Coxiella burnetii

Disease Agent:

- *Coxiella burnetii*

Disease Agent Characteristics:

- Small, Gram-negative, pleomorphic coccobacillus; obligate intracellular bacterium that lives in macrophages
- Order: Rickettsiales; Family: Rickettsiaceae
- Size: 0.5-0.8 μm × 1.2-3 μm
- Nucleic acid: Rickettsial genomes are among the smallest of bacteria. *Coxiella* is approximately 1600 kb.
- Physicochemical properties: Resistant to heat, low or high pH, 0.5% sodium hypochlorite, UV irradiation, and environmental conditions, such as desiccation, drying, and sunlight, because of the presence of a spore stage. It can survive for 7-10 months on wool at 15-20°C, for more than 1 month on fresh meat in cold storage, and for 40 months in skim milk at room temperature. It can be isolated from infected tissues stored in formaldehyde.
- The microorganism exists in two antigenic forms: phase I and phase II. Phase I is highly infectious, whereas phase II is sporelike, metabolically dormant, and avirulent.

Disease Name:

- Q fever

Priority Level:

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

Background:

- Described in 1935 by E. H. Derrick in abattoir workers in Australia as a disease of unknown origin and, therefore, termed "query fever."
- Isolated in 1937 by Burnet and Freeman who identified the organism as a *Rickettsia* species.
- Cox and Davis isolated the pathogen from ticks in Montana in 1938 and described its transmission. The agent was then officially named *Coxiella burnetii* the same year.
- No longer regarded as closely related to *Rickettsia* species
- Classified (Category B) as bioterrorism agent by the CDC.

Common Human Exposure Routes:

- Inhalation of aerosols or contaminated dusts containing air-borne bacteria derived from infected ruminants or their products. A single inhaled organism may produce clinical illness.
- Bacteria are shed in milk, urine, and feces of infected animals. High numbers of organisms in the amniotic fluids and placenta during birthing (e.g., 10^9 bacteria/g placenta)
- Contact with contaminated wool
- Ingestion of unpasteurized contaminated milk or meat
- Ideal for aerosol dissemination

Likelihood of Secondary Transmission:

- Extremely rare
- Has been described in only a few cases involving patients with pneumonia

At-Risk Populations:

- Farmers, veterinarians, or those who handle potentially infected livestock, especially animals giving birth
- A threat as a bioterrorist weapon for susceptible populations

Vector and Reservoir Involved:

- Greater than 40 tick species are involved in transmission among domestic animals and are considered to be the organism's primary vector; tick bites are rarely involved in transmission to humans.
- Reservoirs for human infection include domesticated ruminants, primarily cattle, sheep, and goats.

Blood Phase:

- Bacteremia documented during both acute and chronic infections, with and without symptoms.
- The organism replicates in macrophages. This could result in eventual cell lysis and the dissemination of free bacteria in plasma.

Survival/Persistence in Blood Products:

- No information on storage stability under blood bank conditions

Transmission by Blood Transfusion:

- A single case of transmission from blood transfusion has been described. The donor and the recipient both showed serological evidence of *C. burnetti* infection, and the clinical symptoms and their time courses were compatible with the diagnosis of Q fever.
- Also reported to have been transmitted by bone marrow transplantation

- Increased antibody prevalence in drug users, HIV-infected and dialysis patients further supports the possibility of transmission by blood.

Cases/Frequency in Population:

- Fewer than 30 cases reported annually from 1978-1986
- Worldwide distribution except Antarctica and New Zealand

Incubation Period:

- 20 days (range: 14-39 days)

Likelihood of Clinical Disease:

- 60% of initial infections are asymptomatic.

Primary Disease Symptoms:

- Humans are the only species that exhibit illness as a result of infection.
- Acute disease is characterized by high fever (usually >40°C) and headache (usually retro-orbital). The fever lasts approximately 7-14 days. Other signs and symptoms include hallucinations, diarrhea, weight loss, facial pain, and speech impairment. A rash is rarely observed in Q fever, in contrast to other rickettsial infections.
- Pneumonia or hepatitis in 30-50% of infections, depending on route of exposure (i.e., inhalation or ingestion)
- Infrequently causes endocarditis, pericarditis, myocarditis, or meningoencephalitis

Severity of Clinical Disease:

- May progress to chronicity in approximately 1% of those infected if untreated, in which case mortality increases. Chronic disease is defined as Q fever lasting >6 months.
- Predominantly occurs in individuals with underlying valvular heart disease, vascular aneurysms, or vascular grafts manifesting primarily as culture-negative endocarditis

Mortality:

- 1-2% in acute infection
- Approximately 65% in untreated chronic infection

Chronic Carriage:

- Approximately 1%

Treatment Available/Efficacious:

- Doxycycline (acute) and doxycycline and hydroxychloroquine (chronic illness)

Agent-Specific Screening Question(s):

- No specific question is in use.
- Not indicated because transfusion transmission is very infrequent, and incidence of infection in the population is very low.
- No sensitive or specific question is feasible.
- Under circumstances of a bioterrorism threat, the need for and potential effectiveness of specific donor-screening questions would need to be addressed.

Laboratory Test(s) Available:

- No FDA-licensed blood donor screening test exists.
- Available tests include antibody testing (IgM/IgG) by complement fixation, indirect immunofluorescence, and EIA. Indirect immunofluorescence is sensitive and specific and is the method of choice.
  - The antibody titer is higher to phase II antigen than to phase I antigen in acute disease, whereas the reverse occurs in chronic disease.
- NAT and immunohistochemical staining are additional diagnostic tools.

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; in response to a bioterrorism threat, impact of a local deferral would be significant.
- Laboratory test(s) available: Not applicable

Impact on Blood Safety:

- Agent-specific screening question(s): Not applicable; unknown impact in response to a bioterrorism threat
- Laboratory test(s) available: Not applicable

Leukoreduction Efficacy:

- May have efficacy because organism is an obligate intracellular bacterium in monocytes/macrophages

Pathogen Reduction Efficacy for Plasma Derivatives:

- Unknown, but the bacterium is highly resistant to heat and chemical/physical disinfection.

Other Prevention Measures:

- Vaccine is available in some parts of the world (formalin-inactivated phase I organisms), and its use is recommended for exposed or high-risk individuals (livestock handlers, abattoir workers, veterinarians, and laboratory workers) who do not have immunity.

- Adverse effects when vaccine administered in previously infected individuals
- In the US, investigational vaccines are available.

Suggested Reading:

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