Aino Disease

Aino Virus Infection

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Importance

Aino virus is one of several closely-related viruses that can cause a syndrome of reproductive losses and fetal deformities in ruminants. Relatively little information has been published about this virus, and some assumptions in the literature are based on the other viruses that cause this syndrome, particularly Akabane virus.

Etiology

Aino virus (official species name: *Shuni orthobunyavirus*) is a member of the genus *Orthobunyavirus* in the family Bunyaviridae. Obsolete names for this virus include Samford virus and Kaikalur virus. Serologically, Aino virus belongs to the Simbu serogroup of the Bunyaviridae. This serogroup contains some other viruses that are also teratogenic in ruminants, such as Akabane virus and Schmallenberg virus, as well as some viruses that seem to be nonpathogenic. Simbu serogroup viruses can exchange gene segments (reassort) with each other.

Species Affected

Aino virus has been linked to fetal deformities in cattle and sheep, and it is suspected to affect goats. Antibodies to Aino virus have also been found in horses, pigs, wild boar, water buffalo and wild ruminants, although there is currently no evidence that it is pathogenic in these species. This virus is teratogenic in chick embryos inoculated directly into the yolk sac; however, there are no reports that it affects birds outside this experimental setting.

Zoonotic potential

Antibodies to Aino virus have been detected in humans, but there are no reports of human disease. These antibodies might represent a cross-reaction to other bunyaviruses.

Geographic Distribution

Aino virus is known to occur in Australia and Asia. It is said to be widely distributed in parts of Asia, with reports of its presence in Japan, South Korea, Indonesia and India, and recent serological evidence suggesting that it may exist in China. Antibodies to Aino virus have also been found in a few countries in the Middle East and Africa. Clinical cases have been reported mainly from Japan and Australia; however, a recent outbreak in Jordan was thought to be caused by either Aino virus or a very close relative, rather than Akabane or Schmallenberg virus.

Transmission

Simbu serogroup viruses are transmitted between animals by insect vectors. Biting midges (gnats) in the genus *Culicoides* are thought to be the primary vectors for this group of viruses; however, there is little specific information about the transmission of Aino virus. In addition to being found in *Culicoides brevitarsis*, *C. oxystoma* and other members of this genus, Aino virus has also been detected in mosquitoes (e.g., various species of *Culex*). It can be transmitted across the placenta to the fetus, causing congenital defects.

Disinfection

There is no specific information about the disinfectant susceptibility of Aino virus; however, other Bunyaviridae are susceptible to common disinfectants such as sodium hypochlorite, glutaraldehyde, 70% alcohol, hydrogen peroxide, peracetic acid and iodophors. They are also sensitive to heat and UV light.

Incubation Period

Most studies and reports suggest that Aino virus infections are asymptomatic in adults, but the virus can infect the fetus at this time. Fetal infections do not become evident until the affected animals are born or aborted, which may not occur for several weeks or months.

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Clinical Signs

In naturally infected pregnant cattle and sheep, Aino virus has been associated with abortions, stillbirths, premature births, and birth defects including arthrogryposis, scoliosis, sunken eyes, cataracts, maxillary retraction and dental irregularities. Some calves may have a domed head from hydranencephaly. Surviving calves may be weak and can have difficulty suckling or standing. They may also be blind or have visual defects, as well as a variety of neurological signs (e.g., ataxia, torticollis, tetany, paresis, swimming movements, opisthotonus, circular walking). In most reports, the dam does not seem to show any signs of illness at the time of the infection, although a transient fever was observed in experimentally infected pregnant cows. However, fetal abnormalities can result in dystocia at parturition. One outbreak investigation in Jordan, tentatively attributed to Aino virus or a closely-related agent, reported a history of abortions, congenital malformations, diarrhea and decreased feed intake and milk production in a seropositive diary cattle herd, as well as congenital malformations and reproductive losses in small ruminants.

Clinical signs have not been reported in non-pregnant adults, except for one report of sudden astasia and leukopenia in a naturally infected dairy cow.

