Lyme Disease in Dogs

While the infection we know today as Lyme disease (named for the Connecticut town of Lyme) has been around for at least a century, public awareness (and confusion) did not really occur until the late 1980s. Media exposure of this infection virtually exploded, leaving most of the general public with some basic knowledge and a great deal of misconception. We hope to straighten out some of the myths surrounding at least the canine version of the Lyme disease infection.

Human Lyme Disease vs. Canine Lyme Disease

The first lesson about the Lyme disease infection is that it manifests completely differently in man's best friend compared with the human experience. After being bitten by a tick that has transmitted *Borrelia burgdorferi*, 80% of humans will develop a rash and/or flu-like symptoms.

In the next few weeks, joint pain ensues with 15% of people developing neurologic abnormalities associated with Lyme disease and 5% of people developing a heart rhythm disturbance called A-V block. At this same point in the infection timeline, dogs have yet to develop any symptoms at all.

Weeks to months after infection about 60% of people will experience intermittent arthritis attacks and 5% will develop chronic neurologic manifestations. In humans, Lyme disease presents with the potential for serious long-term illness. In dogs, illness may never even occur.

When canine illness does occur, it does not begin to manifest for weeks to months after infection at which point arthritis signs are noticed. Sometimes there is a fever. In dogs, heart and neurologic issues are exceedingly rare, plus the symptoms of canine Lyme disease generally respond rapidly to an inexpensive course of proper antibiotics (see below for details).

The Borrelia burgdorferi organism is fairly well suited to live in the canine body without causing trouble. Most exposed dogs harbor the organism uneventfully and never get sick. Still, it is important not to discount Lyme disease in dogs completely lest you overlook an easily eliminated cause of chronic joint disease, especially in dogs of the Northeast U.S.

A dog’s most serious long-term potential regards glomerular disease. This is a type of kidney damage that occurs when the immune system is stimulated over a very long time by a latent infectious organism (or other immune stimulus). This is a much more insidious problem for which specific testing is needed (see below).
The Tick and Its Control

An organism that serves to transport and deliver an infectious organism from one host to another is called a vector. The vector of Lyme disease in the Northeastern United States is the deer tick, *Ixodes scapularis*. The female tick lays a clump of approximately 2000 eggs in the spring. A small six-legged larva hatches and attaches to a host as soon as it is able. Since the larva is very small, it typically can only reach a small host, usually a white-footed mouse. If the mouse is carrying the Lyme disease spirochete, the larva can get infected at this point.

When the larva is full of blood, it will drop off the host and lie dormant until the following spring, about a year later. At this point the larva molts and becomes a nymph. The nymph is a bit larger and may select another mouse as host or may approach larger game such as a dog or human. The nymph feeds 3 to 5 days and when it is full it drops off and remains dormant until late summer. It then molts into an adult tick. When the nymph is feeding it may infect its host with the Lyme spirochete. If the nymph was not already infected from its larval stage, it may become infected now, during its spring feeding.

The adult tick seeks a larger host, hence its name the deer tick; however, with man encroaching upon the deers’ range, there are often plenty of dogs or humans for the tick to attack. The adult ticks mate on their new host, feed, and transmit the Lyme spirochete if they are carrying it. The male tick remains attached through the winter but the female, once engorged with the host’s blood, drops off, hides under leaves and other debris through the winter, and lays her eggs in the spring for the two-year cycle to begin again.

The feeding tick is basically a blood-sucker. It must keep its host’s blood from clotting in order to continue sucking so it is able to regurgitate assorted enzymes to keep the blood flow liquid and smooth. It is during this regurgitation process that the Lyme spirochete is brought up from the tick’s mid-gut to its mouthparts.

*This process requires a minimum of 48 hours, which means that if the tick is removed within 48 hours after attaching, the spirochete cannot be transmitted and the host will not get the disease.*

Tick control on the host is an effective means of infection prevention. There are several effective tick control products available including: the Scalibor® collar, Advantix®, Activyl®, Bravecto®, and Nexgard®. All of these products either kill the tick or cause it to drop off prior to the 48-hour deadline.
On the west coast of the United States, there is far less Lyme disease than in the east, although the northern coast of California is considered to have moderate risk. This is because the Lyme vector in these areas is primarily *Ixodes pacificus*, a tick that strongly prefers to feed on reptiles rather than mammals. Reptile blood has natural anti-Borrelia factors that kill the Lyme spirochete and prevent further transmission.

![Lyme disease map](image)

This 2013 map is taken from the CDC (Center for Disease Control Website).

**Antibody Levels**

The spirochete that causes Lyme disease cannot live outside the body of a host. It must live within either a mammal or a tick.

