Theileriosis

East Coast Fever,
Corridor Disease,
Theileriasis,
January Disease,
Zimbabwean Tick Fever,
African Coast Fever;
Tropical Theileriosis,
Mediterranean Coast Fever,
Mediterranean Theileriosis

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Importance

Infection by *Theileria* parasites limits the movement of cattle between countries and can result in production losses and high mortality in susceptible animals. Because these diseases are most severe in recently introduced animals, they are a constraint on the importation of new breeds or improved stock. The two diseases with the greatest economic impact in cattle are East Coast fever (infection with *Theileria parva*) and tropical theileriosis (infection with *Theileria annulata*). *Theileria lestoquardi*, which causes a severe disease with a high morbidity and mortality rate, is the most important species in sheep and goats.

Etiology

Theileriosis results from infection with protozoa in the genus *Theileria* of the suborder Piroplasmorina. *Theileria* spp. are obligate intracellular parasites. The two most important species in cattle and water buffalo are *T. parva*, which causes East Coast fever, and *T. annulata*, which causes tropical theileriosis.

A number of other *Theileria* species including *T mutans, T buffeli, T. velifera, T. taurotragi* and *T. sergenti* can also infect domesticated and wild ruminants. Many of these organisms are carried asymptomatically, but some can cause anemia, and concurrent infections may increase the severity of East Coast fever or tropical theileriosis.

T lestoquardi (formerly *T hirci*) is the most virulent species in sheep and goats. *T. separata* and the nonpathogenic species *T. ovis* also occur in small ruminants.

Species Affected

T. parva can infect cattle, African buffalo (*Syncerus caffer*), water buffalo (*Bubalus bubalis*), and waterbucks (*Kobus* spp.). Symptomatic infections are common only in cattle and water buffalo. *T. annulata* occurs in cattle, yaks, water buffalo and camels. Mildly pathogenic and nonpathogenic species found in cattle include *T. mutans, T. buffeli, T. velifera, T. taurotragi* and *T. sergenti*. *T. taurotragi* has also been recognized in eland. *Theileria* spp. have been found in most wild Bovidae in Africa. They have also been reported in wild animals on other continents.

T. lestoquardi, T. separata, T. ovis and other species occur in sheep and goats.

Geographic Distribution

T. parva (East Coast fever) is found in sub-Saharan Africa. *T. annulata* (tropical theileriosis) occurs from southern Europe and the Mediterranean coast through the Middle East and North Africa, and into parts of Asia. *T. parva* and *T. annulata* are not usually found in the same region; these two parasites seem to occur together only in southern Sudan.

T. mutans has been found in African and on some Caribbean islands, and was reported from the U.S. in 1950 and 1975. *T. velifera* and *T. taurotragi* occur in Africa, while *T. sergenti* has been reported from parts of Asia. *T. buffeli* is widespread, and has been reported from Europe, Asia, Australia, North America and parts of Africa.

T. lestoquardi has been documented in Asia, the Middle East and parts of Africa and Europe. *T. ovis* and *T. separata* occur in Asia.

Transmission

Theileria spp. are transmitted by ticks acting as biological vectors. *Rhipicephalus appendiculatus* is the most important vector for *T. parva*, but *R. zembeziensis* and *R. duttoni* carry this organism in parts of Africa. *T. annulata* is transmitted by ticks in the genus *Hyalomma*. *Hyalomma* spp. are also the vectors for *T lestoquardi, T. ovis* and *T. separata*, while *T. buffeli* and *T. sergenti* are transmitted by *Haemaphysalis* spp,. and *T mutans* and *T. velifera* are transmitted by *Amblyomma* spp. Ticks in the genus *Rhipicephalus* spread *T. taurotragi*.

Theileria sporozoites are transmitted to animals in the saliva of the feeding tick. Ordinarily, *T. parva* and *T. annulata* only mature and enter the saliva after the tick attaches to a host; a tick must usually be attached for a few days before it becomes

infective. However, if environmental temperatures are high, infective sporozoites of *T. parva* can develop in ticks on the ground, and may enter the host within hours of attachment. Transovarial transmission does not occur with *Theileria* spp.

