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Togaviridae

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This is a family of enveloped, positive sense, single-stranded linear RNA viruses. Only one of the two genera, Alphavirus, has viruses of veterinary significance. They are arboviruses causing important equine encephalidides.

Viral Characteristics

- They are enveloped viruses (~ 70 nm) with an icosahedral nucleocapsid (see Fig. 26.1) containing a single linear, positive sense, single-stranded RNA.
- The genome has a 5' cap and a 3' poly A tail.
- The envelope has characteristic glycoprotein spikes.
- They replicate in the cytoplasm and the nucleic acid alone is infectious.
- The virions mature by budding from the plasma membrane.
- They agglutinate goose and chick erythrocytes.
- They are labile in the environment.

Figure 26-1. Togaviridae (50 nm in diameter). They are enveloped viruses with an icosahedral nucleocapsid containing a single linear, positive sense, single-stranded RNA. - To view this image in full size go to the IVIS website at www.ivis.org . -

Classification

The family Togaviridae has two genera, Alphavirus and Rubivirus. Only Alphavirus contains viruses of veterinary significance. The diseases caused by the viruses of each genus are as follows:

Alphavirus: The following are significant veterinary alphaviruses:

Eastern Equine Encephalomyelitis virus
Western Equine Encephalomyelitis virus
Venezuelan Equine Encephalomyelitis virus
Highlands J virus. This virus was originally thought to be a WEE virus that occurred in the eastern USA. It has been isolated from rodents, wild and domestic birds, and mosquitoes in the eastern USA and is now considered a distinct alphavirus.
Getah Virus

Rubivirus

Rubella virus: The cause of rubella (German measles) and the more serious congenital rubella syndrome involving serious human fetal abnormalities.

Alphavirus

Eastern Equine Encephalomyelitis (EEE), Western Equine Encephalomyelitis (WEE) and Venezuelan Equine Encephalomyelitis (VEE).

General

Cause

Each of the three equine encephalidides, EEE, WEE and VEE is caused by a serologically distinct Alphavirus designated as WEE virus, EEE virus and VEE virus. RNA sequence analysis shows that most of the WEE virus genome is closely related to that of the EEE virus genome. The constituents of these "categories" are referred to below.

Transmission / Reservoir

Mosquitoes of various genera are the principal vectors. These viruses infect and replicate in mosquitoes for their entire life. In tropical and subtropical regions the viruses are endemic in swamp habitats in a bird/rodent-mosquito cycle. It is not clear how the viruses are maintained from one year to another in temperate regions.

Pathogenesis

After initial infection the virus travels to lymph nodes via the lymphatics. It replicates in neutrophils and macrophages followed by viremia and replication in other organs, including the brain. Neurologic signs, when seen, develop in less than a week of infection. Subclinical infections occur with all of these viruses.

Clinical Signs

Infections are most common during summer and early fall when mosquito populations are high. After exposure, there is an incubation period of about 1 to 7 days followed by fever, depression, anorexia, sopor, pharyngeal paralysis, head pressing, incoordination, paralysis of the legs, recumbency and death frequently occurs in 2 - 7 days.

Specific

Eastern Equine Encephalomyelitis

- EEE is caused by two antigenic variants, the North American and the South American.
- Causes disease in equids, pigeons, pheasants, quail and humans.
- The North American variant occurs in the Caribbean, states east of the Mississippi, Texas and eastern Canada. The South American variant occurs in Central and South America. It is less pathogenic than the North American variant.
- The principal vectors are mosquitoes. In North America, EEE is commonly transmitted by Culiseta melanura and other mosquito species in some regions.
- The reservoir hosts are mainly wild birds and small rodents.
- It is estimated that ~10% of the horses infected develop clinical disease.
- The mortality in horses may reach 90%; in humans 30 - 50%.

Western Equine Encephalomyelitis

- The genome of WEE virus is closely related to that of EEE virus. Several subtypes have been identified including Sindbis, Fort Morgan, and Aura, which are not important causes of equine encephalitis. It has been suggested that WEE virus arose as recombinant between Sindbis virus and EEE virus.
- Causes disease in equids and humans.
- Occurs in western Canada and in states west of the Mississippi in the USA, Mexico and South America.
- Principal vectors are Culex and Aedes spp. mosquitoes and the tick Dermacentor andersoni.
- The reservoir hosts are wild birds; the avian and mosquito infections are harmless.
- WEE is milder than EEE. The mortality in horses is 20 - 30%; in humans about 10%.

Venezuelan Equine Encephalomyelitis

- Six antigenically related subtypes of VEE virus have been identified and given names. The most important subtype is designated subtype 1; it contains five serovars of which several are the principal causes of VEE.
- Causes disease in equids and humans.
- Occurs in the Central and South America, Mexico and infrequently in the southern USA Subtypes other than 1 have the same distribution and are enzootic with a rodent/bird-mosquito cycle. They are not causes of VEE.
- The principal vectors are considered to be mosquitos and hematophagous insects.
- The reservoir hosts are birds and small forest rodents.
- The virus of VEE is shed in oral secretions and contact transmission may occur.

- The disease is more viscerotropic than neurotropic with damage to blood vessels and lesions in many organs including less frequently the brain.
- The mortality rate in horses may approach 80%; in humans, who suffer a milder disease, mortality is about 1%.

General

Diagnosis

- Clinical specimens: Whole blood collected during the febrile stage and brain tissue from horses that have died. Acute and convalescent sera.
- A presumptive diagnosis is often based on clinical signs and microscopic brain lesions, which consist of an inflammatory cell infiltrate with perivascular cuffing, and congestion and edema of the meninges (EEE and WEE). A neutrophilic inflammatory cell response is characteristic of EEE virus infection.
- Confirmation requires isolation and identification of the virus. The viruses can be propagated in various cell cultures and in young mice inoculated intracerebrally.
- A definitive diagnosis can also be obtained by demonstrating a significant increase in specific antibody between acute and convalescent sera. The procedures used include hemagglutination-inhibition, virus neutralization, complement fixation and capture ELISA .
- A presumptive diagnosis can be made on the basis of signs and a single positive serum sample, if the horse has not been vaccinated.

Treatment

- Steroids to reduce inflammation.
- General supportive care.
- Horses that recover and have had neurologic signs frequently have neurologic deficits.

Getah Virus Infection

An outbreak of Getah virus infection occurred in racehorses in Japan in 1978. The infection was mild and characterized by fever, edema of the hind legs, and urticaria. Recovery was uneventful in about seven days.

Getah virus has been isolated from mosquitoes in Japan, Southeast Asia, and Australia. Serologic studies indicate that infections occur in a number of other animal species, including cattle and especially pigs. The virus has been incriminated as a cause of fetal death in infected sows.

Transmission was thought to be by mosquitoes principally.

The virus can be propagated in cell cultures and in mice inoculated intracerebrally.

Glossary

Capture ELISA: In this method, specific antibody is used to bind any viral antigen that may be present in the sample. Presence of any bound antigen is then detected spectrophotometrically using a labeled antibody specific for the antigen, following addition of the enzyme substrate.