

Nairobi Sheep Disease

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Importance

Nairobi sheep disease is one of the most pathogenic diseases of sheep and goats. In susceptible animals, this viral infection results in a hemorrhagic gastroenteritis with very high morbidity and mortality. There is no effective treatment.

Etiology

Nairobi sheep disease results from infection by a tick-borne virus, Nairobi sheep disease virus (NSDV), in the genus *Nairovirus* (family Bunyaviridae). Ganjam virus is an Asian variant of this virus.

Species Affected

Among domesticated and laboratory animals, only sheep and goats can be infected readily by NSDV, and only these species appear to be important as reservoir hosts. A few fatal cases of Nairobi sheep disease have been reported among duikers (*Cephalophus monticola*) in zoos or in the wild. The African field rat (*Arvicanthus abyssinicus nubilans*) can be infected experimentally.

Geographic Distribution

Nairobi sheep disease is found in East and Central Africa. Serological evidence suggests that this disease may also be present in Botswana and Mozambique. Ganjam virus, a variant, has been reported from parts of Asia including India and Sri Lanka.

Transmission

Nairobi sheep disease virus and Ganjam virus are transmitted through tick bites. *Rhipicephalus appendiculatus* is the most important vector for NSDV in East Africa. Unfed adult ticks can transmit this virus for more than two years after they are infected. Other vectors include *R. pulchellus*, *R. simus*, and *Amblyomma variegatum*. Transovarial transmission has been demonstrated in *R. appendiculatus*, as well as in *R. pulchellus* in Somalia. Transstadial transmission can occur in all host ticks that have been described. In Asia, *Haemaphysalis intermedia* is the principal tick vector for Ganjam virus. This virus has also been described in the ticks *H. wellingtoni* and *R. haemaphysaloides*, as well as in the mosquito *Culex vishnui*.

Although it may be found in urine and feces, NSDV does not seem to be contagious via casual contact. However, animals may be infected experimentally with large oral doses (50 cc) of blood or serum. Experimental infections can also be established by injecting blood, serum or organ suspensions.

Incubation Period

The incubation period is 1 to 15 days; most infections become apparent in 2 to 6 days.

Clinical Signs

Nairobi sheep disease is characterized by acute hemorrhagic gastroenteritis. The disease begins with a fever, leukopenia, rapid respiration, anorexia and profound depression, followed by fetid diarrhea and a concomitant drop in body temperature. At the onset, the feces are thin, profuse and watery; later, blood and mucus may appear. Straining and signs of colicky pain can also be seen. The superficial prescapular and precrucial lymph nodes are often palpable, and some animals have a bloodstained mucopurulent or serosanguineous nasal discharge. Conjunctivitis may also be seen. Pregnant animals frequently abort. Many animals die during the early febrile stage of the disease, in some cases within 12 hours of the onset of the fever. Deaths are also seen later, from hemorrhagic diarrhea and dehydration. Goats may have less severe clinical signs than sheep.

Ganjam virus infections in Asia are reported to be similar but less severe. However, at least one outbreak with severe clinical signs has been reported, and improved disease diagnosis and investigations are needed to determine whether NSDV and Ganjam virus differ in their ability to cause disease.

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Post Mortem Lesions

Early in the course of the disease, the only abnormalities may be enlargement of the superficial and mesenteric lymph nodes, with congestion of most organs, and ecchymotic and petechial hemorrhages on the serosal surfaces of various organs including the heart, gastrointestinal tract, spleen, liver, lungs and kidney. In animals that survive longer, evidence of catarrhal mucoid or hemorrhagic gastroenteritis is apparent. Typically, the intestinal contents are liquid and bloodstained. Extensive ulceration and/or hemorrhages may be present, especially in the abomasum, colon, cecum and distal ileum, and around the ileocecal valve. Zebra striping of the cecum and colon (congestion or hemorrhages appearing as longitudinal striations in the mucosa) may be seen. The gall bladder is often swollen and hemorrhagic. The nasal mucosa may be congested and inflamed, and signs of conjunctivitis can be apparent. The genital tract may be inflamed, hyperemic and hemorrhagic if the animal has aborted. Aborted fetuses may have hemorrhages throughout their organs, and the fetal membranes can be edematous and hemorrhagic.

Morbidity and Mortality

Sheep and goats in enzootic regions are often immune to Nairobi sheep disease, and their offspring are protected by maternal antibodies. Outbreaks are usually seen when animals without immunity are exposed to the virus. This may occur when susceptible animals are imported into an enzootic area, or when they are moved from dry regions where tick vectors are absent into forests and grasslands where ticks are abundant. Outbreaks can also be seen when tick populations temporarily expand their range during a period of high rainfall or other ecological change.

In animals showing clinical signs, the prognosis is generally poor. Although some animals can have mild infections and recover, the mortality rate is usually 30-95%. Breed-related differences in susceptibility have been reported. Nairobi sheep disease is less likely to be fatal in breeds that are not native to Africa, such as Romney and Corriedale sheep. The mortality rate in such exotic breeds and crossbred animals is 30-40%. In contrast, indigenous breeds are particularly susceptible to Nairobi sheep disease, with mortality rates of 75% or higher in East African hair sheep and Persian fat-tailed sheep. Nairobi sheep disease may be less virulent in goats; however, mortality rates as high as 90% have been reported in some indigenous breeds. Ganjam virus infections are reported to be much milder than NSDV infections, and imported breeds are more susceptible than breeds native to Asia.

