Canine Diseases

Canine Lyme Disease

Lyme borreliosis is a bacterial, tick-transmitted disease of animals (dogs, horses, probably cats) and humans. Areas of greatest incidence in the USA are regions in the northeast (particularly the New England states), the upper Midwest, and the Pacific coast. Lyme borreliosis also occurs in moderate climatic regions of Europe and Asia. The importance of borreliosis as a zoonotic disease is increasing.

Etiology and Pathogenesis

Currently, on the basis of DNA-DNA reassociation analysis, 12 different species fall within the *Borrelia burgdorferi* sensu lato complex. Within this complex the most important spirochete species are *B. burgdorferi* sensu stricto (North America, Europe), *B. afzelii* (Europe, Asia), and *B. garinii* (Europe, Asia). Tick vectors of *B burgdorferi* sensu lato are hard-shelled Ixodes ticks. In the USA these are primarily *Ixodes pacificus* on the Pacific coast and *I. scapularis* in the Midwest and northeast. *I. ricinus* and *I. persulcatus* are primary vectors in Europe and Asia.

Ixodid ticks hatch from eggs as uninfected larvae. Both larvae and nymphs may acquire spirochetes from Borrelia-carrying hosts. Small mammals, especially rodents, often play a major role as reservoir hosts. Birds and lizards may also harbor certain Borrelia species and serve as reservoir hosts. Infection rates of the vectors vary according to region and season and can be as high as 50% in adult ticks. After tick attachment, >24 hrs elapse before the first *B. burgdorferi* sensu lato organisms are transmitted into the host's skin. Stable infection of the host occurs at >53 hrs into the blood meal. Therefore, early removal of attached ticks reduces the potential for spirochete transmission. *B. burgdorferi* sensu lato organisms are not transmitted by insects, body fluids (urine, saliva, semen), or bite wounds. Experimental studies have shown that dams infected prior to gestation may transmit spirochetes to their pups *in utero*.

Clinical and Pathological Findings

Numerous clinical syndromes have been attributed to Lyme borreliosis in domestic animals, including limb and joint disease and renal, neurologic, and cardiac abnormalities. In dogs, intermittent, recurrent lameness; fever; anorexia; lethargy; and lymphadenopathy with or without swollen, painful joints are the most commonly observed clinical signs. The second most common syndrome associated with Lyme borreliosis is renal failure and is generally fatal. It is characterized by uremia, hyperphosphatemia, and severe protein-losing nephropathy, often accompanied by peripheral edema. Bernese Mountain Dogs and Labrador Retrievers in particular often show high Borrelia-specific antibody levels; immune

complexes in kidney tissues lead to severe inflammation. In human medicine, single case reports have described abnormalities with bradycardia with the cardiac form of Lyme borreliosis, while facial paralysis and seizure disorders are thought to be expressions of the neurologic form.

Diagnosis

Diagnosis is based on history, clinical signs, elimination of other diagnoses, laboratory data, epidemiologic considerations, and response to antibiotic therapy. Autoimmune panels, CBC, blood chemistry, radiographs, and other laboratory data are generally normal, except for results pertaining directly to the affected system (eg, soft-tissue swelling in limbs, neutrophil accumulation in synovial fluids of affected joints, uremia in renal disease).

Clinical signs for Lyme borreliosis are nonspecific. In addition to other orthopedic disorders (eg, trauma, osteochondritis dissecans, immune-mediated diseases), other infections should be considered. *Anaplasma phagocytophilum* can also induce intermittent, recurrent lameness. *A. phagocytophilum* is transmitted by the same ticks, and epidemiologic studies have revealed that up to 30% of all dogs in central Europe carry antibodies specific for this agent. Mixed infections should be considered when clinical signs are apparent.

Serologic testing for antibodies specific for *B. burgdorferi* sensu lato is an adjunct to clinical diagnosis. Antibodies can be detected with ELISA (including rapid test systems) and protein immunoelectrophoresis (Western blot). Due to their low specificity, indirect immunofluorescent antibody assays are no longer recommended. The standard procedure for antibody detection is a two-tiered approach in which samples are screened with a sensitive ELISA, and only positively reacting samples are rechecked with a specific Western blot assay. Western blot testing helps to differentiate the immune response elicited by infection from that induced by vaccination.

Alternatively, blood or serum samples can be tested with peptide-based assays (C6 peptide), which is specific for infection-induced antibodies. However, demonstration of specific antibodies indicates exposure to bacterial antigen only and does not equate to clinical disease. About 5–10% of dogs in central Europe carry Borrelia-specific antibodies with no clinical signs. Additionally, false-negative results can occur with the C6 peptide assays shortly after infection. Long incubation periods, persistence of antibodies for months to years, and the disassociation of the antibody response from the clinical stage of disease make diagnosis by blood testing alone impossible.

Isolation of *B. burgdorferi* sensu lato by culture or detection of specific DNA by PCR from joints, skin tissue samples, or other sources may also be helpful in diagnosis. However, direct detection of the organism is difficult, time consuming (up to 6 wk for culture), and in most cases produces negative results. Only a positive result is meaningful. Blood samples are generally negative, because the organism resides in tissue and not in the circulation.