

Heartwater

Cowdriosis

Importance

Heartwater is one of the most important diseases of livestock in Africa. This tick-borne illness is characterized by fever, rapid respiration and anorexia, followed by neurologic symptoms. Infection is often fatal. Experimentally it has been demonstrated that white-tailed deer are susceptible to infection, and also act as hosts for the tick that transmits the disease; thus, heartwater has the potential to become endemic in the United States.

Etiology

Heartwater results from infection by *Cowdria ruminantium*, a rickettsia (tribe Ehrlichia, family Rickettsiaceae). This organism is pleomorphic, measuring from 400 to more than 1,000 nm diameter. It is usually coccoid but occasionally ring-formed. *C. ruminantium* is usually seen in clumps of several to several thousand organisms in the cytoplasm of infected capillary endothelial cells.

Strains of *C. ruminantium* vary in their pathogenicity. At least one strain seems to be nonpathogenic for cattle; however, all strains appear to be pathogenic for sheep and goats.

Species affected

Cattle, sheep, goats, and wild buffalo are severely affected by heartwater, although in some indigenous African breeds of sheep and goats, the symptoms are mild. Blesbok, wildebeest, guinea fowl, leopard tortoises, and scrub hare are carriers. *C. ruminantium* can also infect eland, springbok, antelope, white-tailed deer, ferrets, the striped mouse, the albino mouse, and the multimammate mouse.

Geographic distribution

Heartwater is endemic in most of Africa south of the Sahara desert, as well as in Madagascar, and in a few islands on the Caribbean. The disease has also been reported in Tunisia and the former country of Yugoslavia.

Transmission

Heartwater can be transmitted by at least twelve species of *Amblyomma* ticks. Ticks become infected as larvae or nymphs, and can transmit the disease as nymphs or adults. Transovarial passage does not occur.

A. variegatum (the tropical bont tick) is the major vector in Africa and some parts of the Caribbean. Other vectors include the bont tick *A. hebraeum* (in southern Africa), *A. lepidum* (in East Africa and the Sudan), *A. astrion*, and *A. pomposum*. *A. sparsum*, *A. gemma*, *A. cohaerans*, *A. marmoreum* and *A. tholloni* (the elephant tick) are capable of transmitting experimental infections. Two North American species, *A. maculatum* (the Gulf Coast tick) and *A. cajennense*, can also transmit *C. ruminantium* in the laboratory, but neither has been implicated in natural infections.

The Caribbean *Amblyomma* Program, established in 1995, focuses on a regional approach to eradicating the Tropical Bont tick on the 16 Caribbean islands where it is currently established. This will help to prevent the introduction of heartwater into the U.S.

C. ruminantium is very fragile and does not survive outside a host for more than a few hours at room temperature. However, cows may transmit the infection to their calves in colostrum.

Incubation period

The incubation period in natural infections is usually two weeks, but can be as long as a month. The incubation period after intravenous inoculation is 7 to 10 days in sheep and goats, and 10 to 16 days in cattle.

Clinical signs

Peracute disease is usually seen in Africa in non-native breeds of sheep, cattle, and goats. Heavily pregnant cows are particularly susceptible to this form. The clinical signs may include a fever, severe respiratory distress, hyperesthesia, lacrimation, terminal convulsions, and sudden death. Some breeds of cattle, including Jerseys and Guernseys, may develop severe diarrhea as well. The peracute form of heartwater is relatively rare.

The most common form of heartwater is acute disease. This syndrome is seen in both non-native and indigenous cattle, sheep, and goats. The symptoms begin with a sudden fever (up to 42° C), anorexia, listlessness, and rapid respiration. Occasionally, animals also have diarrhea. These symptoms are followed by nervous signs, particularly chewing movements, protrusion of the tongue, twitching of the eyelids, and circling, often with a high-stepping gait. Affected animals sometimes stand with their heads lowered and legs apart. Some animals may become aggressive or anxious. As the disease progresses, the neurologic signs become more severe, and the animal goes into convulsions. In the terminal stages, galloping movements, opisthotonos, hyperesthesia, nystagmus and frothing at the mouth are common. Animals with the acute form of heartwater usually die within a week after the onset of the disease.

On rare occasions, heartwater appears as a subacute disease. In this form, the clinical signs include a prolonged fever, coughing, and mild incoordination. The animal either recovers or dies within 1 to 2 weeks.

Mild or subclinical infections are seen in calves less than 3 weeks old, partially immune cattle or sheep, antelope, and some indigenous breeds of sheep and cattle. The only symptom is a transient fever. This form of the disease is known as "heartwater fever."

Post mortem lesions

The characteristic post-mortem lesion of heartwater is hydropericardium, with straw-colored to reddish pericardial fluid. Hydropericardium is more consistently found in sheep and goats than in cattle. Other common lesions include ascites, mediastinal edema, hydrothorax, and edema of the lungs. Subendocardial petechial hemorrhages are frequent;

submucosal and subserosal hemorrhages may also be noted in other organs. Animals may also have splenomegaly, edematous lymph nodes, degeneration of the myocardium and liver parenchyma, nephrosis, and catarrhal and hemorrhagic abomasitis and enteritis. Congestion and edema are sometimes found in the brain.