Diagnosis

Clinical

Nairobi sheep disease should be suspected in sheep or goats with severe gastroenteritis and nasal discharge in or near an enzootic area. The presence of attached ticks is supportive. The diagnosis is particularly likely if sheep native to the area do not become ill, and if clinical signs are absent in cattle and other animals.

Differential diagnosis

Other diseases that may resemble Nairobi sheep disease include heartwater, rinderpest, Rift Valley fever, anthrax, peste des petits ruminants, salmonellosis, coccidiosis and some toxicities including arsenic poisoning.

Laboratory tests

Nairobi sheep disease can be diagnosed by virus isolation. NSDV can be recovered in cell culture, particularly in BHK-21-C13 cells, a baby hamster kidney cell line. Other cells including primary hamster or lamb kidney cells can also be used. The virus is identified by immunofluorescence or other techniques. Animal inoculation can also be used for virus recovery; the test animals of choice are suckling mice inoculated intracerebrally or laboratory-raised sheep.

Nairobi sheep disease virus can be identified directly in clinical samples with agar gel immunodiffusion. Cross-reactions can occur with other viruses in the genus *Nairovirus*. Molecular probes have been developed for research, and molecular testing could become feasible in diagnostic laboratories in the future.

Serological tests used for diagnosis include an indirect fluorescent antibody test, immunodiffusion, complement fixation, indirect hemagglutination and enzyme-linked immunosorbent assays (ELISA). Cross-reactions can occur with other nairoviruses, especially Dugbe virus. Virus neutralization tests give equivocal results and are unreliable in this disease.

Samples to collect

Before collecting or sending any samples from animals with a suspected foreign animal disease, the proper authorities should be contacted. Samples should only be sent under secure conditions and to authorized laboratories to prevent the spread of the disease. Rare cases of an influenza-like disease have been seen in humans; investigators should take precautions when working with this virus.

NSDV can be isolated from uncoagulated blood (plasma) in live animals during the initial febrile stage; little or no virus can be found in the blood after the body temperature falls. Samples of the spleen and mesenteric lymph nodes should be collected for virus isolation and/or the AGID test at necropsy. Samples for virus isolation should be kept cool, but freezing may decrease virus

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recovery. Paired acute and convalescent serum samples should be submitted for serology.

Recommended actions if Nairobi sheep disease is suspected

Notification of authorities

Nairobi sheep disease must be reported to state or federal authorities immediately upon diagnosis or suspicion of the disease.

Federal: Area Veterinarians in Charge (AVIC):
http://www.aphis.usda.gov/animal_health/area_offices/
State Veterinarians:
<http://www.aphis.usda.gov/vs/sregs/official.html>

Control

In areas where Nairobi sheep disease does not occur, the disease might be eradicated by movement controls, quarantines and euthanasia of infected animals, together with tick control measures. NSDV can persist in an infected tick for more than two years, and this disease is very difficult to eradicate once it becomes established in vector populations. Nairobi sheep disease virus is not transmitted between animals by direct contact; however, hypochlorite, phenolics, 2% glutaraldehyde and other disinfectants are effective decontaminants for the Bunyaviridae.

Sheep and goats can be protected from tick vectors by dipping and/or spraying with an acaricide. Acaricide treatments are generally used in areas bordering enzootic regions when extension of the ticks' range is expected or seen. In enzootic areas, the use of tick controls may weaken immunity, and animals are usually allowed to develop resistance via tick bites. Experimental vaccines have been developed, and may be available in some regions. These vaccines can be used to protect naive animals entering enzootic areas, or to protect animal populations when the tick vector expands its geographic range. During outbreaks, supportive treatment with good shelter and quality feed may improve survival. Strict quarantine is not necessary in enzootic areas, as the infection is not transmitted by casual contact. Dead animals should be buried or incinerated.

Public Health

NSDV or Ganjam virus can cause a mild, influenza-like disease in humans. The clinical signs may include fever, headache, back and abdominal pain, joint pains, nausea and vomiting. Infections might be acquired via tick bites, needlestick injuries or other means. NSDV infections are reported to be rare in African laboratory workers, but several Ganjam virus infections have been reported from laboratories in India. Antibodies to either NSDV or Ganjam virus have also been found among the general population, laboratory workers, and/or agricultural workers in Uganda, India and Sri Lanka. Investigators should take precautions to prevent infections

when working with these viruses. NSDV and Ganjam virus are classified as Biosafety Level 3 agents.

Internet Resources

- Food and Agriculture Organization of the United Nations (FAO). Manual for the Recognition of Exotic Diseases of Livestock
<http://www.spc.int/rahs/>
- FAO Manual on Meat Inspection for Developing Countries
<http://www.fao.org/docrep/003/t0756e/T0756E00.HTM>
- OIE Manual of Diagnostic Tests and Vaccines for Terrestrial Animals
http://www.oie.int/eng/normes/mmanual/a_summry.htm
- OIE Terrestrial Animal Health Code
http://www.oie.int/eng/normes/mcode/A_summry.htm
- United States Animal Health Association. Foreign Animal Diseases.
http://www.vet.uga.edu/vpp/gray_book02/fad/index.php
- World Organization for Animal Health (OIE)
<http://www.oie.int>

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*Link defunct as of 2009