My Bugaboo: Lyme disease—Can you hit the bullseye?
A microbiological overview of the spirochete *Borrelia burgdorferii.*

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GREETINGS FELLOW INFECTION PREVENTIONISTS!

THE SCIENCE OF infectious diseases involves hundreds of bacteria, viruses, fungi, and protozoa. The amount of information available about microbial organisms poses a special problem to infection preventionists (IPs). Obviously, the impact of microbial disease cannot be overstated. Traditionally, the teaching of microbiology has been based mostly on memorization of facts (the “bug parade”). Too much information makes it difficult to tease out what is important and directly applicable to practice. This quarter’s My Bugaboo column features information about Lyme disease. The intention is to convey succinct information to busy IPs for reportable infectious diseases and common etiologic agents of healthcare-associated infections.

Please feel free to contact me with questions, suggestions, and comments at irena@case.edu.

Under a magnification of 158X, this Warthin-Starry stained photomicrograph of a heart tissue specimen revealed the presence of a number of *Borrelia burgdorferi* spirochetes. At this stage, after having infected the heart muscle, the disease is more specifically referred to as Lyme carditis.
The disease was first recognized in the United States in 1975 near Lyme, Connecticut, after an unusual outbreak of arthritis. Primary reservoirs for the spirochete include small rodents such as mice, but deer and other mammals serve as hosts for the ticks.1

Today Lyme disease is the most common arthropod-transmitted disease in the United States, and there are more than 30,000 cases of Lyme disease reported to the Centers for Disease Control and Prevention (CDC) each year.2 Lyme disease occurs in Europe and Asia by other Borrelia species, including Borrelia garinii and Borrelia afzelii. Disease manifestations of these Borrelia species differ in their late-stage symptoms.2

Figure 1: Reported cases of Lyme disease—United States, 2012 (CDC, 2012)3.
LYME DISEASE DISTRIBUTION IN THE U.S.
There is worldwide distribution of Lyme disease in northern temperate regions. Ticks that transmit *Borrelia burgdorferi* need constant high relative humidity at ground level. In the United States, most infections occur in three regions: 1) northeast, from Virginia to Maine; 2) north-central states mostly Wisconsin and Minnesota; and 3) west coast, particularly northern California, as shown in Figure 1.1,3

CLINICAL SIGNIFICANCE
The first stage of Lyme disease begins 3 to 32 days after a tick bite. A characteristic red, circular lesion with a clear center, known as erythema migrans and resembling a bullseye, appears at the site of the bite (Figure 2). Flu-like symptoms may or may not develop. From the site of the bite, the organism spreads via the lymphatic system or the circulatory system to musculoskeletal sites, skin, central nervous system, heart, and other tissues and organs.1,2

The erythema migrans rash associated with early infection is found in approximately 80 percent of patients and can have a range of appearances including the classic target bullseye lesion and non-target appearing lesions. The 20 percent without the erythema migrans and the non-target lesions can often cause misidentification of Lyme disease.1,2

The second stage of Lyme disease occurs weeks to months after onset. Symptoms include arthritis, arthralgia, and cardiac and neurological complications such as meningitis. Months to years later, the third stage begins with symptoms of chronic arthritis, progressive central nervous system disease, chronic skin manifestations, and cardiac dysfunction. Lyme disease is rarely fatal, but the sufferer’s quality of life is poor. The general progression of Lyme disease is similar to the disease progression of the spirochete that causes syphilis.1,2

SURVEILLANCE CASE DEFINITION
Lyme disease is a national notifiable disease and is based on standard surveillance case definitions developed by the Council of State and Territorial Epidemiologists (CSTE) and the CDC. The case definition includes case-by-case descriptions of the background, clinical description, laboratory criteria for diagnosis, exposure, endemicity, and case classification (suspected, probable, and confirmed). The entire case definition for surveillance reporting can be found at the link provided in the reference section of this article.4

TWO-TIERED LABORATORY TESTING FOR LYME DISEASE
The first required test is the enzyme immunoassay (EIA) or immunofluorescence assay (IFA). If the first test is positive, the second required test has two options: 1) if the patient had symptoms for less than or equal to 30 days, an IgM Western Blot test should be performed, and 2) if the patient had symptoms for more than 30 days, the IgG Western Blot test is performed. Figure 3 depicts the
Two-Tiered Testing for Lyme Disease

First Test

Enzyme Immunoassay (EIA)
OR
Immunofluorescence Assay (IFA)

