LYME DISEASE AND OTHER TICK-BORNE INFECTIONS IN HORSES

Kara M Lascola DVM, MS, DACVIM
Associate Professor Equine Internal Medicine
Auburn University College of Veterinary Medicine
1500 Wire Road
Auburn AL 36849
334-844-4490 (phone); 334-844-4368 (fax)
kml0068@auburn.edu

Tick-borne disease poses a worldwide health threat for humans as well as wildlife and domesticated animals, including horses. Within the United States, the natural geographic ranges of most tick species have expanded into areas previously considered "tick free". This expansion has corresponded to increased disease prevalence. Over the past 10 years the occurrence of disease has doubled in humans with over 59,000 cases of tickborne disease reported to the CDC in 2017 (www.cdc.gov/ticks/). In humans, ticks of importance for the transmission of the most commonly reported diseases in the US (Lyme, anaplasmosis, ehrlichiosis, Rocky Mountain spotted fever, babesiosis), include species of *Ixodes*, *Dermocenter*, *Amblyomma*, and *Rhipicephalus*. The tick-borne diseases of greatest clinical significance among horses within the United States are Lyme disease, Anaplasmosis, and Equine Piroplasmosis. Currently, *Ixodes* species (*I. scapularis* and *I. pacificus*) represent the only tick species confirmed to transmit disease to horses in the US. Much remains to be learned however, regarding the significance of other ticks such as *Dermocenter* or *Amblyomma* in disease transmission, of co-infection with multiple tick-borne pathogens, and with respect to pathogens of emerging significance.

Lyme disease represents the most common vector-borne infectious disease diagnosed among humans in the United States (> 42,000 cases 2017; www.cdc.gov/ticks/). This disease was first described in the 1970's in Lyme Connecticut as a disease primarily causing signs of rheumatoid arthritis in children. The causative agent is the spirochete bacteria *Borrelia burgdorfer*i. In

addition to humans and horses, dogs, cats and cattle also represent susceptible species. *Ixodes* ticks are involved in the transmission of *B. burgdorfer*i and have geographic distributions covering expanding regions in the Midwest and along both the Eastern and Pacific coasts. Corresponding increases in seroprevalence and infection have been noted in other species and may also exist in horses.

Ixodes scapularis and *I pacificus* (bear tick, blacklegged tick, deer tick) are the vector species involved in the transmission of *B. burgdorferi*. Small mammals, such as the white-footed mouse serve as the natural reservoir for *Borrelia* while deer and other large mammals serve as hosts for *Ixodes* ticks. The life cycle for *Borrelia* and *Ixodes* is a 2 year, 3 stage cycle. Ticks become infected in the larval stage and go on to transmit the disease during the nymphal and adult stages. The highest disease transmission is thought to occur during the nymphal stage.

While serologic evidence suggests that infection with *B. burgdorferi* is common in certain geographical regions within the US, the actual diagnosis of "Lyme disease" in horses is often presumptive and remains challenging as not all infected horses develop clinical signs of disease and because clinical manifestation of disease is highly variable. Furthermore, definitive diagnosis of infection through available diagnostic tests has not been consistently reliable. Three clinical syndromes – neuroborreliosis, *Borrelia* associated uveitis, and *Borrelia* associated pseudolymphoma – have been documented in horses. Other clinical signs that are commonly attributed Lyme disease include: sporadic or shifting lameness, weight loss, behavioral changes, increases skin sensitivity, low grade fever, muscle tenderness or wasting, and swollen joints. A presumptive diagnosis of Lyme disease is often made in horses living in or visiting endemic regions, when *Ixodes* ticks are identified on the horse, when clinical signs are compatible, upon

exclusion of other differential diseases, when clinical signs resolve with treatment, and when laboratory tests support a diagnosis of Lyme disease.

Available serologic testing for *B. burgdorferi* antibodies includes the SNAP® 4Dx® test (IDEXX), ELISA, Western Blot analysis, an immunofluorescence assay, and most recently, the Lyme Multiplex Assay (Cornell Diagnostics). All tests can indicate infection with *B. burgdorferi* but definitive determination of actual disease is challenging particularly in endemic areas. The Lyme multiplex identifies antibodies to antigens of three outer surface proteins (OspA, OspC, OspF) and has been proposed to facilitate distinction between acute and chronically infected horses. Testing for intrathecal antibody production can also be performed on CSF collected from horses with suspect neuroborreliosis.

