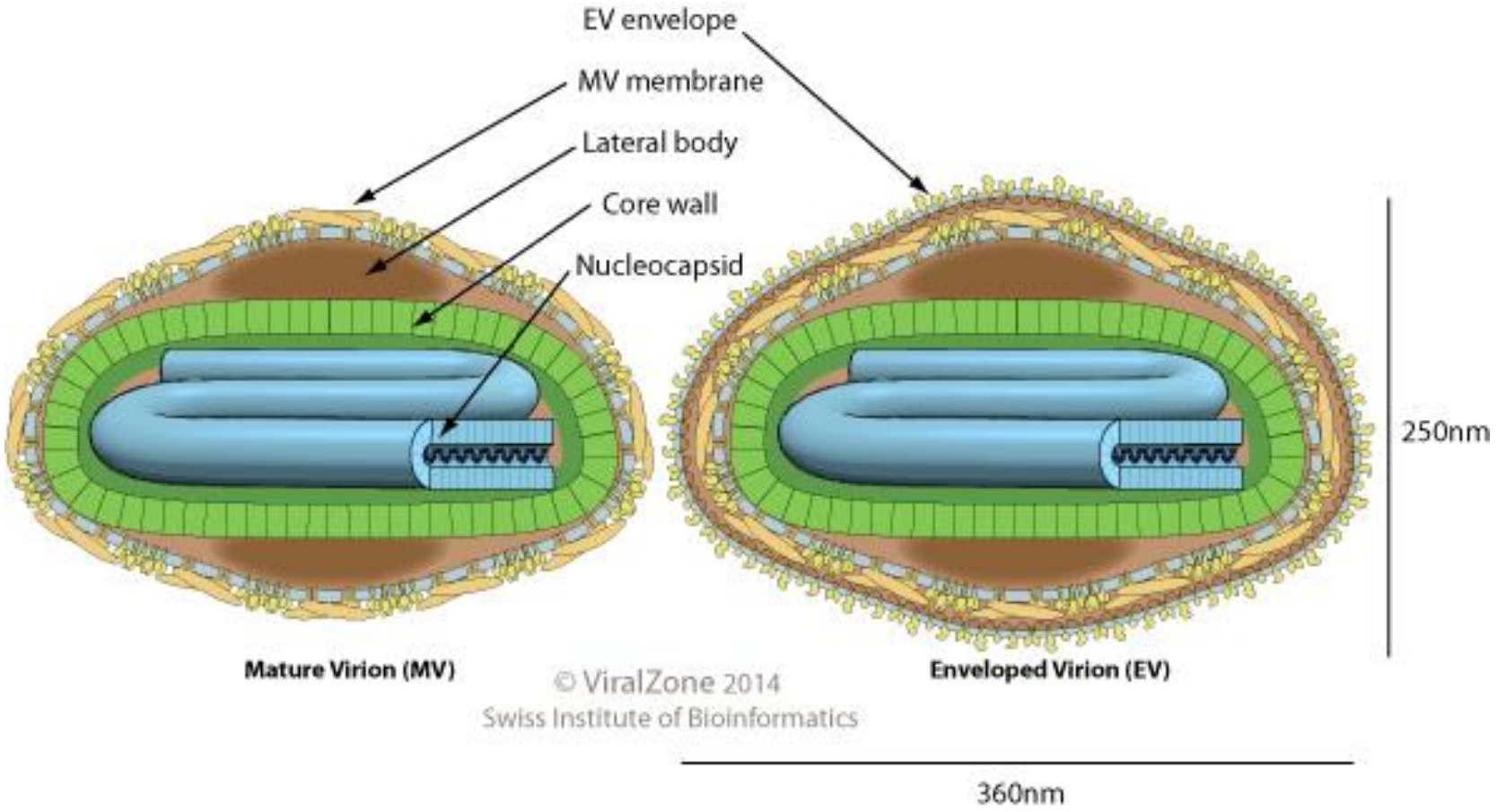
II. Poxviridae:

