CONTAGIOUS BOVINE PLEUROPNEUMONIA

AETIOLOGY

Classification of the causative agent

Mycoplasma mycoides subsp*. mycoides* Small Colony - bovine biotype (*Mmm*SC)

The *M. mycoides* cluster consists of six mycoplasma strains from bovines and goats that share serological and genetic characteristics, creating difficulties for taxonomy and diagnostics by traditional techniques. Specific identification of *Mmm*SC can now be achieved by polymerase chain reaction (PCR) or the use of specific monoclonal antibodies (MAbs). Although *Mmm*SC has been considered to be a very homogeneous biotype, recent molecular techniques have identified differences among strains. Recently described multi-locus sequence analysis distinguishes the three main lineages that correlate with their geographical origins (Europe, Southern Africa, rest of Africa). The strains of European origin can be differentiated from African ones by molecular methods, and are not able to oxidise glycerol, which may account for an apparent lower pathogenicity. African strains seem to be more diverse. The sequence of the complete genome of the reference strain PG1 has been published.

Mycoplasmas lack cell walls and are, therefore, a) pleomorphic and b) resistant to antibiotics of the beta-lactamine group, such as penicillin

Growth of mycoplasma is relatively fastidious and requires special media rich in cholesterol (addition of horse serum).

Resistance to physical and chemical action

Mycoplasma mycoides subsp*. mycoides* SC does not survive for long in the environment and transmission requires close contact, although, under favourable atmospheric conditions of humidity and wind, aerosols can transport the agent for longer distances.

Temperature:	Inactivated within 60 minutes at 56°C and 2 minutes at 60°C
pH:	Inactivated by acid and alkaline pH
Chemicals/Disinfectants:	Inactivated by many of the routinely used disinfectants. Inactivated by mercuric chloride (0.01%/1 minute), phenol (1%/3 minute), and formaldehyde solution (0.5%/30 seconds)
Survival:	Survives outside the host for up to 3 days in tropical areas and up to 2 weeks in temperate zones. May survive more than 10 years frozen.

EPIDEMIOLOGY

Hosts

Cattle, both *Bos taurus* and *Bos indicus*, are the main hosts. Infections have also been reported from Asian buffalo (*Bubalus bubalis*), captive bison (*Bison bison*) and yak (*Poephagus grunnien*, formerly *Bos grunnien*). Sheep and goats can also be naturally infected, but with no clear associated pathology. Wild bovids and camels seem to be resistant, and, so far, do not appear to be important in the transmission of CBPP.

Incubation period of the disease is usually 1–4 months, but can be longer. After experimental inoculation into the trachea, clinical signs may appear in 2–3 weeks.

Transmission

- CBPP is spread mainly by inhalation of droplets from infected coughing animals, especially if they are in the acute phase of the disease.
- Although close and repeated contact is generally thought to be necessary for transmission, transmission may occur up to 200 metres under favourable climatic conditions

- Organism also occurs in saliva, urine, fetal membranes and uterine discharges.
- Transplacental infection can occur
- Nonclinical bovine carriers with chronic infection are a major source of infection, and may retain viable organisms in encapsulated lung lesions (sequestra) for up to 2 years.
    - It is widely believed that recovered animals harbouring infectious organisms within pulmonary sequestra may become active shedders when stressed or immunodepressed.
- Cattle movement is an important factor in the spread of the disease
- Outbreaks usually begin as the result of movement and contact of an infected animal with a naive herd
- There are a few anecdotal reports of transmission on fomites, but Mycoplasmas do not survive for long periods in the environment, and indirect transmission is thought to be unimportant

Sources of infection

*Mmm*SC occur in great numbers in bronchial secretions, nasal discharges, exhaled air and nasal aerosols. Spread of infection through urine droplets was not fully confirmed. Microorganisms have also been isolated from bull semen, but transmission through semen requires further investigation.

Occurrence

CBPP is widespread in sub-Saharan Africa, including countries in the West, South, East, and Central regions of Africa.

For more recent, detailed information on the occurrence of this disease worldwide, see the OIE *World Animal Health Information Database* (WAHID) Interface [http://www.oie.int/wahis/public.php?page=home] or refer to the latest issues of the *World Animal Health* and the OIE *Bulletin*.

DIAGNOSIS

Clinical diagnosis

In adults

- Initial signs are usually a depressed, inappetent animal with moderate fever, followed by coughing, thoracic pain and increased respiratory rate.
- As pneumonia progresses, there is laboured respiration and dyspnoea, and animals prefer to stand with elbows abducted to decrease thoracic pain and increase chest capacity
- Auscultation of the lungs may reveal a wide variety of sounds, depending on how severely the subjacent pulmonary parenchyma is affected.
    - Reputations, rales, and pleuretic friction rubs are all possible.
    - At percussion, dull sounds can be noticed in the low areas of the thorax.
- CBPP often evolves into a chronic disease, characterised by ill thrift and recurrent low-grade fever that may be difficult to recognise as pneumonia
- Forced exercise may precipitate coughing

In calves

- Pulmonary tropism is not the general rule, and infected calves present arthritis with swelling of the joints
    - Co-existence of pulmonary signs in adults and arthritis in young animals should alert the clinician to a diagnosis of CBPP

Lesions

- Gross pathologic lesions of the lung are characteristic and often unilateral; the affected pulmonary parenchyma is odourless

