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Ovine Epididymitis:
Brucella ovis

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Overview

- Organism
- History
- Epidemiology
- Transmission
- Disease in Animals
- Prevention and Control
- Actions to Take

In today's presentation we will cover information regarding the organism that causes ovine epididymitis and its epidemiology. We will also talk about the history of the disease, how it is transmitted, species that it affects, and clinical and necropsy signs observed. Finally, we will address prevention and control measures for ovine epididymitis, as well as actions to take if ovine epididymitis is suspected.

[Photo: Sheep. Source: US Department of Agriculture]

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THE ORGANISM

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The Organism

- *Brucella ovis*
  - Gram negative coccobacillus
  - Facultative intracellular pathogen
- Persists in the environment

Ovine epididymitis is caused by *Brucella ovis*, a Gram-negative coccobacillus or short rod. This organism is a facultative intracellular pathogen. *Brucella* spp. can persist in the environment invariably depending on temperature, pH, and humidity.

[Photo: Micrograph of *Brucella* organisms. *Brucella* spp. are gram-negative in their staining morphology. *Brucella* spp. are poorly staining, small gram-negative coccobacilli (0.5-0.7 x 0.6-1.5 µm), and are seen mostly as single cells and appearing like "fine sand". Source: CDC Public Health Image Library #1901]

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The Many Names of Brucellosis

Human Disease	Animal Disease
• Malta Fever	• Bang's Disease
• Undulant Fever	• Enzootic Abortion
• Mediterranean Fever	• Epizootic Abortion
• Rock Fever of Gibraltar	• Slinking of Calves
• Gastric Fever	• Ram Epididymitis
	• Contagious Abortion

Due to its illustrious history, brucellosis has many different names. The disease is commonly known as undulant or Malta fever in humans and Bang's disease in animals.

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HISTORY

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History of Brucellosis

- Early 1800s
  - Sir William Burnett differentiates fevers affecting seamen in the Mediterranean
- Late 1880s
  - Sir David Bruce isolates the cause of Malta fever, *Micrococcus melitensis*
  - Dr. Bernhard Band discovers cause of cattle abortion in Denmark, *Bacterium abortus* ("Bang's disease")

Sir William Burnett was a physician to the British Navy in 1810 and was the first person to differentiate between the various fevers affecting seamen in the Mediterranean. It is thought that Malta became such an important center for the study of undulant fever because many British troops were sent there to recuperate following the Crimean War (1853-1856). The microorganism responsible for Malta fever was discovered by a British Army physician, Sir David Bruce, on July 9, 1887, which he called *Micrococcus melitensis*. It was isolated from the spleen of a British soldier who had died of the disease. He later established goats as the main reservoir for infection by identifying the organism in their blood, urine, and milk. A Danish physician and veterinarian, Bernhard Bang discovered *Bacterium abortus* in 1897 while investigating contagious abortion that had been affecting cattle in Denmark for over a century. He also discovered the organism affected horses, sheep, and goats. Thus the disease became known as "Bang's disease". The connection between animals and humans was discovered by Alice Evans, an American bacteriologist in the 1920s.

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History of *B. ovis*

- First described in the 1950s in New Zealand and Australia
  - Aborting ewes
  - Epididymitis
- Initially considered a mutant of *Brucella melitensis*

Brucella ovis was first described in the 1950s in New Zealand and Australia; it was isolated from aborting ewes and rams with epididymitis. Although it was initially considered a mutant form of *B. melitensis*, it was later recognized as a separate species. However, some microbiologists have proposed that the genus be *Brucella* be reclassified into a single species (*B. melitensis*), which contains many biovars.

Source: *Animal brucellosis*. Klaus Nielsen and J. Robert Duncan. 1990. [Photo: Map of Australia and New Zealand. Source: Wikimedia Commons at http://commons.wikimedia.org/wiki/File:Map_of_Australia_and_New_Zealand_coloured.png]

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EPIDEMIOLOGY

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Geographic Distribution

- Most sheep-raising regions
  - Australia
  - New Zealand
  - North America
  - South America
  - South Africa
  - Many European countries

B. ovis probably occurs in most sheep-raising regions of the world. It has been reported from Australia, New Zealand, North and South America, South Africa, and many countries in Europe.

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Species Affected

- Natural infection
  - Sheep
  - Farmed red deer
- Experimental infection
  - Goats
  - Cattle

B. ovis infects sheep, as well as farmed red deer (*Odocoileus virginianus*) in New Zealand. Experimental infections have been reported in goats and cattle, but there is no evidence that these species are infected in nature.

