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Lyme Disease: An Influential Outdoor Hazard

BY KEVIN KANG ‘18

Lyme Disease Discovered in New England

Lyme disease is an important, common illness in New England (See Figure 2) (Shapiro, 2014; Stanek et al., 2012; Centers for Disease Control and Prevention, 2016). A relatively new illness, it was discovered about forty years ago in the town of Lyme, Connecticut. Now, it has become the most common vector-transmitted illness in the United States, with over 30,000 cases annually (Centers for Disease Control and Prevention, 2016). Lyme disease arises when a bacterium is transmitted to a human via deer tick bite, so those of us involved in outdoor sports are most likely to contract the disease. Inhabitants of New England and the northeastern U.S. are most vulnerable to the disease, as 95% of Lyme Disease cases occur in only 14 out of 50 states. The most common season for the sickness is from Spring to Fall. The disease is becoming increasingly common as the deer population expands. The disease is also becoming increasingly common in Canada and temperate regions of Europe.

Causes of Disease

The deer tick that transmits the disease belongs to the genus Ixodes (Sikand and Steere, 2003). The illness begins with a skin rash called erythema migrans at the site of the tick bite. As the bacteria moves through the body under the skin and via circulation, the illness spreads to distant organs (Edlow and Tibbles, 2007). The bacterium responsible is a spirochete (spiral-shaped) bacterium of the genus Borrelia. The only disease-causing bacterium in America is the Borrelia burgdorferi sensu stricto, but in Europe, other genera like the afzelii and garinii dominate as the leading-causes of Lyme-disease cases. Although the spirochete itself does not produce any toxins, the illness produces symptoms when the body mounts an immune response against the spreading spirochete infection. The centrifugal spread of the bacterium within the skin is responsible for erythema migrans (which creates a rash with a red ring around it) and the blood-borne spread of the spirochete can lead to heart, nervous system, or joint infection.

Figure 1: Life cycle stages of Ixodes ricinus deer ticks. Unfed larva at far left, engorged larva next, unfed nymph, engorged nymph, unfed male and female top right, partially engorged female bottom right.

Source: Wikimedia Commons
(Credit: Alan R. Walker)
The Tick and the Tick Bite

Fewer than half of the people with Lyme disease recall the tick bite because the tick is very small and does not cause irritation when it bites. The ticks exist in the larval, nymph, and adult stages. Interestingly, the nymph tick is the type that causes infection, since it is only 1 mm in size, and the infected individual typically does not notice the tick for three days, the amount of time necessary for the attached tick to cause infection. The newborn larval-stage ticks do not carry the bacterium, while adult ticks are too large and cause too much irritation to go unnoticed by their targets. Encouragingly, even when an individual suffers a tick bite, that individual develops Lyme disease in only about three percent of cases.

Bite Prevention is the Key to Disease Prevention

The key to disease prevention is to avoid tick-infested environments and to cover bare skin with clothes, along with using tick repellants. Interestingly, taking simple hygienic precautions like bathing within two hours of exposure may reduce the risk of Lyme disease by physically removing the tick. 

"Interestingly, taking simple hygienic precautions like bathing within two hours of exposure may reduce the risk of Lyme disease by physically removing the tick."

Catching the Early Signs

It is important to recognize Lyme disease early, since a lack of early treatment with antibiotics makes distant spread more likely. Early treatment can prevent problems that occur weeks to months after the initial tick bite, like cardiac disease, neurological disease, and arthritis. The most common marker for Lyme disease is a characteristic rash present in 80% of bitten individuals. The rash usually appears 1-2 weeks after the tick bite. Since antibodies against the bacterium take time to develop, antibody blood tests are usually normal during early stages, so the rash facilitates diagnosis. The rash initiates at the site of the bite and then spreads outward in a circular fashion. The rash is called erythema migrans, which translates to migrating red rash. The rash occurs due to the literal movement of the bacteria outwards in a circular manner.

Early-Stage Symptoms

About 60% of those who contract Lyme disease also develop flu-like symptoms including muscle aches and fever, along with joint pains. Early Lyme disease can spread to the brain and heart. Early Lyme disease can also spread via blood to distant skin sites, causing rashes distant from the original tick bite. After an individual has been infected for a few weeks to months, neurological disease consisting of cranial nerve palsy, meningitis, and painful nerve root involvement occurs. Early cardiac
Lyme disease—most commonly consisting of a block in the heart’s conduction system, leading to passing out—also appears weeks-to-months after infection. If not treated with antibiotics, cardiac disease can recur.

**Late-Stage Symptoms**

If the early disease is missed and not treated with antibiotics, up to 60% of Lyme disease patients will develop late problems (problems occurring about 6 months after the initial tick bite). For example, Lyme arthritis occurs 6 months after infection and is the biggest cause of late disability in both children and adults affected by Lyme disease. Late Lyme arthritis can recur or last for months or years and may not be curable in about 10% of cases despite prolonged antibiotic courses. Late neurological disease appears months to years after initial tick bite. Due to effective and timely treatment of early disease, late diseases are becoming rarer in recent years. However, if late neurological disease does appear, it may affect peripheral nerves, spinal cord, or the brain.

**Diagnosis**

Early on, diagnosis is based on the presence of the characteristic rash. By the time multiple rashes arise and the heart or nervous systems become involved, blood tests for IgG and IgM antibodies yield positive results. With late neurological disease like meningitis, a spinal tap procedure can indicate the presence of Lyme antibodies in the cerebrospinal fluid in high titers. However, blood tests are not always useful, since individuals who are exposed to Lyme bacteria but never developed Lyme disease will test positive in antibody tests. Nevertheless, blood tests remain useful for those living in an area endemic to Lyme disease and presenting with clinical symptoms including radiculopathy, meningitis, mononeuritis, cranial nerve palsy, carditis, and arthritis. Blood tests are also useful in excluding Lyme disease for those with arthritis but no circulating antibodies. Furthermore, in someone with Lyme-induced arthritis, synovial fluid drawn from a joint space would show PCR evidence of *Borrelia* bacteria.

**Treatment**

Early treatment (treatment within a month of the tick bite) is antibiotics for two to three weeks. Patients usually present with the characteristic rash at this time. For neurological and heart disease, which appears weeks to months after tick bite, antibiotics are administered intravenously for 3 weeks. For arthritis—a feature of late Lyme disease occurring months to years after initial tick bite—antibiotics are given for 4 weeks.

**References**


*Figure 3:* This figure shows a method of tick removal.

**Source:** Wikimedia Commons (Credit: The Center for Disease Control and Prevention)