Borrelia burgdorferi

Disease Agent:

- *Borrelia burgdorferi*

Disease Agent Characteristics:

- Not classified as either Gram-positive or Gram-negative, facultatively intracellular bacterium
- Order: Spirochaetales; Family: Spirochaetaceae
- Size: 20-30 × 0.2-0.3 μm
- Nucleic acid: Approximately 1440 kb of DNA including the genome and several plasmids

Disease Name:

- Lyme Disease
- Lyme borreliosis

Priority Level:

- Scientific/Epidemiologic evidence regarding blood safety: Theoretical
- Public perception and/or regulatory concern regarding blood safety: Very low
- Public concern regarding disease agent: Moderate

Background:

- First identified in 1977 following an investigation of a cluster of arthritis cases among children in Lyme, Connecticut
- Present throughout the northern hemisphere and is the most commonly reported vector-borne disease in the US
- Frequency of reported cases in the US annually has increased 101% from 9908 in 1992 to 19,931 in 2006; observed increase is highest in children.
- Geographic distribution of cases is highly focused with the majority of reported cases occurring in 10 states within the northeastern and north central US.
- Emergence linked with changes in the environment favoring deer and rodent reservoirs and changing residential patterns putting humans in more intimate contact with the tick vector.

Common Human Exposure Routes:

- Bite of infected tick; for transmission to occur, the tick must be attached to the human host for a minimum of 36 hours.

Likelihood of Secondary Transmission:

- None

At-Risk Populations:

- Persons with exposure to the tick vector (gardeners, campers, forestry workers, hikers, etc.)

Vector and Reservoir Involved:

- *Ixodes* (hard) ticks, referred to as black-legged or deer ticks, including *I. scapularis* and *I. pacificus*—Same tick also can be infected with *B. microti* and *A. phagocytophilum*.
- White-footed mice (*Peromyscus leucopus*) and white-tailed deer (*Odocoileus virginianus*) serve as reservoir hosts; unlike mice, deer do not become infected but serve to transport and maintain the tick population.
- Birds and other animals may contribute to the spread of infected ticks.

Blood Phase:

- Spirochete grows in skin and often causes characteristic erythema migrans (EM; bull's eye rash) and then enters the blood days to weeks after the initial infection, enabling the spread of the spirochete to other areas of the body.
- Positive blood cultures are found but are infrequent, and the detection period is short lived.

Survival/Persistence in Blood Products:

- Laboratory studies indicate that *B. burgdorferi* survives in fresh frozen plasma, RBCs, and platelets for the duration of its storage period.

Transmission by Blood Transfusion:

- Theoretical; no transfusion case has been documented. In lookback studies of recipients of components from DNA-positive donors, no evidence of infection was found.

Cases/Frequency in Population:

- Notifiable disease in the US
- In excess of 20,000 cases reported in the US annually since 2006
- Case reporting is on the increase likely because of increases in recognition, in tick density, and/or encroachment of humans into rural/suburban areas, and to geographic expansion of reservoir mammals and ticks.

Incubation Period:

- For erythema migrans, 3-32 days

Likelihood of Clinical Disease:

- Early infection appears to be asymptomatic in about 11% of infected individuals in the US.
- Approximately 60% of patients present with an EM rash as the first manifestation.

Primary Disease Symptoms:

- Characteristic EM rash in 70-80% of cases within 30 days

- A wide variety including: malaise, fatigue, headache, myalgias, large joint arthralgias, neurological, and cardiac symptoms
- These may not immediately suggest Lyme disease in the absence of EM rash or known tick exposure.

Severity of Clinical Disease:

- Generally self-limiting, even without treatment
- May cause permanent impairment because of joint, cardiac, or neurological problems
- In rare cases, life-threatening complications may occur.

Mortality:

- Rare

Chronic Carriage:

- The existence of chronic, antibiotic unresponsive infection is controversial.
- Some experts contend that prolonged clinical symptoms are a result of co-infection with *Babesia* or *Anaplasma*.
- Chronic asymptomatic spirochetemia has not been documented.

