

***Ehrlichia ruminatum* (HEARTWATER)**

Animal Groups Affected	Transmission	Clinical Signs	Severity	Treatment	Prevention and Control	Zoonotic
Mammals - domestic and wild ruminants.  Infections in other mammals (mice), and possibly (although not definitively proven) in reptiles, and birds.	Non-contagious tick borne disease via <i>Ambylomma</i> spp. ticks including US tick species: <i>A. maculatum</i> , <i>A. cajennense</i> , <i>A. dissimile</i> , <i>A. americanum</i> .	Acute – fever, anorexia, diarrhea, serosa or mucosa petechiae, respiratory and neurologic signs.  Peracute – sudden death!	Subclinical to peracute death. Dependent on strain, host, and environment. Most common is acute clinical disease.	Remove ticks and antibiotics (e.g., tetracycline).  Submit ticks for diagnosis using the pCS20 RT or nested PCR.	Tick control and test for carrier status in animals prior to translocations.  “Vaccination” (see below) can be used in areas with endemic heartwater present.	No

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**Susceptible animal groups:** Ruminant species (domestic and wild) and other mammals (mice). Sheep and goats more susceptible than cattle and European breeds more susceptible than zebu type. Infections in birds and reptiles have not been confirmed.

**Causative organism:** *Ehrlichia ruminantium* (previously called *Cowdria ruminantium*). A small, intracellular, Gram negative, pleomorphic coccus bacteria found in endothelial cells, monocytes and neutrophils.

**Zoonotic potential:** Not definitively, although pCS20 sequences have been amplified in humans in South Africa.

**Distribution:** Endemic countries are on the African continent south of the Sahara, Madagascar, various small islands in the Indian and Atlantic Oceans, and islands in the Caribbean. A foreign animal disease for US, concern of entry is high due to illegal wildlife trade with infected ticks and the potential for domestic ruminants and white tailed deer in the US to serve as host species. All susceptible animals legally imported (e.g., zoo animals and stocking of exotic animal ranches) to the US from heartwater endemic regions may serve as a route of introduction of *E. ruminantium* to the American continents. Ticks on tortoises from Africa can carry infected ticks.

**Incubation period:** This period varies with species infected, route of infection, and strain of *E. ruminantium*. In domestic cattle, incubation is 12 days after intravenous injection of *E. ruminantium* “vaccine”. The period is shorter (e.g., 7 days) when more virulent strains are used. Incubation period of tick transmitted heartwater is 18-21 days.

**Clinical signs:** Severity ranges from subclinical infection to peracute disease. Clinical signs range from mild transient fever in subclinical cases to death without premonitory signs in peracute cases – i.e., presenting as sudden death. The acute form is characterized by rapid onset of fever (41.5° to 42°C), tachypnea, inappetence, petechiation on serosal and mucosal surfaces, and neurologic signs (e.g., hyperesthesia, high-stepping or unsteady gait, twitching eyelids, head pressing, chewing, abnormal tongue movement, individual

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muscle tremors). In domestic cattle and goats profuse, fetid, hemorrhagic diarrhea commonly occurs terminally.

**Post mortem, gross, or histologic findings:** Hydrothorax, pulmonary edema, ascites, hydropericardium (“heartwater”), cerebral edema, edema of the lymph nodes, and splenomegaly are observed. *E. ruminantium* found in brain endothelial cells lining capillaries as colonies in all animals that have died of heartwater. Rare to find colonies in brain smears of infection carrier animals.

**Diagnosis:** Clinical signs in ruminants with known *Amblyomma* spp. tick infestations may be suggestive although a number of differential diagnoses must be considered due to the non-specific gastrointestinal and neurologic signs. In peracute cases, anthrax and peracute typanosomiasis are top differentials. In acute cases, rabies, cerebral babesiosis, cerebral theileriosis, tetanus, cerebral listeriosis, coccidiosis, arsenical or plant intoxication, hemorrhagic septicemia, and hemonchosis can be confused with *E. ruminantium*. Differential diagnoses are host species and geographical location dependent. Clinical pathologic changes are variable but may include progressive anemia, marked decline in thrombocytes, fluctuations in total and differential white cell counts, increased total bilirubin, and a decrease in total serum proteins. Serologic diagnostics for antibodies (e.g., ELISA and Western blot) and pathogen detection (e.g., DNA probes and pCS20 PCR) are available. It is recommended that MAP1B ELISA and the pCS20 PCR (nested or reverse transcript) be run on samples from animals with suspected *E. ruminantium* infection to detect both antibodies and the pathogen. (NB: Animals that die of heartwater will not have antibodies detected in the blood.) Definitive diagnosis (gold standard) is brain smears showing the organisms in endothelial cells that stain positive with Giemsa stain. In addition to the brain, organisms may be identified by light microscopy in kidney, lung, and heart tissue.