General characters:

1. **Most poxvirus virions are Enveloped, large and pleomorphic, (220-450 nm long x 140-260 nm wide)**
2. **The surface membrane displays surface tubules or surface filaments.**
3. **Two distinct infectious virus particles exists: the intracellular mature virus (IMV) and the extracellular enveloped virus (EEV).**
4. **Complex symmetry, typically brick-shaped or ovoid virion**
5. **Linear double-stranded DNA genome of (130-375kb)and replicate in cytoplasm., dsDNA**
6. **Virions are stable at room temperature under dry conditions, but sensitive to heat, detergents, formaldehyde and oxidizing agents.**
7. **Skin lesions prominent feature.**
8. **Genetic recombination within genera results in extensive serological cross reaction and cross-protection.**

Genera of Poxviridae:

a. **Orthopoxvirus:** infect mammals ike: **cow pox , variola virus(Smallpox) ,** Monkeypox virus.
b. **Parapoxvirus: Orfvirus, Bovine popular stomatitis virus, pseudo complex.**
c. **Capripox virus : goat pox, sheep pox, lumpy skin disease virus.**
d. **Avipoxvirus: Fowl pox virus, pigeon pox, Turkey pox.**
e. **Suipox virus: Swinepox virus.**
f. **Leporipox virus:Myxoma virus. (Rabbit)**
g. **Entomopox virus: infect insects.**


EV envelope
MV membrane
Lateral body
Core wall
Nucleocapsid
250nm
Mature Virion (MV)
© ViralZone 2014
Swiss Institute of Bioinformatics
Enveloped Virion (EV)
360nm

Poxviridae

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.

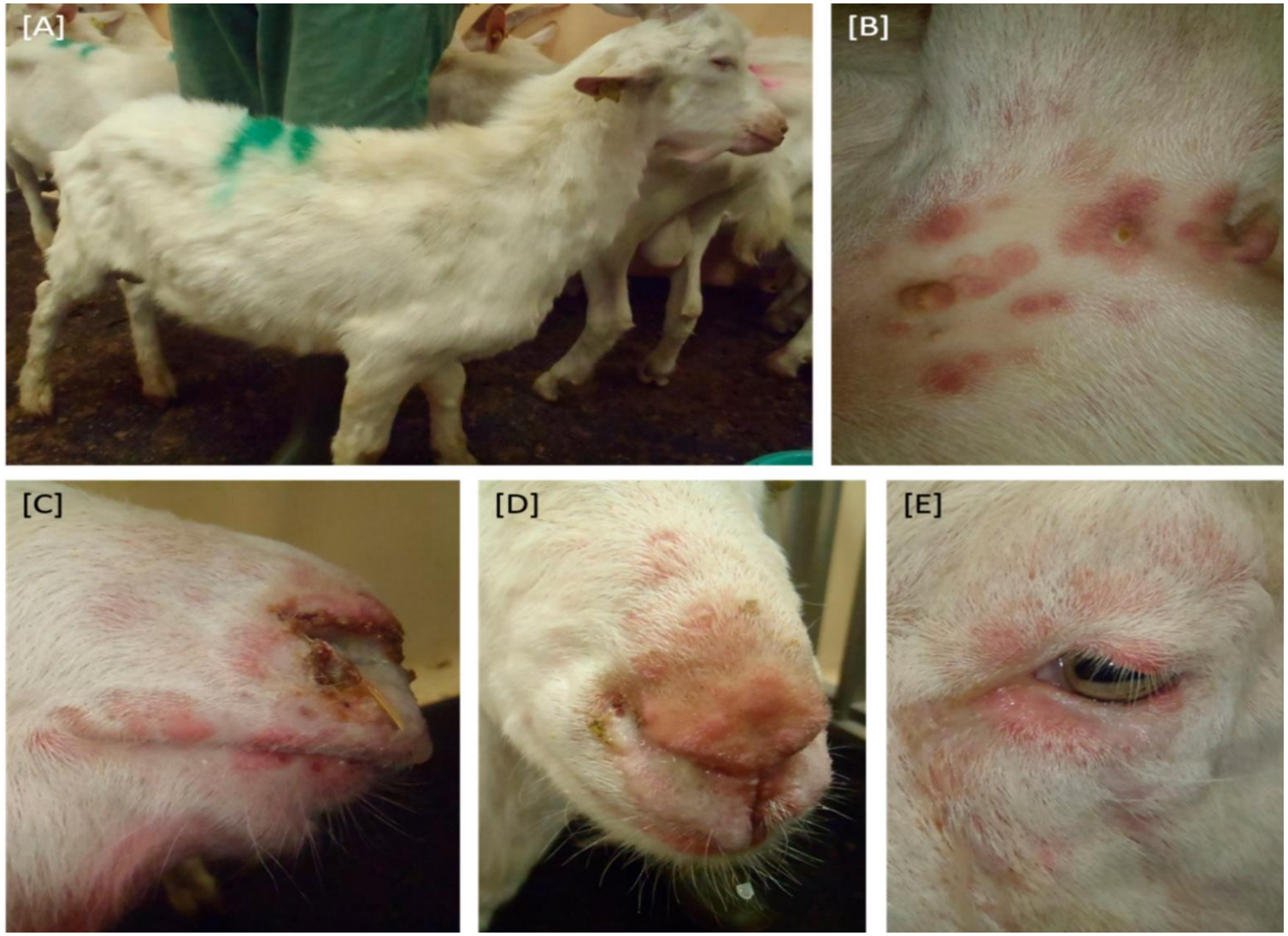
Etiology Capripox virus.

