

# Contagious Bovine Pleuropneumonia

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## Importance

Contagious bovine pleuropneumonia (CBPP) is one of the most important infectious diseases of cattle in Africa. Naïve herds can experience losses up to 80%, and many cattle that survive remain chronic carriers. These carriers may suffer from recurrent low-grade fever, loss of condition, and respiratory signs upon exercise. They can also introduce the virus into uninfected herds. Although contagious bovine pleuropneumonia was once found worldwide, it was eradicated from most continents, including North America, by the mid-20<sup>th</sup> century. Its incidence also began to decline in Africa by the 1970s. However, this disease recently made a resurgence. During the late 1980s and 1990s, it re-emerged in African countries that had been free of disease, in some cases for 25 years or more. Some countries were able to eradicate the disease by slaughtering large numbers of cattle; in others, CBPP has become established or is continuing to spread. This disease also reappeared in some European countries in the 1980s and 1990s, but was eradicated; the last case was reported in 1999.

## Etiology

Contagious bovine pleuropneumonia is caused by the bovine biotype of *Mycoplasma mycoides* subsp. *mycoides* small-colony type (SC), a member of the family Mycoplasmataceae. *M. mycoides* SC (bovine) strains can be grouped into at least two major lineages, one containing isolates from Europe and the other made up of isolates from Africa. Other strains of *M. mycoides* SC have been recovered from goats or sheep. Although these isolates are antigenically similar to bovine strains, they do not appear to be pathogenic for cattle; however, they may cause diseases other than CBPP in small ruminants.

## Species Affected

Cattle are the main hosts for *M. mycoides* SC (bovine). Infections have also been reported in Asian buffalo (*Bubalus bubalis*), captive bison (*Bison bison*) and yak (*Poephagus grunniens*, formerly *Bos grunniens*). Sheep can be infected experimentally with a bovine strain of *M. mycoides* SC, as well as with ovine strains. Wildlife does not appear to be important in the epidemiology of CBPP.

## Geographic Distribution

Contagious bovine pleuropneumonia is endemic in parts of Africa. Sporadic outbreaks are also reported in the Middle East, and are probably caused by cattle imported from Africa. The situation in Asia is uncertain, but in the past, this disease was reported in many countries. Although CBPP reemerged in Europe in the 1980s and 1990s, it was eradicated and has not been reported since 1999. The Western hemisphere remained free of the disease during the recent outbreaks.

## Transmission

*M. mycoides* SC is mainly transmitted from animal to animal in aerosols. This organism also occurs in saliva, urine, fetal membranes and uterine discharges. Carrier animals, including subclinically infected cattle, can retain viable organisms in encapsulated lung lesions (sequestra) for up to two years. These animals may shed organisms, particularly when stressed.

Close, repeated contact is generally thought to be necessary for transmission; however, *M. mycoides* SC might be spread over longer distances (up to 200 meters) if the climatic conditions are favorable. *M. mycoides* SC can also be transmitted through the placenta. Although there are a few anecdotal reports of transmission on fomites, mycoplasmas do not survive for long periods in the environment and indirect transmission is thought to be unimportant.

## Incubation Period

The incubation period for contagious bovine pleuropneumonia can be three weeks to six months. After experimental inoculation into the trachea, the clinical signs appear in 2 to 3 weeks.

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## Clinical Signs

Animals infected with *M. mycoides* SC can have peracute, acute, subacute or chronic disease. Subclinical infections also occur.

A few cattle may die of peracute disease with no symptoms other than fever. Acute cases in cattle are characterized by fever, loss of appetite, depression and a drop in milk production, followed by respiratory signs which may include coughing, purulent or mucoid nasal discharges, and rapid respiration progressing to dyspnea. Severely affected cattle typically stand with their head and neck extended and forelegs apart, and breathe through the mouth. The throat and dewlap may swell. Respiration can be painful, and animals may react intensely if pressed between the ribs. Epistaxis may also be seen and diarrhea has been reported. Some animals abort or give birth to stillborn calves. In calves up to six months of age, respiratory disease may be accompanied by polyarthritis; the large joints (particularly the carpal and tarsal joints) may be enlarged and warm. Affected joints can be so painful that the animal is very reluctant to bend them. Severely affected cattle often die, typically within three weeks. Animals that recover are frequently weak and emaciated, and may have chronic disease.

The clinical signs are similar but milder in subacute cases, and these infections often become chronic. Chronic cases are characterized by recurrent low-grade fever, loss of condition, and respiratory signs that may be apparent only when the animal is exercised. Many cattle eventually recover fully, although the lung lesions can take a long time to heal.

Experimentally infected sheep inoculated with a bovine strain of *M. mycoides* SC were reported to be asymptomatic, with the exception of a slight cough in some animals.