Post Mortem Lesions

Affected calves may be aborted, stillborn or premature. The typical birth defects associated with Aino virus infection are arthrogryposis, hydranencephaly, and cerebellar hypoplasia or agenesis. Some reports mention necrotic foci in the cerebrum, porencephaly, partial absence of the cerebrum, micrencephaly, hydrocephalus, scoliosis, torticollis, maxillary retraction, sunken eyes, cataracts and dental irregularities.

Diagnostic Tests

In outbreak descriptions, Aino disease has generally been diagnosed by serology, using serum or body fluids from the fetus or presuckle neonate and/or by demonstrating rising titers in the dams. However, antibody titers are often stable by the time a pregnant animal gives birth to affected offspring, and such titers are indistinguishable from exposure before the pregnancy. Virus neutralization seems to be the most commonly used serological test, although hemagglutination inhibition assays have also described in research papers. Cross-reactivity has been reported between Aino virus and other Simbu serogroup viruses in some serological tests, although it is more likely to be an issue when the titers are low. Histopathology is also helpful.

Virological evidence of infection is most likely to be found in fresh fetuses aborted soon after they were infected, but before they have developed an immune response. Aino virus, its nucleic acids and antigens have been detected in the central nervous system of the fetus. The placenta and fetal skeletal muscle are also reported to be useful samples in cases caused by Akabane virus, a Simbu serogroup virus that causes similar congenital defects. Although most affected fetuses have cleared Akabane virus infections by the time they are born, real-time RT-PCR assays may sometimes find residual nucleic acids in neonatal tissues or the placenta. Whether this is also true for Aino virus has not been published. Published RT-PCR assays for Aino virus include both single tests and multiplex assays that can simultaneously identify other Simbu serogroup viruses that cause reproductive losses. Immunohistochemistry has been used to identify Aino virus antigens in the brain. Virus isolation is also possible. The ability of Simbu serogroup members to exchange gene segments may complicate the development and interpretation of some diagnostic tests.

Treatment

There is no treatment for animals affected by Aino virus.

Control

Disease reporting

A quick response is vital for containing outbreaks in disease-free regions. Veterinarians who encounter or suspect an Aino virus infection should follow their national and/or local guidelines for disease reporting. In the U.S., state or federal veterinary authorities should be informed immediately.

Prevention

Aino virus is not thought to be transmitted between animals except by insect vectors. If this virus is introduced into an area where it is not endemic, care should be taken to prevent it from infecting potential vectors, especially *Culicoides* spp. gnats.

Vaccines for Aino disease are available in Japan. Similar reproductive losses caused by Akabane virus can also be controlled by moving pregnant animals into an endemic area in time to develop immunity before they are first bred. Insect control techniques, including the use of repellents, might be effective for a few days; however, they are ineffective for controlling diseases caused by Simbu serogroup viruses in the long term.

Morbidity and Mortality

Aino disease is seasonal, although fetal defects can occur months after the insect vectors were active. In one outbreak in Japan, this virus was isolated primarily from July to August, and affected calves were born mainly from November to March. Clinical cases caused by Aino virus are generally thought to be uncommon compared to those caused by other Simbu serogroup viruses; however, it is possible that this disease is underdiagnosed, especially when it affects few animals. There have been reports of

both sporadic infections and severe outbreaks, some potentially involving up to 2000 calves.

Some other Simbu serogroup viruses have varying effects on the fetus, depending on its gestational age when infected. An analysis of one outbreak caused by Aino virus suggested that this virus may affect bovine fetuses between 120 and 180 days of gestation, based on a comparison between the periods when viruses were isolated and when affected calves were born. In an experimental study in cattle, the critical gestational age for congenital malformations appeared to be 132 to 156 days. One experimental study suggests that the fetal infection rate may be low, as all of the calves from five intravenously inoculated cattle were normal. However, 43% of cows with evidence of exposure were affected during one large outbreak in Japan. The mortality rate is high in calves with congenital defects.

Internet Resources

World Organization for Animal Health (OIE)
http://www.oie.int

OIE Manual of Diagnostic Tests and Vaccines for Terrestrial Animals
http://www.oie.int/international-standard-setting/terrestrial-manual/access-online/

OIE Terrestrial Animal Health Code
http://www.oie.int/international-standard-setting/terrestrial-code/access-online/

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