Recommended treatment for Lyme disease includes longterm administration of acceptable antimicrobials. Resolution of clinical signs remains challenging in chronic cases and in cases of neuroborreliosis. The most commonly administered antimicrobials are β-lactams and tetracyclines. Minocycline and doxycycline are typically administered for 4-6 weeks, although some practitioners may administer oxytetracycline IV for a few weeks prior to switching to an oral tetracycline. Concern exists that antimicrobial resistance is developing in *B. burgdorferi* and investigation into alternative antimicrobial options is ongoing. At this time a licensed vaccine against *B. burgdorferi* is not available and prevention of disease mostly relies on appropriate tick prevention.

Anaplasmosis (Equine granulocytic anaplasmosis) is a tick-borne bacterial disease caused by *Anaplasma phagocytophilum* (formerly *Ehrlichia equi*). The bacterium is also transmitted through *I. scapularis* and *I. pacificus* with horses serving as an aberrant host. Upon infection, *A. phagocytophilum* infects granulocytic white blood cells (neutrophils and eosinophils) and

morulae can sometimes be identified in vacuoles within the cytoplasm of these cells. Most cases of anaplasmosis occur in the late fall and winter. The pathogenesis of disease is poorly understood. The bacteria demonstrate tropism for neutrophils and eosinophils and may also invade endothelial cells. Development of clinical disease involves the development of vasculitis and is most likely mediated by the host's immune response to bacterial invasion.

Typical clinical signs associated with anaplasmosis include fever, anorexia, lethargy, distal limb edema, stiffness, ataxia, petechiation, icterus, and pancytopenia. Rarer and more severe signs may include recumbency, rhabdomyolysis, DIC, and cavitary effusions. Clinical manifestation of anaplasmosis is thought to be less severe in younger horses and the disease is often self-limiting if left untreated. Treatment is warranted in more severe cases and generally involves administration of parenteral or oral tetracyclines. The diagnosis of anaplasmosis involves a history of tick exposure and supporting clinical signs. Characteristic findings on blood smear include identification of morulae within neutrophils and eosinophils. This is best performed in the acute stages of infection. Additional diagnostics include a buffy coat PCR and paired serology using an IFAT.

Equine Piroplasmosis (EP) is a reportable tick-borne disease of horses and other equids. EP is caused by infection with the hemoprotozoan parasites *Theileria equi* and *Babesia caballi*. These two parasites are biologically distinct but share similar life cycles and tick vectors. EP has a global distribution and is considered endemic in certain tropical and subtropical regions. In addition to tick-borne infection, transmission occurs iatrogenically through contaminated blood transfusions or poor management, hygiene, or biosecurity practices. In utero transmission from mares to foals has also been documented

Infection by either *Theileria* or *Babesia* can result in clinical disease of varying severity which manifests as one of three forms: acute EP, chronic EP, or an inapparent carrier state. In the acute form hemolytic anemia along with nonspecific signs of systemic illness (fever, anorexia, lethargy, peripheral edema, petechiation) are noted. In severe cases multiple organ dysfunction may occur as well as fatal peracute infections. Chronically infected horses may be mildly anemic and often demonstrate nonspecific signs of chronic inflammation. The majority of horses infected with *B. caballi* or *T. equi* serve as inapparent carriers. In the absence of medical treatment infection with *T. equi* results in a life-long carrier state. Horses infected with *B. caballi* may clear the infection without medical treatment after several years. Mortality rates often exceed 50% in naïve horses from non-endemic regions.

EP is not endemic in the United States or Canada but is considered endemic in Central and South America and the Caribbean. EP is sporadically reported in the United States and in the past decade multiple states have reported individual cases or outbreaks primarily involving Quarter Horse racehorses. The most recently reported outbreak involved 22 Quarter Horse racehorses in May 2019 in Tennessee. Competent tick vectors with natural ranges within the US include three *Dermocenter* species and *Amblyomma mixtum*. However, infections in the US are rarely thought to be tick-borne. Instead, iatrogenic infection secondary to poor hygiene and management practices is more commonly suspected.