Transmission:

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.



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

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, nasal discharge and a drop in milk yield.
3. Superficial lymph nodes 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 which sloughs producing a deep ulcer.
7. Secondary bacterial infection or myiasis can exacerbate the condition.
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.

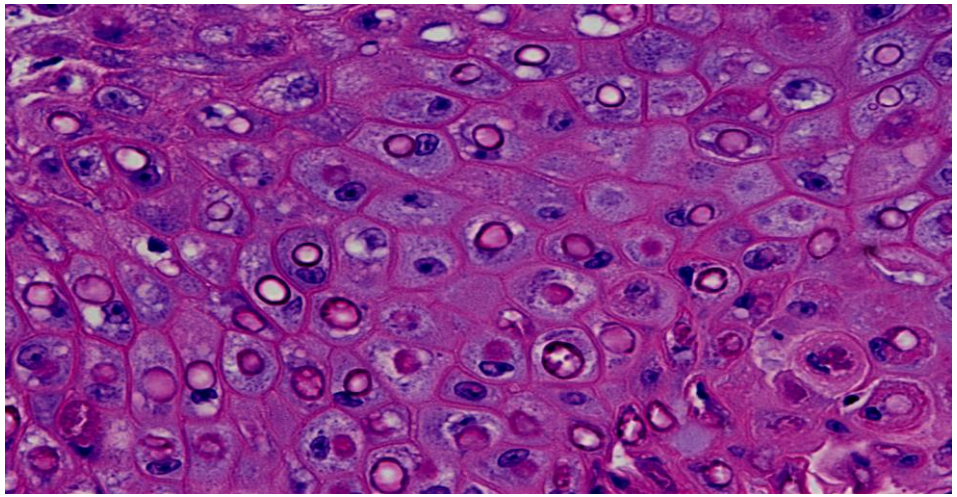
Fowlpox causes a transient drop in egg production and a reduced growth rate in young birds. The fowl pox virus is highly infectious for chickens and turkeys, rarely so for pigeons, and not at all for ducks and canaries, but turkey pox virus is virulent for ducks.

