

# Equine Piroplasmosis

*Equine Babesiosis, Equine Theileriosis, Biliary Fever*

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## Importance

Equine piroplasmosis is a tick-borne protozoal disease that affects horses and other equids. The consequences of infection may include asymptomatic carriage, an acute and potentially life-threatening illness, or chronic disease with vague clinical signs such as reduced exercise tolerance. Piroplasmosis is a significant constraint to the international movement of equids, limiting both trade and participation in international competitions. Approximately 90% of equids worldwide are thought to live in areas where this disease is endemic, and detecting asymptomatic carriers can be difficult. In particular, the complement fixation test used for screening imported animals in the past had a significant number of false negative results. Some asymptomatic carriers screened with this test may now live in areas thought to be piroplasmosis-free. Such carriers can transmit this disease to other equids through tick vectors or procedures that transmit blood, including the reuse of needles.

## Etiology

Equine piroplasmosis can be caused by two protozoa, *Babesia caballi* and *Theileria equi* (formerly *Babesia equi*), both members of the phylum Apicomplexa and order Piroplasmida. *T. equi* is a very diverse species and has been divided into at least 3 major genotypes, A through C. Concurrent infections with *B. caballi* and *T. equi* are possible. An organism related to *T. equi* was described in North American horses in 2018 and proposed as a new species, *Theileria haneyi*. Its clinical significance is currently unclear.

Species of *Babesia* and *Theileria* that are normally found in other animal hosts have been reported occasionally in equids.

## Species Affected

*T. equi* and *B. caballi* affect equids including horses (*Equus caballus*), Przewalski's horses (*Equus ferus przewalskii*), mules, donkeys and zebras. Maintenance hosts include domesticated and wild equids, with zebras serving as an important reservoir in Africa. All three species of zebra - plains zebra (*Equus quagga*), mountain zebra (*Equus zebra*) and Grevy's zebra (*Equus grevyi*) - can be infected in nature.

Nucleic acids of *T. equi* and *B. caballi* have also been found in significant numbers of dromedary camels, and sporadically in dogs. A few infected dogs had illnesses thought to be caused by these organisms, but the clinical significance remains to be determined in camels. There are also rare reports of nucleic acids in other species including *T. equi* in a sheep, a goat, a cow, a South American tapir (*Tapirus terrestris*) and a South American rodent (*Thrichomys fosteri*); and *B. caballi* in crab-eating foxes (*Cerdocyon thous*). Organisms that appear to be related to *T. equi* but were not definitively identified have been described in additional species such as coatis (*Nasua nasua*), waterbuck (*Kobus defassa*) and a Malayan tapir (*Tapirus indicus*).

## Zoonotic potential

*Babesia* and *Theileria* do not seem to be entirely species-specific, and some organisms occasionally infect animals other than their usual host. Human babesiosis is still incompletely understood, but *B. caballi* and *T. equi* are not thought to be significant human pathogens. While there have been suggestions that these organisms might have caused a few infections in the past, species identification at the time was not necessarily definitive. One recent survey found antibodies to *T. equi* in 6% of veterinarians and <1% of the general public in Italy. Virological evidence for infection was not assessed in this study, and serological cross-reactivity with other organisms is possible.

## Geographic Distribution

The parasites that cause equine piroplasmosis are endemic in parts of Africa, the Middle East, Asia, Central and South America, Mexico, the Caribbean and southern Europe. Some countries, including Australia, New Zealand, Canada, Japan and parts of Europe, are thought to be free of this disease. Infected equids have occasionally been identified in piroplasmosis-free countries, generally as the result of either illegal

importation or asymptomatic carriers there were not detected during import testing. The latter was more prevalent among horses imported in the past, when complement fixation, which has a significant risk of false negatives, was prescribed for international trade. Infected equids are found periodically in the U.S., which is otherwise thought to be free of equine piroplasmosis, as a result of these issues. Extensive surveillance after a recent outbreak found a low level (< 0.1%) of seropositive animals by ELISA. However, a re-analysis of these sera by immunoblotting suggests that they may be false positives.

Wildlife reservoirs are known to exist in Africa (zebras) and Mongolia (Przewalski's horses). Surveillance of wild or feral horses in many areas is limited.

## Transmission

*B. caballi* and *T. equi* are transmitted by ticks, which act as biological vectors. Approximately 30 species of ticks in the genera *Dermacentor*, *Hyalomma*, *Haemaphysalis*, *Ixodes*, *Rhipicephalus* and *Amblyomma* have been implicated as natural or experimental vectors, although the epidemiological significance of some species is uncertain. *B. caballi* and *T. equi* can be transmitted transstadially in ticks, but transovarial transmission is only known to be significant for *B. caballi*. This species can be maintained in a tick population for several generations without reinfection from a vertebrate host. *B. caballi* and *T. equi* complete their maturation in the tick after it attaches to a host, and there is a delay before they are transmitted. These organisms can also be spread directly between animals by transfusions and blood-contaminated fomites such as reused needles. Transplacental transmission has been documented for both *T. equi* and *B. caballi*.