[Photos: (Top) Sheep. Source: U.S. Department of Agriculture; (Bottom) Red deer. Source: Bill Ebbesen/Wikimedia Commons]

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TRANSMISSION

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Transmission

- Transmission in sheep
  - Venereal transmission
    - Ewes act as mechanical vectors
  - Direct contact
    - Ram-to-ram
  - Fomite spread
- Red deer
  - Venereal, nasal, direct contact

B. ovis is often transmitted from ram to ram by passive venereal transmission via ewes. Ewes can carry this organism in the vagina for at least two months and act as mechanical vectors. Some ewes become infected, and shed *B. ovis* in vaginal discharges and milk. Rams often become persistently infected, and many of these animals shed *B ovis* intermittently in the semen for 2 to 4 years or longer. *B. ovis* can also be transmitted by direct non-venereal contact between rams. Ram-to-ram transmission is poorly understood and may occur by a variety of routes, including oral transmission. Shedding has been demonstrated in the urine as well as in semen and genital secretions. Red deer can be infected by venereal transmission, direct contact between infected stags, and experimentally by the intravenous, conjunctival, nasal and rectal routes. Contamination of pastures does not seem to be an important method of transmission for *B. ovis*.

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DISEASE IN HUMANS

B. ovis does not infect humans.

Unlike most other species of *Brucella*, *B. ovis* is not known to infect humans.

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DISEASE IN ANIMALS

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Clinical Signs

- Incubation period: 3 to 8 weeks
- Reproductive signs
  - Epididymitis, orchitis, impaired fertility
  - Abortion, placentitis, weak lambs
- Systemic signs rare in adult sheep

The incubation period for *B. ovis* appears to be 3 to 8 weeks. *B. ovis* can cause epididymitis, orchitis and impaired fertility in rams. Initially, only poor quality semen may be seen; sperm motility and concentration may be decreased, and individual sperm are often abnormal. Later, palpable lesions may occur in the epididymis and scrotum. Epididymitis may be unilateral or, occasionally, bilateral. The testes may atrophy. Palpable lesions are often permanent, although they are transient in a few cases. Some rams shed *B. ovis* for long periods without clinically apparent lesions. *B. ovis* can also cause abortions and placentitis in ewes, but this appears to be uncommon. Infected ewes may give birth to weak lambs that die soon after birth. Systemic signs are rare in adult ewes and rams. *B. ovis* can cause poor semen quality in red deer stags, but abortions have not been reported in hinds.

[Photo: Lambs. Source: Pam Zaabel/CFSPH]

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Post Mortem Lesions

- Lesions found primarily in rams
  - Epididymis
  - Tunica vaginalis
  - Testis
- Lesions found in ewes
  - Placentitis

Lesions are mainly found in the epididymis, tunica vaginalis and testis in rams. The lesions vary from a slight enlargement of the epididymis to large indurations. Epididymal enlargement can be unilateral or bilateral, and the tail is affected more often than the head or body. Spermatoceles containing partially inspissated spermatic fluid may be found in the epididymis. Fibrous atrophy can occur in the testis. The tunica vaginalis is often thickened and fibrous, and can have extensive adhesions. Placentitis may be observed in ewes.

[Photo: (Top) Enlarged testis. Source: Food and Agriculture Organization of the United Nations; (Bottom) Sheep, testis (bisected). The epididymis is markedly enlarged and contains bands of fibrous tissue (chronic epididymitis). In this case, the testis itself is relatively unaffected. Source: Armed Forces Institute of Pathology/CFSPH]

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Morbidity and Mortality

- Rams
  - 30 to 50% of infected rams have palpable lesions of the epididymis
  - Effect on sperm quality varies
- Ewes
  - Abortion relatively rare

Approximately 30-50% of all infected rams have palpable lesions of the epididymis. *B. ovis* has little effect on sperm quality in some individual animals, but causes severe decreases in sperm motility, concentration and morphology in others. Estimates of the abortion rate in ewes and perinatal mortality vary. Some sources report rates of 1% to 2%, while others suggest that these outcomes are rare. Limited experimental studies have reported abortion rates from 0% to 8%. Abortions and increased perinatal mortality have not been reported in red deer hinds.

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Differential Diagnosis

- Causes of epididymitis and orchitis
  - *Actinobacillus seminis*
  - *A. actinomycetemcomitans*
  - *Histophilus ovis*
  - *Haemophilus* spp.
  - *Corynebacterium pseudotuberculosis ovis*
  - *Chlamydophila abortus*
  - *B. melitensis*

B. ovis infections should be considered when rams develop epididymitis and testicular atrophy, or poor semen quality is seen. Other bacteria that cause epididymitis and orchitis should be considered. Commonly isolated organisms include *Actinobacillus seminis*, *A. actinomycetemcomitans*, *Histophilus ovis*, *Haemophilus* spp., *Corynebacterium pseudotuberculosis ovis*, *Chlamydophila abortus* and *B. melitensis*, but many other organisms can also cause these conditions. Sterile, trauma-induced spermatic granulomas should also be ruled out.