Positive or Equivocal Result

Signs or symptoms ≤ 30 days

IgM and IgG Western Blot

Signs or symptoms > 30 days

IgG Western Blot ONLY

Negative Result

Consider alternative diagnosis
OR
If patient with signs/symptoms consistent with Lyme disease for ≤ 30 days, consider obtaining a convalescent serum

Second Test

TREATMENT

A vaccine for Lyme disease is not available.\(^1\) There was a vaccine on the market in the 1990s, but due to lawsuits it was taken off the market because the vaccine allegedly caused Lyme arthritis. Subsequently, it was found that there is no evidence to suggest that the Lyme disease vaccine ever caused Lyme arthritis. Early clinical trials are underway for at least one new candidate vaccine. Early study results are estimated to be completed in November 2014.\(^9\)

Rapid and complete recovery usually occurs when Lyme disease is treated with appropriate antibiotics during the early stage of the disease. The Infectious Diseases Society of America (IDSA) released guidelines in 2006 for the treatment of Lyme disease. According to this guideline, antibiotics commonly used for oral treatment include doxycycline, amoxicillin, or cefuroxime axetil. Furthermore, IDSA states that patients with neurological or cardiac manifestations of the illness may require treatment with the antibiotics ceftriaxone or penicillin. The link to the entire guideline and recommendations by IDSA for treatment can be found in the reference section of this report.\(^5\)

Unfortunately, 10 to 20 percent of patients (especially those diagnosed in the later stages of the disease) develop persistent or recurrent symptoms, even if they received timely and appropriate antibiotic therapy. These patients develop a syndrome known as Post-Treatment Lyme Disease Syndrome (PTLDS) and require long-term treatment.\(^5\)

INFECTION PREVENTION

As an IP, questions invariably come up about various infectious diseases, including Lyme disease. Having answers to possible questions is important because of the complications of this disease and the fact that it is a reportable disease. First, there is no known person-to-person spread of Lyme disease; Standard precautions are needed.\(^1,2\) Second, there are many opportunities for educating patients, families, colleagues, and the community. A few facts about Lyme disease prevention appear below.

THERE ARE PREVENTIVE LYME DISEASE ACTIVITIES, BEGINNING WITH WAYS TO AVOID EXPOSURE TO TICKS

- Avoid tick-infested areas especially in May, June, and July. Many health departments and parks have information on the local distribution of ticks.\(^1\)
  - When in a tick-infested area, avoid contact with overgrown grass, brush, and leaf litter at trail edges.
- Use appropriate insect repellent. The CDC recommends using a 20 percent
concentration of DEET on clothes and on exposed skin.1,6
• Shower soon after being outdoors.
• Call your doctor if you develop a fever or rash.
• Perform daily tick checks after being outdoors, even in your own yard.
• If you find a tick, early removal can reduce the risk of infection.
  ◦ First, inspect all body surfaces carefully.
  ◦ Second, remove attached tick(s) with tweezers as per the following steps (Figure 4):1
    • Avoid crushing the tick’s body.
    • Do not use petroleum jelly, a hot match, nail polish, or other products.
    • With tweezers, grasp the tick firmly and as close to the skin as possible.
    • With a steady motion, pull the tick’s body away from the skin.
    • Do not be alarmed if the tick’s mouth parts remain in the skin.
    • Cleanse the area with an antiseptic.

For prevention of Lyme disease after a recognized tick bite, routine use of antimicrobial prophylaxis or serologic testing is not recommended.3 A single dose of doxycycline may be offered to adult patients (200 mg dose) and to children 8 years of age or older (4 mg/kg up to a maximum dose of 200 mg) when all of the following circumstances exist:
1. The attached tick can be reliably identified as an adult or nymph *Ixodes scapularis* tick that is estimated to have been attached for more than 36 hours on the basis of the degree of engorgement of the tick with blood or of certainty about the time of exposure to the tick.
2. Prophylaxis can be started within 72 hours of the time that the tick was removed.
3. Ecologic information indicates that the local rate of infection of these ticks with *B. burgdorferi* is greater than 20 percent.
4. Doxycycline treatment is not contraindicated.

The time limit of 72 hours is suggested because of the absence of data on the efficacy of antibiotic prophylaxis for tick bites following tick removal after longer time intervals.3

**FURTHER RESEARCH IS NEEDED**

Lyme disease research continues and focuses on the following questions:1
• Where are ticks most likely to be found and what strategies should be employed to best protect against them?
• Which chemicals and other alternative strategies are best for controlling ticks in each type of habitat?
• What are ways of making diagnostic tests more accurate?
• What are best treatment alternatives for post-treatment Lyme disease syndrome? R3

**References**


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