

Coxiella burnetti

Patricia Bolívar MS., CLS, PHM

Description and Significance

- *Coxiella burnetti* is an obligate intracellular Gram-negative coccobacillus that causes Q fever in mammals and humans.
- Harold Cox and MacFarlane Burnet initially identified Q fever as “query fever” in 1935 when a number of infections were found to be from an Australian slaughterhouse.
- Its global pathogenic effect demonstrates the need for preventive measures to control the rate of infection worldwide and its potential use for bioterrorism.
- Main reservoirs are cattle, sheep, and goats.



Transmission



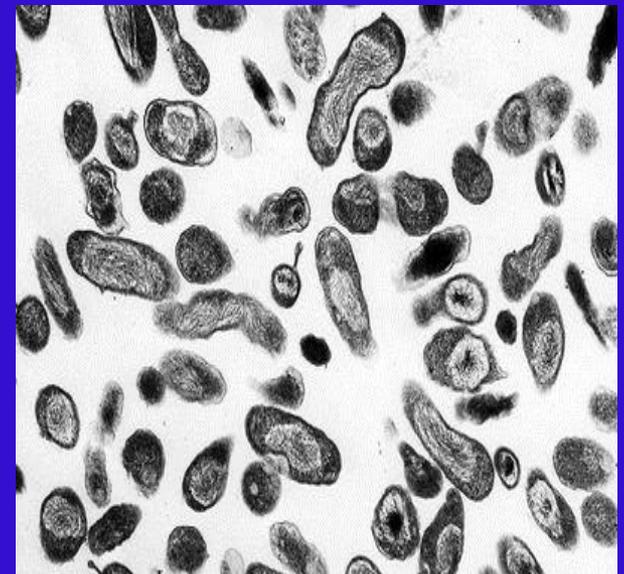
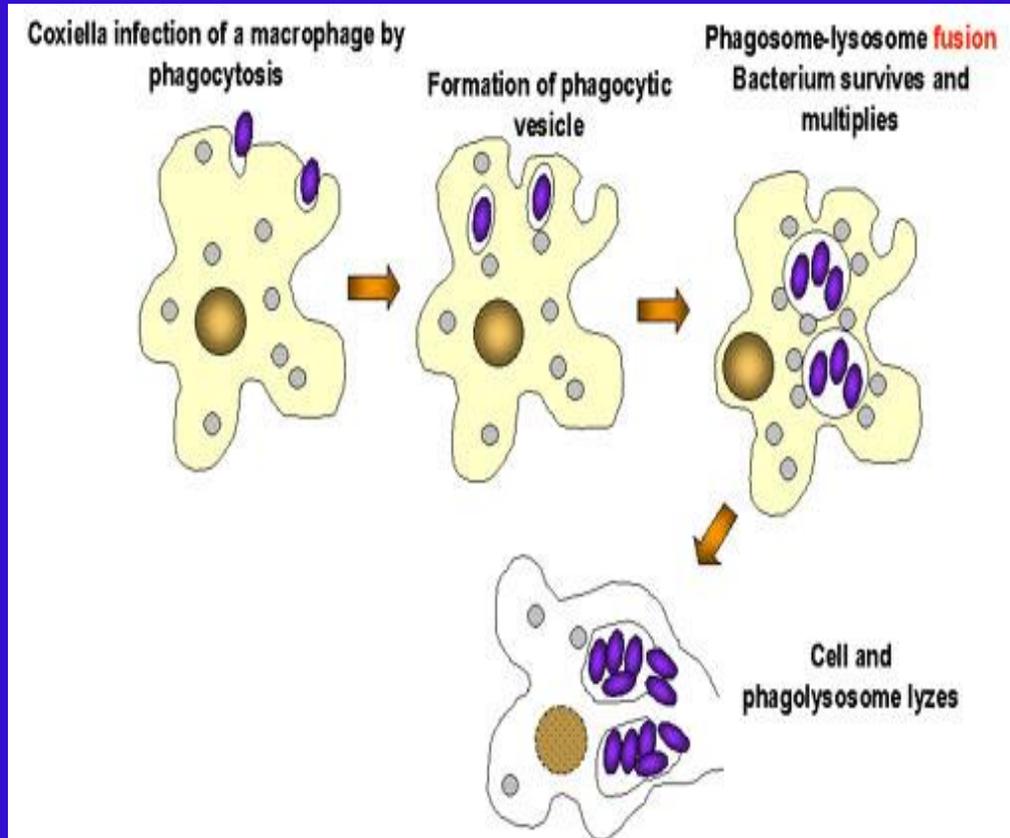
- External waste excretions from infected animals: sheep, cattle, goat, dogs, and cats. These infected animals can produce excretions through urine, feces, and milk that contain infectious dosages, which can be inhaled, consumed, or be in contact with.
- Inhalation of contaminated air : the main mode of transmission
- Insect vector