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Sample Collection

- Rams
  - Semen, inguinal lymph nodes, seminal vesicles, epididymis
- Ewes
  - Vaginal swabs, milk, iliac lymph nodes, uterus
- Aborted lambs
  - Stomach and lungs

B. ovis is not a zoonotic disease, but care should always be used when collecting samples as a possibility exists that the animal may be infected with *B. melitensis.* In rams, the preferred tissues are from inguinal lymph nodes, seminal vesicles, and the epididymis. If the semen is used for testing, repeated testing may be required as rams can shed the organism intermittently. When collecting samples from ewes, the common sites are vaginal swabs, milk samples, iliac lymph nodes, or the uterus. When there is an aborted lamb or fetus, the abomasal contents and lungs should be submitted.

[Photo: Diagnostic swab. Source: Danelle Bickett-Weddle/CFSPH]

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Laboratory Diagnosis

- Microscopic examination
- Culture and identification
  - Phage typing
  - Biochemical and serological characteristics
- PFGE, PCR
- Serology
  - ELISA, AGID, complement fixation

Microscopic examination of semen or smears stained with the Stamp's modification of the Ziehl-Neelsen method can be useful for a presumptive diagnosis. A definitive diagnosis can be made if *B. ovis* is cultured from an animal. *Brucella* spp. can be isolated on a variety of plain media, or selective media such as Farrell's medium or Thayer-Martin's modified medium. Enrichment techniques can also be used. *B. ovis* colonies usually become visible after three to four days. *B. ovis* can often be identified to the species level by its cultural, biochemical and serological characteristics, although phage typing can be used for definitive identification. Pulse-field gel electrophoresis or specific polymerase chain reaction restriction fragment length polymorphism (PCR RFLP) can also distinguish *B. ovis* from other *Brucella* species. Serological tests used to detect *B. ovis* include enzyme-linked immunosorbent assay (ELISA), agar gel immunodiffusion (AGID) and complement fixation *Dichelobacter nodosus*, which causes foot rot, is reported to cross-react with *B. ovis* in serological assays, but the practical significance is unknown.

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PREVENTION AND CONTROL

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Recommended Actions

- Notification of authorities
  - Federal Area Veterinarian in Charge (AVIC)
    http://www.aphis.usda.gov/animal_health/area_offices/
  - State veterinarian
    http://www.aphis.usda.gov/emergency_response/downloads/nahems/fad.pdf

B. ovis occurs in the U.S. State authorities should be consulted for reporting requirements in each state.

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Prevention and Control

- Examine, test, cull
- Vaccine available in some areas
  - Vaccination not practiced in the U.S.
- Treatment
  - Antibiotics
  - Not usually economically feasible

B. ovis is generally introduced into a flock by infected animals or semen. The prevalence of infection can be reduced by examining rams before the breeding season and culling rams with palpable abnormalities. However, palpable lesions are not found in all infected rams, and laboratory testing of rams should also be considered. In some areas, *B.-ovis*-free accredited flocks and rams may be available. A commercial killed *B. ovis* vaccine is used in New Zealand. In other countries, weaner rams may be vaccinated with the *B. melitensis* Rev-1 vaccine. Vaccination is not practiced in the U.S. Antibiotic treatment has been used successfully in some valuable rams, but it is usually not economically feasible for most animals. Fertility may remain low even if the organism is eliminated. Infections in ewes are generally prevented by controlling infections in rams.

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Prevention and Control

- Readily killed by most disinfectants
  - Hypochlorite
  - 70% ethanol
  - Isopropanol
  - Iodophores
  - Phenolics
  - Formaldehyde/glutaraldehyde
- Quaternary ammonium compounds not recommended

Brucella species are readily killed by most commonly available disinfectants including hypochlorite solutions, 70% ethanol, isopropanol, iodophores, phenolic disinfectants, formaldehyde, glutaraldehyde and xylene; however, organic matter and low temperatures decrease the efficacy of disinfectants. Alkyl quaternary ammonium compounds are not recommended. Autoclaving [moist heat of 121°C (250°F) for at least 15 minutes] can be used to destroy *Brucella* species on contaminated equipment.

[Photo: Disinfection bottles. Source: Dani Ausen/CFSPH]

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Additional Resources

- Center for Food Security and Public Health
  - www.cfsph.iastate.edu

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