Many states have implemented EP testing regulations and a negative EP test is required at AQHA world shows. There are 13 laboratories with APHIS approval for the cELISA EP test. Horses testing positive for EP in the US are placed under state quarantine with possible options for the horse including euthanasia, export from the US, lifelong quarantine, or longterm quarantine with USDA directed medical treatment. Horses successfully completing this last

option may be released from quarantine once they have tested negative according to established stringent testing guidelines.

Literature

Tickborne diseases of the United States. Centers for Disease Control and Prevention. US Department of Health and Human Services. https://www.cdc.gov/ticks/index.html

Aucott JN, Honey K, Adams W, et al. U.S. Department of Health and Hyman Services Tick-borne Disease Working Group 2018 report to congress. https://www.hhs.gov/ash/advisory-committees/tickbornedisease/reports/index.html

Freese S, Sheats MK. A suspected case of Rocky Mountain Spotted Fever in an adult horse in the southeastern United States. *J Equine Vet Sci*, 2019; 78: 134-137.

Lyme Disease

Divers TJ, Gardner RB, Madigan JE, *et al*. *Borrelia burgdorferi* infection and Lyme disease in North American horses: A consensus statement. *J Vet intern Med*, 2018; 32:617-632.

Swinebroad EL. Borreliosis in sport horse practice. *Vet Clin Equine*, 2018; 34: 313-343.

S Caol, T Divers, M Crisman *et al*. In vitro susceptibility of *Borrelia burgdorferi* isolates to three antibiotics commonly used for treating equine Lyme disease. *BMC Veterinary Research*, 2017; 13:293.

Johnson AL, Johnstone LK, Stefanovski D. Cerebrospinal fluid Lyme multiplex assay results are not diagnostic in horses with neuroborreliosis. *J Vet Intern Med*, 2018; 32: 832-838.

Pecoraro HL, Felippe MJB, Miller AD, *et al*. Neuroborreliosis in a horse with common variable immunodeficiency. *J Vet Diag Invest*, 2019; 31:241-245.

Johnstone LK, Engiles JB, Aceto H, *et al*. Retrospective evaluation of horses diagnosed with neuroborreliosis on postmortem examination: 16 Cases (2004–2015). *J Vet Intern Med*, 2016;30:1305–1312.

Guarino C, Asbie S, Rohde *et al*. Vaccination of horses with Lyme vaccines for dogs induces short-lasting antibody repsonses. *Vaccine*, 2017; 35: 4140-4147.

Anaplasmosis

Fielding CL, Rhodes DM, Howard EJ *et al*. Evaluation of potential predictor variables for PCR assay diagnosis of *Anaplasma phagocytophilum* infection in equids in northern California. *Am J Vet Res*, 2018; 79: 637-642.

Restifo MM, Bedenice D, Thane KE *et al*. Cavitary effusion associated with *Anaplasma phagocytophilum* infection in 2 equids. *J Vet Intern Med* 2015;29:732–735.

Schvartz G, Epp T, Burgess HJ, *et al*. Comparison between available serologic tests for detecting antibodies against *Anaplasma phagocytophilum* and *Borrelia burgdor*feri in horses in Canada. *J Vet Diagn Invest*, 2015; 27: 540-546.

Equine Piroplasmosis

Wise LN. Equine Piroplasmosis. *Vet Clin Equine*, 2014; 30:677-693.

Wise LN, Kappmeyer LS, Mealey RH *et al*. Review of Equine Piroplasmosis. *J Vet Intern Med*, 2013;27:1334–1346.

USDA-APHIS Equine Piroplasmosis 2018 Disease Information. https://www.aphis.usda.gov/aphis/ourfocus/animalhealth/animal-disease-information/horse-disease-information/ep/equine-piroplasmosis

Leblond A. Equine piroplasmosis – the view of a practitioner from an endemic region. *Veterinary Record*, 2019; 184: 92-94.

Onyiche TE, Suganuma K, Igarashi et al. A review on Equine Piroplasmosis: epidemiology, vector ecology, risk factors, host immunity, diagnosis, and control. *Int J Environ Res Public Health*, 2019; 16:pii: E1736. doi: 10.3390/ijerph16101736