Morbidity and Mortality

Symptomatic infections in untreated non-native sheep, goats, and cattle are often fatal. In cattle, a mortality rate of 60% is common and, in merino sheep, the death rate may be 80%. Angora goats are also extremely susceptible to this disease. Native animals are often more resistant to the infection; mortality in Persian or Afrikander sheep is only 6%.

Treatment with antibiotics is very effective, particularly when treatment is started soon after the symptoms appear. Immunization with virulent strains, followed by treatment with antibiotics, is often practiced in endemic areas and confers good immunity.

Diagnosis

Clinical

Heartwater should be suspected in animals with the typical clinical signs including fever, respiratory distress, characteristic nervous symptoms, and sudden death. The presence of *Amblyomma* ticks and typical post-mortem lesions support the diagnosis of heartwater.

Differential Diagnosis

The peracute form of heartwater can be confused with anthrax. The acute form may resemble rabies, tetanus, bacterial meningitis or encephalitis, chlamydiosis, piroplasmiasis, cerebral trypanosomiasis, or theileriosis. It must also be differentiated from poisoning with strychnine, lead, organophosphates, arsenic, chlorinated hydrocarbons, or some poisonous plants (*Cestrum laevigatum*, *Pavetta* species, and *Pachystigma* species). Accumulations of fluid similar to heartwater are also sometimes seen in heavy helminth infestations.

Laboratory Tests

C. ruminantium is often diagnosed by microscopic examination of brain smears. The best samples are well-vascularized portions of the brain such as the cerebrum, cerebellum, or hippocampus. Brain smears are air dried, fixed with methanol, and stained with Giemsa. *C. ruminantium* will be seen as purplish-blue organisms among the capillary endothelial cells. The organisms can be found for 2 days in brains stored at room temperature and up to 34 days in refrigerated brains. The rickettsias can also be found in smears made from the intima of large blood vessels and during histopathologic examination of kidney glomeruli and lymph nodes.

Heartwater can also be diagnosed in tissue samples with DNA probes. This method is effective in clinical cases, but is not sensitive enough to identify most carriers.

Polymerase chain reaction (PCR) tests can detect clinical infections and some carriers.

Serologic tests include the indirect fluorescent antibody (IFA) test, enzyme-linked immunosorbent assays (ELISA), and immunoblotting (Western blotting). Cross-reactions

with *Ehrlichia* species occur in most of these tests, but the ELISAs that use recombinant antigens are more specific and reliable. Occasionally, the causative organism is isolated from the blood by cultivation on ruminant endothelial cells. Inoculation of fresh blood into a susceptible sheep or goat can also be used.

Samples to collect

Before collecting or sending any samples from animals with a suspected foreign animal disease, contact the AVIC. These samples should only be sent under secure conditions, by authorized personnel, and to authorized laboratories to prevent the spread of disease.

Samples from live animals should include 50 ml of heparinized blood and 10 ml serum. In addition, 10 ml of blood should be collected into heparin anticoagulant, then 10% DMSO should be added. Samples should be kept refrigerated and shipped with ice packs. From dead animals, a set of tissues in 10% buffered formalin should be submitted, together with smears of the cerebral cortex or half of an unpreserved brain. Brain tissue can also be collected at necropsy by driving a large nail through the unopened skull, and aspirating a sample with a syringe. Another technique is to cut off the head and collect tissue through the foramen magnum with a curette.

Recommended actions if heartwater is suspected

Notification of authorities

Heartwater must be reported to state or federal authorities immediately upon diagnosis or suspicion of the disease. Federal: Area Veterinarians in Charge (AVICS)

http://www.aphis.usda.gov/vs/area_offices.htm

State vets: <http://www.aphis.usda.gov/vs/sregs/official.html>

Quarantine and Disinfection

C. ruminantium cannot survive outside a living host for more than a few hours at room temperature. Control of this disease relies mainly on control of the tick vector with acaricides, and prevention of tick infection from infected animals. Transfer of blood between animals must also be avoided.

Public health

There is no indication that humans can be infected by *C. ruminantium*.

For More Information

World Organization for Animal Health (OIE)

<http://www.oie.int>

OIE Manual of Standards

http://www.oie.int/eng/normes/mmanual/a_summry.htm

OIE International Animal Health Code

http://www.oie.int/eng/normes/mcode/A_summry.htm

USAHA Foreign Animal Diseases book

http://www.vet.uga.edu/vpp/gray_book/FAD/

The Caribbean Amblyomma Programme (CAP)

<http://forest.bio.ic.ac.uk/stvm/caribamb.htm>

References

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“Heartwater.” In *The Merck Veterinary Manual*, 8th ed. Edited by S.E. Aiello and A. Mays. Whitehouse Station, NJ: Merck and Co., 1998, pp. 531-2.

Mare, C.J. “Heartwater.” In *Foreign Animal Diseases*. Richmond, VA: United States Animal Health Association, 1998, pp. 253-264.

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http://www.aphis.usda.gov/mrpbs/manuals_guides/fy2001_reference_book/tropicalbonttick.pdf, Accessed on December 4, 2003.