Inside the mammalian host, *Theileria* sporozoites undergo a complex life cycle involving the replication of schizonts in leukocytes and piroplasms in erythrocytes. Cattle that recover from *Theileria* infections usually become carriers for months or years. Iatrogenic transmission can also occur via blood (e.g., on re-used needles).

Incubation Period

The incubation period for East Coast fever is 8 to 12 days in experimentally infected animals. It might be as long as three weeks in naturally infected animals. The incubation period for tropical theileriosis is thought to be approximately 1 to 3 weeks.

Clinical Signs

In East Coast fever, the clinical signs include generalized lymphadenopathy, fever, anorexia and loss of condition with decreased milk yield. Petechiae and ecchymoses may be found on the conjunctiva and oral mucous membranes. Lacrimation, nasal discharge, corneal opacity and diarrhea can also be seen. Terminally ill animals often develop pulmonary edema, severe dyspnea and a frothy nasal discharge. Some cattle have a fatal condition called "turning sickness." In this form of the disease, infected cells block capillaries in the central nervous system and cause neurological signs. Animals that recover from East Coast fever often become asymptomatic carriers, but some animals have poor productivity and their growth is stunted.

Tropical theileriosis generally resembles East Coast fever, but these parasites also destroy red blood cells, causing jaundice, anemia, and in some cases, hemoglobinuria. Hemorrhagic diarrhea may be seen in the late stages. Petechiae are often found on the mucous membranes. Neurological signs have been documented in some terminally ill water buffalo, but "turning sickness" does not seem to be a feature of tropical theileriosis in cattle. Abortions can be seen.

Other species of *Theileria* including *T. mutans*, *T. sergenti* and *T. buffeli* can cause anemia in cattle or increase the severity of clinical signs in animals coinfected with *T. parva* or *T. annulata*. On their own, these organisms usually cause mild disease compared to East Coast fever or tropical theileriosis. Some species such as *T. velifera* appear to be non-pathogenic.

T. lestoquardi is the most virulent species in small ruminants, and often causes fatal disease. The clinical signs may include fever, anorexia and weight loss, listlessness, lymphadenopathy, edema of the throat, difficulty breathing, anemia and icterus. Subacute, chronic or mild cases can also be seen.

Post Mortem Lesions

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Petechial and ecchymotic hemorrhages are often found on the serosal surfaces of internal organs, and the body cavities may contain serous fluid. In acutely infected animals, the lymph nodes are usually enlarged and may be edematous and hemorrhagic. In chronic cases, they may be shrunken. The spleen is typically enlarged. The liver may also be larger than normal, and white foci of lymphoid infiltration (pseudoinfarcts) may be present in the liver and kidney. The gastrointestinal tract can have signs of hemorrhagic enteritis, particularly in the small intestine and abomasum.

Interlobular emphysema and severe pulmonary edema are common in animals that die of East Coast fever. A frothy exudate may be found around the nostrils and in the trachea and bronchi. The lungs are hyperemic and full of fluid. Pulmonary edema also occurs in goats infected with *T. lestoquardi*.

Morbidity and Mortality

Morbidity and mortality vary with the host's susceptibility, and the strain and dose of the parasite. The case fatality rate for untreated East Coast fever can be as high as 100% in taurine, zebu or sanga cattle from non–endemic areas. In contrast, the morbidity rate approaches 100% among indigenous cattle, but the mortality rate is usually low. Similarly, tropical theileriosis is more severe in introduced breeds, with a mortality rate of 40-90%, while the mortality rate in indigenous cattle can be as low as 3%. Breeds of cattle that are relatively resistant to experimental infection with *T. annulata* include the Sahiwal breed of *Bos indicus* and the Kenana breed of *B. taurus*. Infections with *Theileri*a spp. other than *T. parva* and *T. annulata* are rarely fatal in cattle.

In sheep and goats, the morbidity rate from *T. lestoquard*i can approach 100%, with a mortality rate of 46-100%.

Diagnosis

Clinical

East Coast fever should be suspected in tick–infested animals with a fever and enlarged lymph nodes. Terminal pulmonary edema and a high mortality rate in introduced breeds are also suggestive. Indigenous animals with tropical theileriosis may be in poor condition, with wasting and signs of anemia.