Characteristics

- Can withstand heat, dryness, and antibacterial compounds, allowing this bacterium to persist outside the host for an extensively long period of time.
- It is an acidophile
- It can be endocytosed by a macrophage and complete replication inside the phagolysosome during its life cycle.
- Can be isolated in the placentas of infected animals and can cause abortions due to inflammation.
- Can infect livestock ,domestic animals, fish and rodents

Cell Structure and Metabolism



Clinical Presentation

- Farmers or veterinarians, have a higher risk of infection
- Typically, there are no obvious symptoms after infection.
- Only about 50% of people who are infected show signs of the disease.
- Symptoms not specific and not always diagnosed as Q fever (Flu)
- Takes the form of pneumonia or hepatitis commonly.
- Chronic Q fever develops.
- Endocarditis, inflammation of the aortic heart valves, associated with the chronic complications of the disease

Specimens

- Serum (red-top or serum separator tube [SST], tiger-top tube).
- Blood in EDTA (lavender tube) or sodium citrate (blue tube).
- Tissue, body fluids, and others, including cell cultures and cell supernatants.
- Specimens can be kept at 2 to 8°C if transported within 24 h. Store frozen at -70°C or on dry ice.

Laboratory Diagnosis

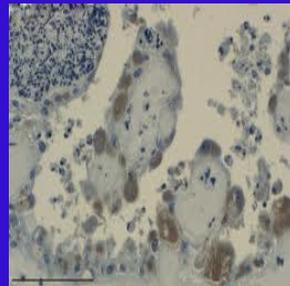
- **Since this organism is an obligate intracellular organism, it cannot be cultured on routine bacteriologic media.**
- **The laboratory diagnosis of Q fever is based mainly on serologic testing.**
- **Antibody responses are measured against phase I and II antigens of *C. burnetii*.**
- **Patients with acute Q fever typically produce an antibody response primarily to *C. burnetii* phase II antigen, while chronic *C. burnetii* infections typically elicit a higher antibody response to phase I antigen.**

Treatment

- Acute Q fever is most effectively treated when doxycycline is administered within 3 days after onset of the illness.
- Chronic Q fever endocarditis carries a poor prognosis and is much more difficult to treat.
- Combination long-term therapy with doxycycline and hydroxychloroquine or doxycycline with a fluoroquinolone is currently recommended
- Overall, the mortality rate of Q fever is low, approximately 2.4%, but it may be as high as 65% among those with chronic Q fever.

Q Fever Diagnosis Confirmation

- **Demonstration of fourfold or greater changes in antibody titer between paired acute- and convalescent-phase serum samples by immunofluorescence antibody testing.**
- **Detection of *C. burnetii* by polymerase chain reaction**
- **Immunohistochemical staining of biopsy material from affected organs**



Precautions

- *C. burnetii* can be inadvertently isolated in conventional cell cultures in a wide variety of cell lines, including all fibroblast cell lines.
- After an incubation period of 5 to 15 days, *C. burnetii* infected cells are detectable as cytoplasmic inclusions



FIG. 2. Fibroblast L.929 cell line infected with *Coxiella burnetii*.

Bioterrorism

- Several potential bioterrorism agents (tularemia, plague, anthrax, or Q fever) could present as community-acquired pneumonias.
- The milder forms of pneumonic tularemia could be clinically indistinguishable from Q fever, whereas plague or anthrax would typically follow a more rapidly fulminate course.

Special Decontamination Procedures

- Household bleach solutions may be ineffective.
- Minor spills should be covered with absorbent paper, such as paper towels, and then flooded with 70% ethanol, a dual quaternary ammonium compound, or 1:10 laboratory strength bleach and allowed to act for 30 min before cleanup.

Application to Biotechnology

- *Coxiella burnetti* can have a variety of biological uses in other organisms (inserting a gene of interest into the DNA of other organisms that may not have been able to express a certain function before).
- The genome of *Coxiella burnetti* contains a gene *mucZ* that encodes for the production of capsule in *E. coli*.
- Through PCR, DNA replication can be amplified and useful for studying gene expression or regulation in other organisms with the assistance of plasmids.

References

- American Society for Microbiology 2005. Guidelines for Suspected Agents of Bioterrorism: *Coxiella burnetti*.
- Centers for Disease Control and Prevention. 2002. Q fever: California, Georgia, Pennsylvania and Tennessee, 2000-2001. *Morb. Mortal. Wkly. Rep.* 51:924-927.
- Fournier, P.-E., T. G. Marrie, and D. Raoult. 1998. Diagnosis of Q fever. *J. Clin. Microbiol.* 36:1823-1834.
- Heinzen, R. H. 1997. Intracellular development of *Coxiella burnetii*, p 99-130. *In* B. Anderson, H. Friedman, and M. Bendinelli. (ed.), *Rickettsial infection and immunity*. Plenum Press, New York, N.Y.
- Maurin, M., and D. Raoult. 1999. Q fever. *Clin. Microbiol. Rev.* 12:518-553.