Treatment Available/Efficacious:

- Antibiotics (e.g., doxycycline, tetracycline, amoxicillin, cefuroxime, ceftriaxone, and penicillin) are used, based on disease stages and manifestations.
- Anti-inflammatory medications, such as ibuprofen, are sometimes used to relieve joint stiffness.

Agent-Specific Screening Question(s):

- No specific question is in use.
- Not indicated because transfusion transmission has not been demonstrated.
- No sensitive or specific question is feasible. In endemic areas, a question on exposure to tick bites has been shown to be ineffective in distinguishing *Babesia*-infected from *Babesia*-uninfected donors. This question probably also lacks sensitivity and specificity for *Borrelia burgdorferi*.

Laboratory Test(s) Available:

- No FDA-licensed blood donor screening test exists.
- Various methods have relatively poor correlation among each other or for clinical diagnosis. EIA tests have had better reproducibility, sensitivity, and specificity. IFA (detecting both IgM/IgG) using paired samples is the most commonly used single method for diagnosis. A two-test approach (sensitive EIA or IFA followed by western blot) has been recently recommended by the CDC.
- Poor specificity has been observed with all serologic methods when used in healthy nonendemic populations. Lyme vaccination and cross-reactivity with other *Borrelia* species also cause problems.
- NAT methods exist.
- The organism requires special media for culture and would not be detected by platelet bacterial culture.

Currently Recommended Donor Deferral Period:

- No FDA Guidance or AABB Standard exists.
- Prudent practice would be to defer donor until signs and symptoms are gone and a course of treatment is completed.

Impact on Blood Availability:

- Agent-specific screening question(s): Not applicable
- Laboratory test(s) available: Not applicable

Impact on Blood Safety:

- Agent-specific screening question(s): Not applicable
- Laboratory test(s) available: Not applicable

Leukoreduction Efficacy:

- Unknown but unlikely to be efficacious as bacteria can be isolated from cell-free plasma.

Pathogen Reduction Efficacy for Plasma Derivatives:

- Specific data indicate that the multiple steps in the fractionation process are robust and capable of inactivating and/or removing bacteria at concentrations that may be present in plasma.

Other Prevention Measures:

- Tick avoidance measures (e.g., long pants, long sleeves, repellants)
- Tick control measures in the environment
- Vaccine is no longer available.

Suggested Reading:

1. Badon SJ, Fister RD, Cable RG. Survival of *Borrelia burgdorferi* in blood products. Transfusion 1989;29: 581-3.
2. Centers for Disease Control and Prevention. Surveillance for Lyme Disease United States 1992-2006; Morb Mortal Wkly Rep MMWR Surveillance Summaries 2008;57:NoSS-10.
3. Coulter P, Lema C, Flayhart D, Linhardt AS, Linhardt AS, Aucott JN, Auwaerter PG, Dumler JS. Two-year evaluation of *Borrelia burgdorferi* culture and supplemental tests for definitive diagnosis of Lyme disease. J Clin Microbiol 2005;43:5080-4.
4. Gabitzsch ES, Piesman J, Dolan MC, Sykes CM, Zeidner NS. Transfer of *Borrelia burgdorferi* s.s. infection via blood transfusion in a murine model. J Parasitology 2006;92:869-70.
5. Gerber MA, Shapiro ED, Krause PJ, Cable RG, Badon SJ, Ryan RW. The risk of acquiring Lyme disease or

babesiosis from a blood transfusion. J Infect Dis 1994; 170:231-4.
6. Steere AC, Coburn J, and Glickstein L. The emergence of Lyme disease. J Clin Invest 2004;113:1093-101.
7. Steere AC, Sikand VK, Schoen RT, Nowakowski J. Asymptomatic infection with *Borrelia burgdorferi*. Clin Infect Dis 2003;37:528-32.
8. Vaz A, Glickstein L, Field JA, McHugh G, Sikand VK, Damle N, Steere AC. Cellular and humoral immune responses to *Borrelia burgdorferi* antigens in patients with culture-positive early Lyme disease. Infect Immun 2001;69:7437-44.