A dog with symptoms of Lyme disease ideally should have a test to confirm or rule out Lyme disease. Since it is almost impossible to culture the Lyme spirochete, efforts have centered on detection of antibodies against the Osps. The problems encountered with this method are:

- In a Lyme endemic area, as many as 90% of the dogs will have antibodies against the Lyme spirochete. Most exposed dogs never get sick but almost all of them will develop antibodies and these antibodies persist for years. How do we tell the dogs that have active infection from those that have been exposed and are not sick from their exposure?
- Vaccine has been available for Lyme disease for a decade or more. How do we distinguish antibodies generated by the vaccine from those generated by natural infection?
- How do we distinguish antibodies generated by similar organisms (*Leptospira*, for example, or harmless other *Borrelia* species)?
The solution to these problems has come about only recently in the form of the C6 test. This is an immunological test for antibody against the C6 peptide, a unique section of one of the *Borrelia burgdorferi* surface antigens. As the spirochete changes its configuration to escape the host’s immune system, the C6 peptide remains constant and always detectable. Vaccine does not contain the C6 peptide so vaccinated dogs will not test positive. The Snap 4DX test more accurately identifies Lyme disease in clinically and subclinically infected dogs with proven C6 ELISA technology. The SNAP 4Dx Plus Test identifies antibodies that are produced only as a result of a *Borrelia burgdorferi* infection. Dogs with other infections will not erroneously test positive. Further, this test is simple enough to be available as an in-house test kit that can be run in most veterinary hospitals with results in approximately 10 minutes.

This still does not address distinguishing active infection from exposure. Dogs will test C6 positive within 3 to 5 weeks of infection. Because quantitative C6 antibody concentrations correlate with organism load and viability, the Lyme Quant C6® Test can help to identify *B. burgdorferi*-infected dogs that would benefit from antibiotic therapy, including those that lack the more recognizable clinical signs or laboratory abnormalities of Lyme disease. In general, *B. burgdorferi*-infected dogs with high concentrations of C6 antibody respond to antibiotic therapy with a marked reduction in C6 antibody concentrations. Thus, even in dogs that show no clinical signs, treatment response can be monitored by measuring a reduction in the concentrations of C6 antibody.

The Lyme Quant C6® Test provides many benefits including:

- Most important, antibodies to C6 are specific for infection, which minimizes the risk of false positives and avoids confusion with Lyme-vaccinated patients.
- C6 also distinguishes between infection and exposure, so practitioners can be confident in their diagnostic conclusions and effectively recommend the appropriate diagnostic tests and treatment for each patient.

**Treatment and Its Goals**

Which of these dogs get sick and which do not? Does the dog with joint pain, fever, and a positive C6 test need medication? This is where the news is particularly good.

Treatment of Lyme disease utilizes a 2 to 4 week course of Doxycycline. If Lyme disease is a consideration, many veterinarians simply prescribe the medication. Obvious improvement is seen within 48 hours. Furthermore, most tick-borne infections capable of causing joint pain, fever, and signs similar to Lyme disease generally are all share responsive to doxycycline so a simple course of medication actually covers several types of infection.

Eradication of the Lyme spirochete is not a reasonable expectation with treatment; the organism is simply too good at hiding. The goal instead is to bring the patient into what is called a
premunitive state. This is the state that 90% of infected dogs achieve when they get infected but never get ill: the organism is in their bodies latently but is not causing active infection.

**Glomerular Disease**

Some dogs are in fact harmed by the long-term presence of an infectious organism in their bodies. The immune system is constantly active in its attempt to remove the invading spirochete, and over the years these complexes of antibodies may deposit in the kidney and cause damage. It has been recommended that dogs with positive *Borrelia burgdorferi* antibody levels be regularly screened for significant protein loss in their urine with a test called a urine protein to creatinine ratio. This group of dogs may require medication for their kidney disease.

**Vaccination: Yes or No?**

Vaccine prevents infection in dogs vaccinated before any exposure to Lyme spirochetes. This means it is only helpful for dogs not yet exposed, such as puppies and dogs from non-endemic areas traveling to endemic areas. Annual boosters continue the vaccine-based immunity.

There are now three types of vaccine available. The killed whole spirochete vaccine uses intact dead spirochetes injected into the host. By using the entire spirochete, the host is exposed to parts of the organism that are not useful in immunization and may lead to vaccine reaction. The next type of vaccine is felt to be superior in preventing reactions, and that is the recombinant vaccine. This vaccine generates antibodies specifically against OspA, the surface protein the spirochete uses to attach to its tick host. When the tick bites and sucks blood full of Anti-OspA antibodies, the spirochete’s migration sequence is blocked and the spirochete is prevented from even exiting the tick. The vaccine utilizes DNA for OspA cloned into a harmless virus so that the entire Lyme spirochete is not used; only the OspA DNA is used. The third type of vaccine targets a protein called OspC as well as the surface protein OspA. The idea is that the OspC antibodies kill any *Borrelia* that have not been de-activated by the OspA antibodies, providing enhanced protection.

*When it comes to prevention, there is nothing controversial about tick control. It is crucial in Lyme endemic areas to use tick-controlling products.*

Lyme disease is a regional problem. For more guidance regarding this infection in your area, or areas where you will be traveling, see your veterinarian.

**Resources:**

Idexx Reference Laboratories. 2012. *The Importance of Differentiating Exposure from Infection with Borrelia burgdorferi in the Diagnosis and Treatment of Canine Lyme Disease.*
