3 | *BORRELIA BURGDORFERI*

3.1 | Disease agent

- *Borrelia burgdorferi*

3.2 | Disease agent characteristics

- Not classified as either Gram-positive or Gram-negative, helical, motile, facultatively intracellular bacterium
- Order: Spirochaetales; Family: *Borreliaceae*
- Size: 10–20 μm × 0.2–0.5 μm x
- Nucleic acid: Approximately 1440 kb of DNA including the genome and several plasmids

3.3 | Disease name

- Lyme disease
- Lyme borreliosis

3.4 | 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

3.5 | 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 northern hemisphere.
- Frequency of reported cases in the United States annually has doubled from 3.74 reported cases per 100,000 in 1991 to 7.21 reported cases per 100,000 in 2018. While about 30,000 cases are reported to the CDC annually, recent methods (other than state reporting to the CDC) suggest that approximately 476,000 may be infected with *B. burgdorferi* in the United States each year.
- Geographic distribution of cases is highly focused with the majority of reported cases occurring in at least 16 states (as reported in 2019 by the CDC) 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.

3.6 | 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 h (may be greater than 48 h).

3.7 | Likelihood of secondary transmission

- None

3.8 | At-risk populations

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

3.9 | Vector and reservoir involved

- *Ixodes* (hard-bodied) 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.

3.10 | 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.
- *Borrelia burgdorferi* is cleared rapidly from the bloodstream in a mouse model.

3.11 | 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.

3.12 | 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.

3.13 | Cases/frequency in population

- Notifiable disease in the United States.
- In excess of 30,000 cases reported in the United States annually, but this is a gross underestimate.
- Case reporting is on the rise likely because of increases in recognition, tick density, and/or encroachment of humans into rural/suburban areas, and to geographic expansion of reservoir mammals and ticks.

3.14 | Incubation period

- For erythema migrans, 3–32 days

3.15 | Likelihood of clinical disease

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

3.16 | Primary disease symptoms

- Characteristic EM rash at the site of the tick bite in 70%–80% of cases within 3–30 days
- A wide variety including malaise, fatigue, headache, myalgias, large joint arthralgias, neurological, and cardiac symptoms; swollen lymph nodes may occur in the absence of a rash these may not immediately suggest Lyme disease in the absence of EM rash or known tick exposure.

3.17 | 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.

3.18 | Mortality

- Rare

3.19 | 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.

3.20 | 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.

3.21 | 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 *B. burgdorferi*.

3.22 | 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. Immunofluorescence assay (IFA) (detecting both IgM/IgG) using paired samples is the most commonly used single method for diagnosis. A two-test approach (FDA-cleared EIA or IFA followed by western blot or second EIA in place of 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 but detect infection only 29%–40% of the time (first 3 weeks of infection); sensitivity increases to 87%–97% for those with neurological or arthritic symptoms, respectively.
- The organism requires special media for culture and would not be detected by platelet bacterial culture.

3.23 | 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.

3.24 | Impact on blood availability

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

3.25 | Impact on blood safety

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

3.26 | Leukoreduction efficacy

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

3.27 | 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.

3.28 | 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

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