## Post Mortem Lesions [Click to view images](#)

The lesions of CBPP are often unilateral. In acute disease, large amounts of straw-colored fluid may be present in the thoracic cavity and pericardial sac. The lymph nodes of the chest are enlarged and edematous, and may contain petechiae and small necrotic foci. The lungs are consolidated and typically marbled, with areas of different color (pale pink, red and dark red) separated by a network of pale bands. Extensive fibrin accumulation can be found on the pleural surfaces and within the interlobular septa, causing enlargement of the septa. The fibrin is replaced by fibrous connective tissue over time. Fluid is not usually seen in chronic cases, but pleural adhesions are common. Necrotic lung tissue becomes encapsulated, forming pulmonary sequestra that may contain viable organisms. These sequestra are 2 cm to 25 cm in diameter and are surrounded by a fibrous connective tissue capsule up to 1 cm thick. The necrotic tissue in the sequestrum is odorless and can retain its lobular structure as it shrinks and dries, although it may later liquefy. Sequestra deep in the lung

may not be seen, but can be palpated. Sequestra can be found even in recovered animals. In calves with polyarthritis, affected joints are filled with fluid and abundant fibrin.

During the recent outbreaks in Europe, some CBPP cases did not have the typical most-mortem lesions such as marbling of lung tissue and the presence of sequestra.

## Morbidity and Mortality

The morbidity and mortality rates for CBPP are highly variable. In a naïve herd, the outcome varies from complete recovery of all animals to the death of the majority. European breeds seem to be more susceptible to this disease than indigenous African breeds. Morbidity also increases with close confinement, due to the increase in transmission. Mortality can be affected by secondary factors such as nutrition and parasitism, and varies from 30% to 80% in Africa, although mortality rates over 50% are uncommon.

When they are first introduced into a naïve herd, African isolates of CBPP usually cause acute disease, severe clinical signs and high mortality. Once the disease has become established, the mortality rate falls and the number of animals with chronic disease rises. There may be some differences in virulence between strains. In one experiment, a strain from Kenya had a long incubation period of up to three months, a morbidity rate of 50%, and a mortality rate of 25%. In contrast, a strain from Cameroon had a short incubation period of 10 to 40 days, a morbidity rate of 82%, and a mortality rate of 40%.

Much milder disease was reported during the recent outbreaks in Europe, and affected animals usually developed subacute or chronic disease. The morbidity rate was generally low and few animals died. One study reported that less than 5% of infected cattle in an Italian herd had clinical signs. The decreased severity of CBPP in Europe might be related to animal husbandry and the availability of antibiotics and anti-inflammatory drugs. In addition, the strains of *M. mycoides* SC found in Europe differed genetically from most strains found in Africa.

## Diagnosis

### Clinical

Contagious bovine pleuropneumonia is difficult to distinguish clinically from other causes of respiratory disease in cattle. CBPP should be considered in herds with signs of pneumonia (particularly unilateral disease) in adults and polyarthritis in calves. African strains are likely to cause severe disease in naïve animals; however, much milder disease was reported during the recent outbreaks in Europe. Lesions found at necropsy may be helpful in diagnosis; animals displaying severe clinical signs are most likely to show the characteristic lesions.

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## Differential diagnosis

The differentials for acute CBPP include other infectious causes of pleuropneumonia or bronchopneumonia, particularly bovine pasteurellosis (mannheimiosis), as well as hemorrhagic septicemia, theileriosis (East Coast fever), bovine ephemeral fever, rinderpest and traumatic pericarditis. Chronic cases must be differentiated from ecchinococcosis (hydatid cysts), abscesses, actinobacillosis, tuberculosis and bovine farcy.

## Laboratory tests

Contagious caprine pleuropneumonia can be diagnosed by culturing *M. mycoides* SC, or by identifying the organism in tissues with nucleic acid techniques or immunological tests. *M. mycoides* SC is a member of a closely related group of mycoplasmas called the *Mycoplasma mycoides* cluster. These species cross-react in serological tests and share biochemical and genetic similarities, complicating the identification of CBPP.

A definitive diagnosis can be made by recovering *M. mycoides* SC from infected animals. Isolation may not be successful after antibiotics have been used, and cultures from sequestra in chronic cases are often negative. Exudates or tissue smears can be examined microscopically for the organism, but recognition requires experience. Culture can be performed on standard mycoplasma media. *M. mycoides* SC colonies are small (approximately 1mm in diameter), and have the classic mycoplasmal 'fried-egg' appearance. Colonies take several days to develop. This organism is 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, using biochemical tests combined with immunological assays. Nucleic acid techniques, including polymerase chain reaction (PCR) assays, are also used in the identification of cultures.

PCR can also identify the organism in tissues, exudates, urine or blood. PCR assays that can differentiate European isolates and African/Australian isolates have been developed. Antigens can be identified in tissues or fluids with immunofluorescence, antigen-capture enzyme-linked immunosorbent assay (ELISA) or agar gel immunodiffusion. Antigens or nucleic acids can sometimes be detected in samples that are culture-negative. One study suggested that antigen detection may be more successful than culture in lymph node samples.