**Material required for laboratory analysis:** Brain tissue, *Amblyomma* spp. ticks, and blood or bone marrow collected in anti-coagulant.

**Relevant diagnostic laboratories:**

Submissions from suspect cases coming from the US:

USDA-APHIS-VS National Veterinary Services Laboratory (NVSL)

1920 Dayton Ave. (for packages)

P.O. Box 844 (for letters)

Ames, IA 50010

Phone: (515) 337-7266

Fax: (515) 337-7397

Submissions from suspect cases coming from foreign countries:

Foreign Animal Disease Diagnostic Laboratory (FADDL), Plum Island, New York

40550 Route 25 (for packages)

Orient Point, NY 11957

P.O. Box 848 (for letters)

Greenport, NY 11944-0848

Phone: (631)323-3256

Fax: (631) 323-3366

**Treatment:** Limited value in clinically ill animals after the onset of neurologic or gastrointestinal signs. Administration of antibiotics (sulfonamides and tetracyclines) at the start of a febrile response may be successful.

**Prevention and control:** In regions free of heartwater (US), control depends on tick control (*Amblyomma* spp.) and regulation of animal movements (e.g., subclinical carriers). In endemic regions, control is

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dependent on maintenance of endemic stability through vaccination and strategic tick control. "Vaccination" (infection and treatment) is possible in endemic regions with intravenous injection of live *E. ruminantium* organisms and then intravenous administration of antibiotics started at first rise in body temperature. Hazard of live vaccination is that it most likely will induce carrier status. Inactivated vaccines are being developed and may soon be commercially available to minimize clinical signs but they do NOT prevent infection.

**Suggested disinfectant for housing facilities:** Organism is extremely fragile outside the host, losing its viability within hours. Tick control is backbone of heartwater prevention. Appropriate acaricides are important and proper quarantine periods when moving animals from heartwater endemic to non-endemic regions.

**Notification:** OIE list B notifiable disease.

**Measures required under the Animal Disease Surveillance Plan:** Heartwater is a reportable foreign animal disease in the US to USDA-APHIS.

**Measures required for introducing animals to infected animal:** Although a non-contagious disease, all infected animals should be quarantined and treated with acaricides routinely. Risk of spread from infected ticks on carrier animals when animals (and their ticks) are introduced to new areas or when potential *Amblyomma* spp. vector ticks in heartwater free regions feed on carrier animals and become infectious.

**Conditions for restoring disease-free status after an outbreak:** Tick control and culling.

**Experts who may be consulted:**

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**References:**

1. Burridge, M.J., T.F. Peter, S.A. Allan, and S.M. Mahan. 2002. Evaluation of safety and efficacy of acaricides for control of the African tortoise tick (*Amblyomma marmoreum*) on leopard tortoises (*Geochelone pardalis*). *J. Zoo Wildl. Med.* 33: 52-57.
2. Deem, S.L. 2007. Heartwater (*Ehrlichia ruminantium*). In: Fowler, M.E., and R.E. Miller (Eds.), *Zoo and Wild Animal Medicine: Current Therapy 6*, Saunders Elsevier, Saint Louis, Missouri, pp. 438-443.
3. Deem, S.L. 1998. A review of heartwater and the threat of introduction of *Cowdria ruminantium* and

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exotic *Amblyomma* spp. ticks to the American mainland. *J. Zoo Wildl. Med.*, 29: 109-113.

4. Karasi, T.R., R.S. Miller, A.M. James, and J.E. Freier. 2010. Recognition of the threat of *Ehrlichia ruminantium* infection in domestic and wild ruminants in the continental United States. *J. Am. Vet. Med. Assoc.* 237: 520-530.
5. Kock, N.D. 2001. Heartwater. *In: Williams, E.S., and I.K. Baker (eds). Infectious Diseases of Wild Mammals.* Iowa State University Press, Ames, Iowa. Pp. 477-480.
6. Louw, M., M.T. Allsopp, and E.C. Meyer. 2005. *Ehrlichia ruminantium*, an emerging human pathogen – a further report. *S. Afr. Med. J.* 95: 948-950.
7. Mahan, S.M. 2008. Heartwater. *In: Brown, C., and A. Torres. (eds.). 2008. Foreign Animal Diseases, 7th Edition.* Saint Joseph, Missouri. United States Animal Health Association. 287-296.
8. Peter, T.F., E.C. Anderson, M.J. Burridge, and S.M. Mahan. 1998. Demonstration of a carrier state for *Cowdria ruminantium* in wild ruminants from Africa. *J. Wildl. Dis.* 34: 567-575.