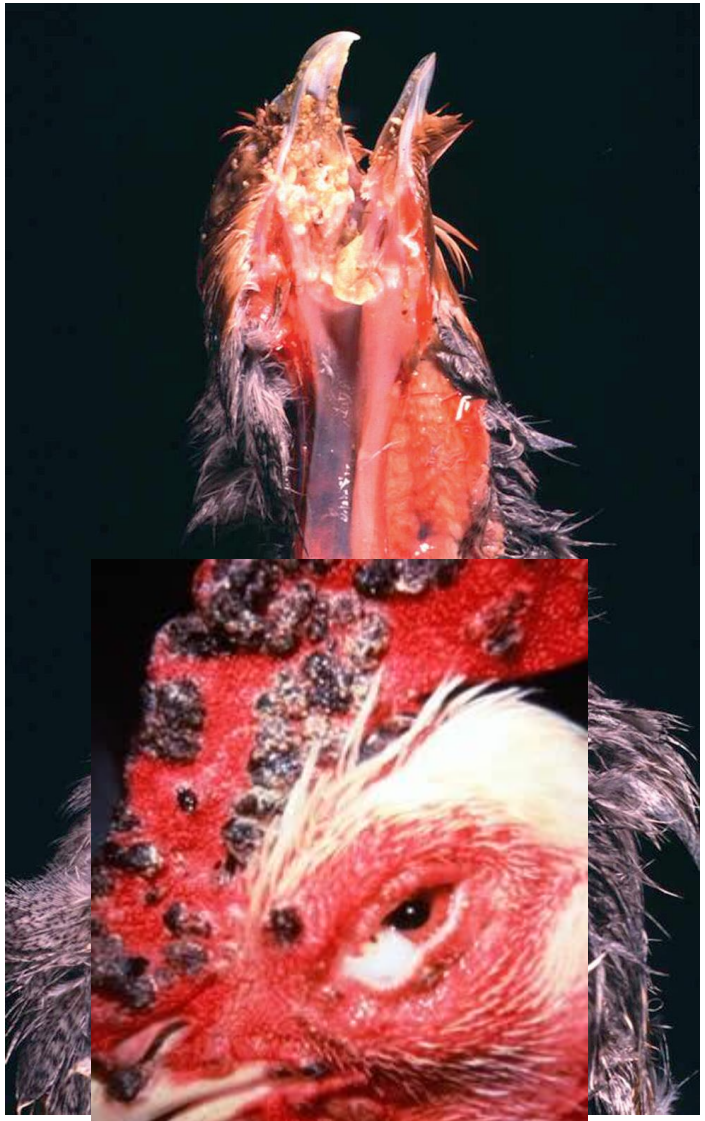
There are two forms of fowl pox, probably associated with different routes of infection.

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 droplete 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.**

The literal definition of infectious is “the process or state of being infected with a disease.” And to infect means “to affect or contaminate someone or something with pathogenic microbial agents.” Pathogenic meaning disease producing, and microbial referring to viruses, bacteria or other microorganisms. To simplify infectious, it basically means germs get into the body and spread, causing sickness. Contagious diseases are infectious diseases that can be transmitted through direct bodily (close) contact with an infected individual or their bodily discharges, or an object or surface they have contaminated (i.e. COVID-19). Other infectious diseases, however, are transmitted indirectly such as by mosquitoes (malaria) or ticks (Lyme disease).

Contagious diseases are spread by contact, while infectious diseases are spread by infectious agents. So when something is contagious, it is also infectious because some contact exposed you or your animal to the infectious agent. Something infectious however is not always contagious. Confused yet? You can be infected with food poisoning (you ate the potato salad that sat out in the sun), but food poisoning isn’t contagious (you aren’t going to pass your food poisoning to someone else or your animals with just a simple contact





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

III. Parvoviridae:- small = picodna

General characters:

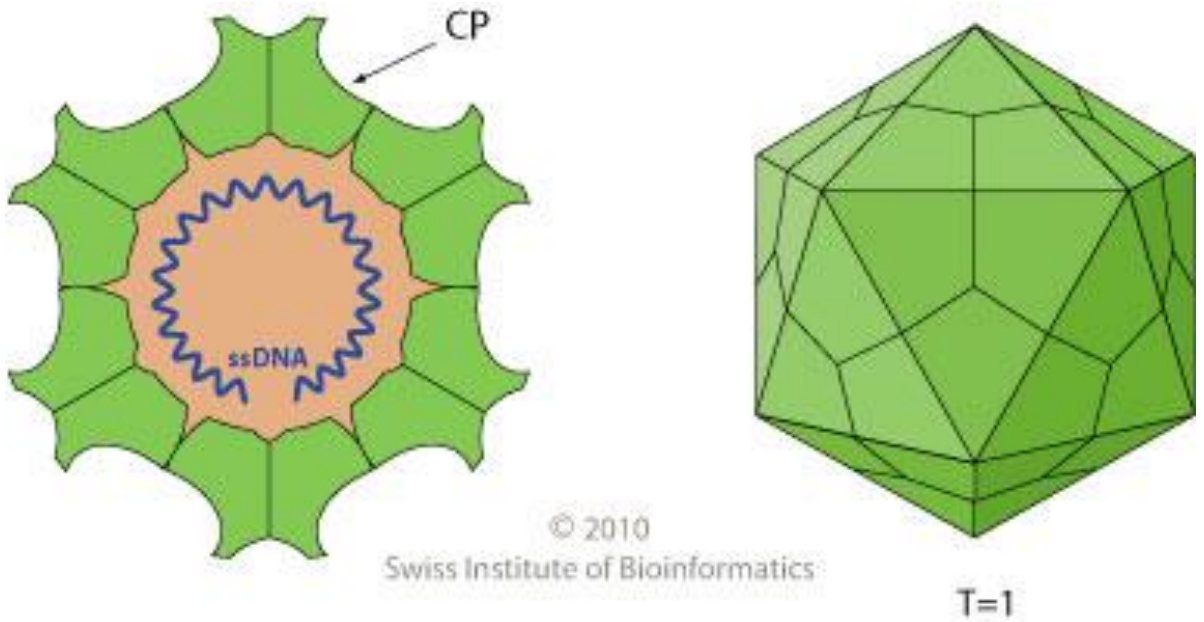
1. **Small (18-26 Nm), Non Enveloped , round**
2. **Icosahedral symmetry , 18-26 nm in diameter, single stranded DNA.**

3. Replicate in the nucleus forming intra nuclear inclusion bodies.

4. Require rapidly- dividing cells for replication.

5. Resistant to heat 56Cº for more than 60 minutes also resistant to lipid solvents,pH (3-9).

6. Inactivated by formalin, Propiolacton, sodium hypochlorite.



Genera of Parvoviridae:

The canine parvovirus (CPV) is a common, acute, high morbidity and high morality virus that mainly infect canine population, in mainaly causes of enteric & systemic disease in dogs & cats (Feline pan leukopenia or feline infectious enteritis.

Feline Panleukopenia(feline infectious enteritis):- feline panleukopenia virus (FPLV) is a highly contagious, often fatal, viral disease of cats that is seen worldwide. Kittens are affected most severely. The causative parvovirus is very resistant; it can persist for 1 yr at room temperature in the environment**.**

Etiology:- Parvovirus

Transmission:-

Cats are infected oro nasally by exposure to infected animals, their feces, secretions, or contaminated fomites(eg, shoes, clothing).Fecal-oral route is the main transmission pathway of 1-Feline Panleukopenia

Clinical Findings

Acute cases show fever (104°–107°F [40°–41.7°C]), depression, and anorexia after an incubation period of 2–7 days.

Vomiting usually develops 1–2 days after the onset of fever; it is typically bilious and unrelated to eating.