Differential diagnosis

In cattle, the differential diagnosis for theileriosis includes heartwater, hemorrhagic septicemia, trypanosomiasis, babesiosis, Rift Valley fever and malignant catarrhal fever. In sheep and goats, *T. lestoquardi* infections

must be distinguished from babesiosis, Rift Valley Fever and malignant catarrhal fever.

Laboratory tests

In live animals, theileriosis can be diagnosed by finding schizonts in Giemsa-stained thin smears from blood or lymph node biopsies. At necropsy, schizonts may be found in impression smears from many internal organs. Piroplasms occasionally occur in the blood of carrier animals, but in many cases, they cannot be detected by direct examination. The diagnosis must be confirmed by detecting schizonts. *Theileria* spp. resemble each other, but they can be differentiated with DNA assays or serological tests.

Polymerase chain reaction (PCR) tests can detect and identify *Theileria* in carriers as well as acutely ill animals. Some PCR assays can identify *Theileria* to the species level. Other nucleic acid-based assays may be available in research laboratories.

Antibodies to *T. parva* and *T. annulata* can be detected with enzyme–linked immunosorbent assays (ELISAs) or an indirect fluorescent antibody test (IFA). Serologic tests may not be sensitive enough to detect all infected cattle, and cross–reactions can occur between some species of *Theileria*, particularly in some tests such as the IFA.

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.

Schizonts may be found in lymph node biopsy smears in the acute stage of both East Coast fever and tropical theileriosis. In East Coast fever, schizonts also occur in blood leukocytes, and in impression smears from a variety of tissues collected at necropsy; the lungs, lymph nodes, spleen and kidney are among the tissues most likely to contain *T. parva*. Few schizonts are found in the blood during the acute stage of tropical theileriosis, and their presence correlates with a poor prognosis. In this disease, schizonts are more likely to occur in smears from the lymph nodes, spleen and liver. Piroplasms may be found in erythrocytes.

Serum should be collected for serology.

Recommended actions if theileriosis is suspected

Notification of authorities

***Theileria* species including *T. buffeli* have been reported in North America.; however, *T. parva, T. annulata* and *T. lestoquardi* are exotic. Tropical theileriosis, East Coast fever and diseases caused by other exotic *Theileria* spp. must be reported to state or federal authorities immediately upon diagnosis or suspicion of the disease.**

Federal: Area Veterinarians in Charge (AVIC):
www.aphis.usda.gov/animal_health/area_offices/

State Veterinarians:
www.usaha.org/Portals/6/StateAnimalHealthOfficials.pdf

Control

Theileriosis is not transmitted by casual contact. If the infection is newly introduced to an area, it might be eradicated with movement controls, by culling infected animals and by preventing ticks from becoming infected.

In endemic areas, the tick burden can be decreased with acaricides and other methods of tick control such as rotational grazing. The transfer of blood between animals must also be avoided. Antiparasitic drugs are effective in animals with clinical signs, but animals may remain carriers. Treatment is most effective in the early stages of the disease.

Animals can be protected from both East Coast fever and tropical theileriosis by vaccination. Attenuated vaccines are used to control tropical theileriosis in some countries. Vaccination against East Coast fever is done by simultaneously injecting virulent *T. parva* and an antibiotic (usually a long-acting tetracycline). This process generally results in a mild or inapparent infection, and the animal becomes a carrier. *T. parva* stocks that infect cattle asymptomatically have been identified, and might be used without simultaneous antibiotic therapy. Considerations in *T. parva* vaccination include the possibility of introducing live organisms into areas where they are not currently endemic.

Public Health

There is no evidence that *T. parva* or *T. annulata* are hazards to humans.

Internet Resources

Food and Agriculture Organization of the United Nations (FAO). Manual on Meat Inspection for Developing Countries
http://www.fao.org/docrep/003/t0756e/T0756E00.HTM

FAO Manual for the Recognition of Exotic Diseases of Livestock
http://www.spc.int/rahs/

The Merck Veterinary Manual
http://www.merckvetmanual.com/mvm/index.jsp

United States Animal Health Association. Foreign Animal Diseases
http://www.usaha.org/pubs/fad.pdf

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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*Link defunct as of 2009