Horses, donkeys and other equids that become infected with *T. equi* and *B. caballi* can carry these organisms for long periods, with or without clinical signs. Carriers are not thought to eliminate *T. equi* without treatment, but how long *B. caballi* persists is unclear. Earlier reports indicated that horses clear this organism eventually, although they may remain carriers for several years; however, more sensitive techniques suggest that at least some horses may remain infected for life. Healthy carriers can include foals infected *in utero*.

## Disinfection

Disinfection is not important in the control of equine piroplasmosis. If needed, an agent effective against protozoa should be selected.

## Incubation Period

The incubation period for tick-transmitted acute illnesses is 12 to 19 days for *T. equi*, and 10 to 30 days for *B. caballi*. Clinical signs can be seen as quickly as 5-7 days when the organisms are inoculated directly into the blood.

## Clinical Signs

### Equids

The effects of equine piroplasmosis are variable, with some animals becoming infected without clinical signs and others developing acute or chronic illnesses.

In rare peracute clinical cases, animals may be found dead or dying. More often, acute cases in horses begin as a febrile illness, with nonspecific signs that may include inappetence, malaise, labored or rapid respiration, and congestion of the mucous membranes. Some cases can be mild and transient, but other animals become markedly ill. Most horses with acute piroplasmosis have some degree of anemia, which can result in pale or icteric mucous membranes, weakness and an increased heart rate and respiration. Hemoglobinuria or bilirubinuria may also be seen, and thrombocytopenia can result in petechiae on the mucous membranes, including those of the eye. Some animals have gastrointestinal signs such as colic, small and dry feces, or diarrhea. Edema of the limbs, a swollen abdomen from ascites, posterior weakness or swaying, and seizures may also be seen. Increased lacrimation, swelling of the eyelids and notably increased thirst are reported to be common in donkeys. Complications in severe cases can include kidney damage or acute renal failure, liver failure, disseminated intravascular coagulation, and secondary infections that can cause syndromes such as pneumonia.

Chronic piroplasmosis is usually a nonspecific illness with signs such as mild inappetence, poor exercise tolerance, weight loss and transient fevers. An enlarged spleen may be palpable on rectal examination. Anemia can be minimal or absent in chronically infected horses. Mild icterus and pale mucous membranes have been reported in some chronically infected donkeys.

Some infected horses, including asymptomatic carriers, may abort or give birth to stillborn foals. Live offspring born to these animals are sometimes weak at birth or appear normal but develop clinical signs after 2-3 days. While the initial signs may be nonspecific, the illness can quickly progress to anemia and severe jaundice. Some foals infected *in utero* have no clinical signs despite carrying the organism.

### Other species

Some dogs found to be infected by PCR were asymptomatic or coinfecting with other organisms; however, *T. equi* appeared to be responsible for anemia and thrombocytopenia in 2 dogs in South Africa. Clinical signs reported in dogs with theileriosis or babesiosis have included fever, pale mucous membranes, icterus, hematuria, hemoglobinuria, hematochezia, bleeding tendencies (petechiae, ecchymoses, oral bleeding) and splenomegaly. *T. equi* was found by PCR in a South American tapir with fever, lethargy and anemia; however, the animal had concurrent osteomyelitis after a fracture, and whether *T. equi* caused any of these signs was uncertain. As of 2018, no clinical signs have been attributed to *T. equi* or *B. caballi* in infected

camels, but some authors suggest that they are probably pathogenic in some individuals.

## Post Mortem Lesions [Click to view images](#)

The gross lesions in acute illnesses may include evidence of anemia and icterus in the internal organs, hemorrhagic lesions (e.g., petechiae in the kidneys, subepicardial and subendocardial hemorrhages in the heart, ecchymoses) and an enlarged spleen. The liver is often enlarged and may be either dark orange-brown or pale from anemia. Additional lesions may include lymphadenopathy, discoloration and enlargement of the kidneys, pulmonary edema and congestion, hydropericardium, hydrothorax, ascites, edema, weight loss and signs related to secondary infections or complications.

## Diagnostic Tests

Equine piroplasmosis can sometimes be diagnosed by detecting the organisms in blood or organ smears stained with Romanowsky-type stains such as Giemsa, Wright's or Diff-Quik®. Blood smears are optimally made from superficial skin capillaries during the acute phase of the disease. Thin films are usually used for parasite identification, but thick blood films can be helpful in detecting organisms present in low numbers. *B. caballi* typically appears as two large piriform merozoites joined at their posterior ends, while *T. equi* merozoites are relatively small, with a piriform, round or oval shape, and are sometimes connected in a tetrad known as a Maltese cross. *T. equi* can often be detected in the blood of acutely ill animals, but the number of *B. caballi* parasites tends to be lower. Both organisms are usually difficult or impossible to find in chronically infected animals.