Serology is generally used at the herd level (i.e. in screening and eradication programs), rather than to diagnose individual animals. Serological tests include complement fixation, ELISA and immunoblotting. A rapid slide agglutination test (SAT) can be used with whole blood or serum in the field; this test is relatively insensitive and can only identify animals in the acute stage of disease. A latex agglutination test has also been developed. Animals may not develop measurable titers in the

early stages of disease, and few animals with chronic disease are seropositive. False positive reactions can occur in serologic tests with other mycoplasmas, particularly other members of the *M. mycoides* cluster.

A recent field isolate of *M. mycoides* SC from Botswana (M375) may have undergone deletion of some genetic material and has altered colony morphology, unique polymorphisms following immunoblotting, and altered properties (compared to other African or European strains) in growth-inhibition and biochemical tests. M375 may be unusually fastidious; this organism grows very poorly compared to other *M. mycoides* strains on standard culture media, but this difference is much less apparent on specialized mycoplasma medium (ME medium)

## Samples to collect

**Before collecting or sending any samples from animals with a suspected foreign animal disease, the proper authorities should be contacted. Samples should only be sent under secure conditions and to authorized laboratories to prevent the spread of the disease.**

Nasal swabs or discharges, bronchoalveolar lavage fluid, transtracheal washing fluid or pleural fluid obtained by puncture should be collected from live animals for culture, antigen detection and/or PCR. The organism may also be recovered from blood. At necropsy, samples should be taken of lung lesions, pleural fluid and regional lymph nodes of the respiratory tract. Samples of lesions should be collected at the interface between diseased and normal tissue. European isolates have been recovered from the lungs of animals without the typical lesions of CBPP. Synovial fluid should also be collected from calves with arthritis. Isolation from the kidneys is sometimes successful. Samples for culture should be shipped in a transport medium to protect the organism and prevent overgrowth of other bacteria. These samples should be kept cool at 4°C (39°F). If they must be kept for more than a few days, they may be frozen at or below -20°C (-4°F).

Serology is generally used as a herd test, rather than to identify individual animals. Whenever possible, both acute and convalescent sera should be collected. The SAT can be used with whole blood or serum in the field.

## Recommended actions if contagious bovine pleuropneumonia is suspected

### Notification of authorities

Contagious bovine pleuropneumonia should be reported immediately to state or federal authorities upon diagnosis or suspicion of the disease.

Federal: Area Veterinarians in Charge (AVIC):

[http://www.aphis.usda.gov/animal\\_health/area\\_offices/](http://www.aphis.usda.gov/animal_health/area_offices/)

State Veterinarians:

<http://www.aphis.usda.gov/vs/sregs/official.html>

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## Control

CBPP is most likely to be introduced in an infected animal or embryo. Quarantines and serologic testing of imported animals are helpful. Fomites are not a major source of transmission; *M. mycoides* SC does not survive for more than a few days in the environment.

Outbreaks are eradicated with quarantines, movement controls, slaughter of infected and in-contact animals, and cleaning and disinfection. Many routinely used disinfectants are effective. The efficacy of eradication efforts can be monitored with serologic tests.

Vaccines are used to control CBPP in endemic areas. Their efficacy may vary for different strains of virus; in one experiment, vaccination provided a protection rate of 67% in cattle challenged with a Kenyan strain and 33% in cattle challenged with a strain from Cameroon. *M. mycoides* SC is susceptible to several antibiotics, but treatment may only slow the progression of the disease. In some cases, it can also promote the formation of sequestra. Antibiotics are ineffective in chronically affected animals. For these reasons, antibiotic treatment is discouraged, even in endemic regions; however, this recommendation is not always followed. On-farm quarantine of CBPP suspects (both clinically affected and carrier animals) and contact animals is helpful in controlling the spread of disease.

## Public Health

Humans are not susceptible to *Mycoplasma mycoides* SC.

## For More Information

- Food and Agriculture Organization of the United Nations (FAO). Manual for the Recognition of Exotic Diseases of Livestock  
<http://www.spc.int/rahs/>
- FAO. Recognizing Contagious Bovine Pleuropneumonia.  
<ftp://ftp.fao.org/docrep/fao/005/y4142E/y4142E00.pdf>
- United States Animal Health Association.  
Foreign Animal Diseases  
[http://www.vet.uga.edu/vpp/gray\\_book02/fad/index.php](http://www.vet.uga.edu/vpp/gray_book02/fad/index.php)
- The Merck Veterinary Manual  
<http://www.merckvetmanual.com/mvm/index.jsp>
- World Organization for Animal Health (OIE)  
<http://www.oie.int>
- OIE Manual of Diagnostic Tests and Vaccines for Terrestrial Animals  
[http://www.oie.int/eng/normes/mmanual/A\\_summry.htm](http://www.oie.int/eng/normes/mmanual/A_summry.htm)
- OIE Terrestrial Animal Health Code  
[http://www.oie.int/eng/normes/mcode/en\\_sommaire.htm](http://www.oie.int/eng/normes/mcode/en_sommaire.htm)

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