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Lecture title: Poxviridae

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Summary: Poxviridae

The family Poxviridae includes several viruses of veterinary and medical importance.

Poxvirus diseases occur in most animal species and are of considerable economic importance in some regions of the world. Diseases such as sheeppox have been eradicated in developed countries but are still a cause of major losses in some developing

Properties of Poxviruses

The family Poxviridae is subdivided into two subfamilies

Chordopoxvirinae (poxviruses of vertebrates)

Entomopoxvirinae (poxviruses of insects).

The subfamily Chordopoxvirinae is subdivided into eight genera

Each of the genera, except Molluscipoxvirus includes species that

cause diseases in domestic or laboratory animals

because of the large size and distinctive structure of poxvirus virions, negative stain electron microscopic examination of lesion material is used in many veterinary and zoonotic virology laboratories for diagnosis--this method allows rapid visualization of poxviruses in various specimens, but it does not allow specific verification of viral species or variants.

Virion Properties

Most poxvirus virions are brick shaped, about 250 x x 200 nm in size

Cocoon shaped of the genus Parapoxvirus are 022 in contrast virions of the members

There is no isometric nucleocapsid conforming to either icosahedral or helical symmetry found in

most other viruses hence poxviruses are said to have a "complex" structure

Virions of most poxviruses are composed of an outer layer of tubular structures arranged rather irregularly giving them a characteristic appearance

virions of the members of the genus Parapoxvirus are covered with long thread-like surface tubules which because of the superimposition of features on the tops and bottoms of virions appear to be arranged in crisscross fashion resembling a ball of yarn.

Virions of some ungrouped viruses from reptiles are brick shaped but have a surface structure similar to that of parapoxviruses

The genome consists of a single molecule of linear double-stranded DNA varying in size from 130 kbp - 280kbp

Poxvirus genomes have crosslinks that join the two DNA strands at both ends; the ends of each DNA strand have long inverted tandemly repeated nucleotide sequences that form single-stranded loops

Poxviruses are transmitted between animals by several routes: by introduction of virus into small skin abrasions or directly or indirectly from a contaminated environment.

For example, orf virus is transmitted by the respiratory route via droplets from infected animals

Sheeppox, swinepox, fowlpox, are transmitted mechanically by biting arthropods.

The viruses generally have narrow host ranges.

Poxviruses are resistant in the environment under ambient temperatures and may survive for many years in dried scabs or other virus-laden material.

Viral Replication

Most poxviruses, except for parapoxviruses, swinepox virus, and molluscum contagiosum virus, grow in cell culture.

They also produce pocks on the chorioallantoic membrane of embryonated hen's eggs, the appearance of which has been used to differentiate orthopoxviruses from each other.

Replication of poxviruses occurs in the cytoplasm. To achieve this total independence from the cell nucleus, poxviruses, unlike other DNA viruses, have evolved to encode all of the enzymes required for transcription and replication of the viral genome, several of which must be carried in the virion itself.

After fusion of the virion with the plasma membrane or after endocytosis, the viral core is released into the cytoplasm

DISEASES CAUSED BY MEMBERS OF THE GENUS CAPRIPOXVIRUS

Sheeppox and Goatpox

Sheeppox and goatpox are the most important of all pox diseases of domestic animals, causing high mortality in young animals and significant economic loss.

They occur as endemic infections in southwestern Asia, the Indian subcontinent, and most parts of Africa, except southern Africa.

Although the geographic distribution of sheeppox goatpox, and lumpyskin disease is different

Clinical signs vary in different hosts and in different geographical areas.

Sheep and goats of all ages may be affected, but the disease is generally more severe in young animals.

An epidemic in a susceptible flock of sheep can affect over 75 % of the animals, with mortality as high as 50%; case-fatality rates in young sheep may approach 100%

. After an incubation period of 4 to 8days, there is a rise in temperature, an increase in respiratory rate, edema of the eyelids, and a mucous discharge from the nose

. Affected sheep may lose their appetite and stand with an arched back. One to 2 days later, cutaneous nodules about 1 cm in diameter develop which may be distributed widely over the body.

These lesions are most obvious in the areas of skin where the wool/hair is shortest, such as the head, neck, ears, axillae and under the tail.

These lesions usually scab and persist for 3-4 weeks, healing to leave a permanent depressed scar.

Lesions within the mouth affect the tongue and gums and ulcerate. Such lesions constitute an important source of virus for infection of other animals.

In some sheep, lesions develop in the lungs, as multisite consolidation

Lumpyskin Disease of Cattle

Lumpyskin disease is characterized by fever, followed shortly by the development of nodular lesions in the skin that subsequently undergo necrosis.

Generalized lymphadenitis and edema of the limbs are common. During the early stages of the disease, affected cattle show lacrimation, nasal discharge, and loss of appetite.

The skin nodules involve the dermis and epidermis; they are raised and later ulcerate and may become infected secondarily.

Ulcerated lesions may be present in the mouth and nares; postmortem, circumscribed nodules may be found in lungs and the alimentary tract.

Healing is slow and affected cattle often remain debilitated for several months.

Morbidity in susceptible herds can be as high 100% as but mortality is rarely more than 1-2%

DISEASES CAUSED BY MEMBERS OF THE GENUS AVIPOXVIRUS

Fowlpox and Other Avian Poxvirus Diseases

Poxviruses that are related serologically to each other and specifically infect birds have been recovered from lesions found in all species of poultry and many species of wild birds.

Viruses recovered from various species of birds are given names related to their hosts, such as fowlpox, canarypox, turkeypox, pigeonpox, and magpiepox

As judged by their pathogenicity in various avian hosts, there seems to be a number of different species of avian poxviruses, but no systematic analysis of their DNAs has yet been made.

Mechanical transmission by arthropods, especially mosquitoes, provides a mechanism for transfer of the viruses between a variety of different species of birds

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

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 nodules become yellowish and progress to a thick dark scab.

Multiple lesions often coalesce.

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.

The second form of fowlpox is probably due to droplet infection and involves infection of the mucous membranes of the mouth, pharynx, larynx, and some times the trachea. This is often referred to as the diphtheritic form