Various PCR tests are available for *T. equi* and *B. caballi*, and are more sensitive than direct observation. However, *T. equi* is genetically variable and PCR tests developed to detect some isolates of this organism may miss others. A reverse line blot assay (RLB), multiplex PCR tests that can detect both organisms, and loop-mediated isothermal amplification (LAMP) assays have also been described.

Serological tests may be used to diagnose clinical cases and are also employed to detect asymptomatic carriers. The most commonly used tests are the indirect fluorescent antibody (IFA) assay and various ELISAs. Immunoblotting (Western blotting) is increasingly available in some countries. The complement fixation test is sometimes employed in clinical cases, but it has fallen out of favor as a screening test for carriers because the number of false negative tests was unacceptably high. Other tests, such as immunochromatographic assays, have also been described.

More labor intensive diagnostic methods may be necessary in some situations, for instance when evaluating whether treatment has eliminated the parasites from a carrier. Some of these techniques include *in vitro* culture, animal inoculation into an equid, and xenodiagnosis. In xenodiagnosis, pathogen-free ticks are fed on a suspect animal, and organisms are identified either in the ticks or in a susceptible mammal upon which the ticks are fed.

## Treatment

Antiprotozoal drugs (e.g., imidocarb, diaminoxene) are used to treat clinical cases in horses and donkeys. Tetracyclines have been used in animals infected with *T. equi*, but are reported to be ineffective against *B. caballi*. Zebras and dogs with clinical signs have also been treated successfully with imidocarb. Supportive care, such as transfusions, may be necessary in some animals.

Some recent reports suggest that certain protocols using imidocarb can clear *T. equi* and *B. caballi* from horses, including asymptomatic carriers. Other studies have found that these organisms usually persist in the body, although they may be suppressed for a time. Differences in the drug susceptibility of circulating strains might account for some conflicting results. If a treated animal is to remain in an equine piroplasmosis-free country, it must be thoroughly evaluated to ensure that the organism has been permanently cleared from the body. In the U.S., horses can only be treated in official programs under supervision by USDA APHIS.

## Control

### Disease reporting

Veterinarians who encounter or suspect an infection with *T. equi* or *B. caballi* should follow their national and/or local guidelines for disease reporting. In the U.S., state or federal authorities should be informed immediately.

### Prevention

Carrier animals and infected ticks can introduce equine piroplasmosis into new regions. Piroplasmosis-free countries usually test equids for this disease during importation, using serological tests. Carriers are sometimes allowed to temporarily enter such countries for international competitions. In the U.S., these carriers are examined, treated for ticks, monitored as needed, and quarantined except when competing. Some events in the U.S. now require a negative test for equine piroplasmosis even if the animal resides within the country.

If an infected animal is discovered in a piroplasmosis-free region, it should be quarantined and kept from all contact with ticks. Options for its disposition may include permanent quarantine, export, euthanasia or treatment; the available options vary with the country. In recent years, the U.S. has allowed treatment under supervision, with post-treatment confirmation of clearance.

Tick bite prevention (e.g., the use of acaricides) may limit exposure in endemic regions. Frequent examination of the animal and the removal of ticks may eliminate some vectors before they can transmit the organism. Practices that can expose horses to blood from other equids, such as sharing needles, should be avoided, and blood donors used by veterinary hospitals should be negative for piroplasmosis. Illegal pre-race blood transfusions (blood doping) were implicated in some cases in the U.S. There is no vaccine for either *B. caballi* or *T. equi*.

## Morbidity and Mortality

Asymptomatic infections with *B. caballi* and *T. equi* appear to be common in endemic regions. In some areas, equids tend to be exposed to these organisms when they are young and have some protection from maternal antibodies, and acute clinical cases are reported to be relatively infrequent. They are more likely to be seen when naive animals are introduced to an endemic region, or if an infected animal transmits the disease to equids in a piroplasmosis-free country. The mortality rate is influenced by the specific organism and the level of exposure, the host's health in general, and the availability of good veterinary care. The case fatality rate in horses is usually reported to be in the range of 5-10%, but rates of 50% or higher have been seen in some outbreaks, especially in naive horses. *T. equi* typically causes more severe clinical signs than *B. caballi*; however, some sources speculate that *T. equi* strains may differ in virulence, as the illnesses caused by this organism seem to be more severe in some countries than others. Relapses have been reported in infected horses after stressors or immunosuppression, including the use of corticosteroids.

There is limited information about the prevalence and significance of *T. equi* and *B. caballi* in feral or wild horses; however, this disease can have a significant impact on reintroduced populations of Przewalski's horses in Mongolia. Anecdotal reports suggest that piroplasmosis may cause fatalities of 20-25% in recently captured Grevy's zebras.

## Internet Resources

[The Merck Veterinary Manual](#)

[United States Animal Health Association. Foreign Animal Diseases](#)

[World Organization for Animal Health \(WOAH\)](#)

[WOAH Manual of Diagnostic Tests and Vaccines for Terrestrial Animals](#)

[WOAH Terrestrial Animal Health Code](#)

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\*Link is defunct