- The predominant gross change is consolidation, or thickening, of individual lobules that become encased in markedly widened interlobular septa, resulting in the characteristic marbled appearance
- Interlobular septa become distended first by oedema, then by fibrin, and finally by fibrosis; the organism produces a necrotising toxin, galactan, which allows for this extensive spread through septa
- Abundant yellow or turbid exudate in the pleural cavity (up to 30 litres in severe cases) that coagulates to form large fibrinous clots
- Fibrinous pleurisy: thickening and inflammation of the pleura with fibrous deposits
- Interlobular oedema, marbled appearance due to hepatisation and consolidation at different stages of evolution usually confined to one lung
- Sequestrae with fibrous capsule surrounding grey necrotic tissue (coagulative necrosis) in recovered animals
- *Mmm*SC can survive within these sequestra for months or longer, facilitating spread

Differential diagnosis

Acute form

- Acute bovine pasteurellosis
- Haemorrhagic septicaemia
- East Coast fever (theileriosis)
- Bovine ephemeral fever
- Traumatic pericarditis

Chronic form

- Ecchinococcosis (hydatid cyst)
- Actinobacillosis
- Abscesses, tuberculosis, bovine farcy

Laboratory diagnosis

Samples

- Samples from live animals include nasal swabs and/or broncho-alveolar washings, or pleural fluid obtained by puncture; blood and sera should also be collected
- Samples to be taken at necropsy are lung lesions, lymph nodes, pleural fluid and synovial fluid from those animals with arthritis
- Samples should be shipped cool but may be frozen if transport to the laboratory is delayed

Procedures

Identification of the agent

- Isolation of pathogen from clinical samples and identification by metabolic and growth inhibition tests
- The growth of *Mmm*SC takes can take up to 10 days. In specific culture media (agar and broth), growth is visible within 3–10 days as a homogeneous cloudiness with whirls when shaken; on agar, small colonies develop, 1 mm in diameter, with the classical ‘fried-egg’ appearance.
- The organism is then identified routinely with immunological tests (growth inhibition, immunofluorescence or dot immunobinding on a membrane filter [MF-dot] test)
- Definitive identification is best done by an OIE Reference Laboratory (http://www.oie.int/eng/OIE/organisation/en_listeLR.htm), using biochemical tests combined with immunological assays.
- Polymerase chain reaction is now used as a rapid, specific, sensitive and easy to use test

Serological tests

- Modified Campbell & Turner complement fixation (CF) test is suitable for determining existence of disease and is a prescribed test in the OIE *Terrestrial Manual*. However, it has low sensitivity (70%), and may miss animals in early infection, those with chronic lesions, and those where therapy has been given; for herds, however, it can detect nearly 100% of infected groups.
- Competitive ELISA is also an OIE prescribed test for international trade and is described in the OIE *Terrestrial Manual*.
- An immunoblotting test (IBT) is highly specific and sensitive; it should be used at the local level in CBPP eradication programmes as a confirmatory test for positive or doubtful results after screening by the CF test and/or ELISA.

For more detailed information regarding laboratory diagnostic methodologies, please refer to Chapter 2.4.9 Contagious bovine pleuropneumonia in the latest edition of the OIE *Manual of Diagnostic Tests and Vaccines for Terrestrial Animals* under the heading "Diagnostic Techniques".

PREVENTION AND CONTROL

Effectiveness of treatment has not been adequately studied. Antibiotic treatment is not recommended because it may delay recognition of the disease, create chronic carriers and encourage emergence of resistant *Mmm*SC strains. The methods used for control depend on the epidemiological situation, animal husbandry methods in effect, and the availability and efficacy of veterinary services in a specific country.

Sanitary prophylaxis

- In disease-free areas: quarantine, movement controls, serological screening and slaughtering of all positive and in-contact animals
- Control of cattle movements is the most efficient way of limiting the spread of CBPP

Medical prophylaxis

- In enzootic areas like Africa vaccination is very important in the control of CBPP
- The only vaccines commonly used today are produced with attenuated *Mmm*SC strains; their efficacy is directly related to the virulence of the original strain used in production
- Attenuated virulent strains stimulate the best immunity, but also induce the most severe and undesirable local and systemic reactions
- Two strains are used for preparing CBPP vaccines: strain T1/44, a naturally mild strain isolated in 1951 by Sheriff & Piercy in Tanzania, and strain T1sr; T1sr is completely avirulent but has shorter immunity than T1/44, which may induce an unpredictable number of animals with post-vaccinal reactions requiring treatment with antibiotics two to three weeks after vaccination
- In low prevalence or free areas such as Europe, vaccination is not recommended as it can interfere with screening surveillance serological tests

For more detailed information regarding vaccines please refer to Chapter 2.4.9 Contagious bovine pleuropneumonia in the latest edition of the OIE *Manual of Diagnostic Tests and Vaccines for Terrestrial Animals* under the heading "Requirements for Vaccines and Diagnostic Biologicals".

For more detailed information regarding safe international trade in terrestrial animals and their products, please refer to the latest edition of the *Terrestrial Animal Health Code*.

REFERENCES AND OTHER INFORMATION

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The OIE will periodically update the OIE Technical Disease Cards. Please send relevant new references and proposed modifications to the OIE Scientific and Technical Department (scientific.dept@oie.int). Last updated October 2009.