Diarrhea may begin a little later but is not always present. Extreme dehydration develops rapidly. Affected cats

IV. Papillomaviridae

General characters:

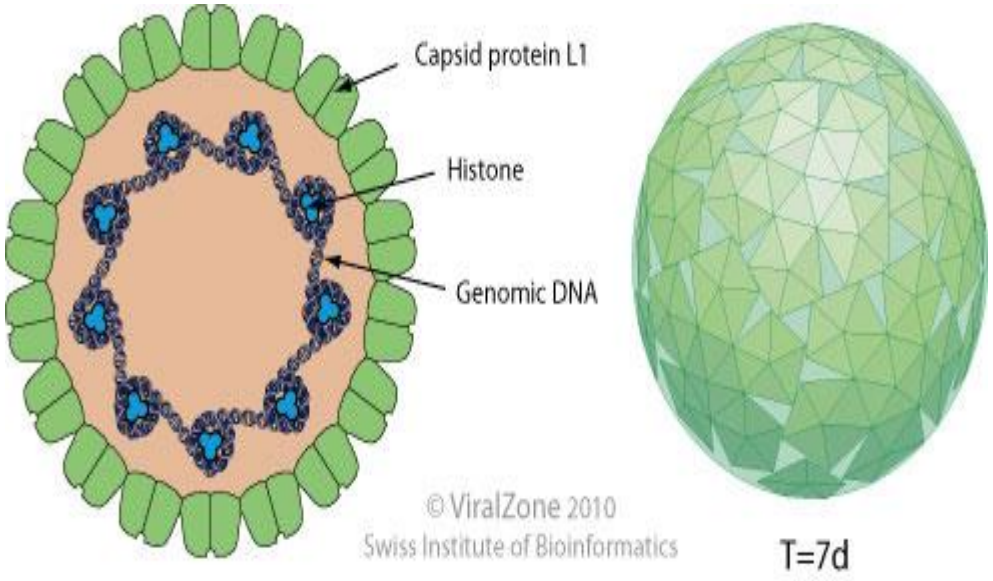
1. Non-enveloped, circular double strand DNA viruses.
2. Icosahedral symmetry, 55 to 60 nm in diameter
3. Replications in nucleus
4. Papillomaviruses can be categorized according to their tissue tropism and the lesions that they cause. The vast majority of papillomaviruses only infect keratinocytes and induce a squamous papilloma comprised of thickened folded epithelium
5. Resistant to lipid- solvents, acids, 60°C for 30 minutes.

Genera of Papillomaviridae:

Contains one genus, Papillomavirus:

Have not been cultured in vitro.

b. Cause papilloma & fibropapilloma in domestic animals.




A
B
C
D

Bovine papillomavirus (**BPV**) is a small circular double-stranded DNA genome virus that belongs to *Papillomaviridae* family, which presents tropism for epithelial and mucous tissues and they are common in cattle.
Infection causes warts (papillomas and fibropapillomas) of the skin and alimentary tract, and more rarely cancers of the alimentary tract and urinary bladder. They are also thought to cause the skin tumour equine sarcoid in horses and donkeys.

Types of papillomavirus

There are at least five strains of papillomavirus, each of which has a specific predilection **site on the cow.**

1-BPV type I:- causes wart like lesion on the nose, teats and affect young cattle and will usually regress over time.

2-BPV type II:- causes warts all over the skin of the head and neck of young cattle and will usually regress (opposite to progress) over time.

3-BPV type III:- causes atypical warts which are smooth and white in appearance and occur mainly on the teats and udders of older cows.

4-BPV type IV causes papillomas in gut, especially the rumen, and bladder, as well as lesions on the eye. This particular systemic form can be refered to as **papillomatosis**. The papillomas caused by this strain can undergo malignant transformation to alimentary carcinomas,

5-BPV type V causes tiny warts on the teat

Transmission:-

infection is spread by direct contact from cow to cow or by indirect contact from fomites. With most strains, calves are most commonly affected.

Clinical Signs

In BPV type IV signs will be synchronized with the body system affected e.g. haematuria if in the bladder or diarrhoea and bloat if in the rumen.

On the skin, the virus will at first appear as small, smooth raised nodules in the characteristic regions, which will then enlarge. Some will become rough and cauliflower like in appearance, whilst others may become pedunculated. A characteristic feature of this disease is that the warts will regress spontaneously over a period no longer than one year.