

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, and might 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-20th century. Its incidence also began to decline in Africa by the 1970s. During the late 1980s and 1990s, however, this disease increased in prevalence in endemic areas. It also re-emerged in some African and European countries that had been CBPP-free, in some cases for 25 years or more. Eradication was successful in Europe, with the most recent case reported in 1999. However, contagious bovine pleuropneumonia remains a serious concern in Africa, where the end of widespread combined rinderpest/CBPP vaccination programs (after rinderpest eradication) may have contributed to its resurgence.

Etiology

Contagious bovine pleuropneumonia is caused by *Mycoplasma mycoides* subsp. *mycoides*, a member of the *Mycoplasma mycoides* cluster in the family Mycoplasmataceae. This organism was previously specified as the small-colony (SC) type of this organism; however, *Mycoplasma mycoides* subsp. *mycoides* large colony type no longer exists (these organisms are now considered to belong to *M. mycoides* subsp. *capri*). Nevertheless, many sources continue to use the full designation *Mycoplasma mycoides* subsp. *mycoides* SC. *M. mycoides* SC can be grouped into at least two major lineages (African and European), or into at least 3 or 4 genetic groups. Strains can differ in virulence.

Zoonotic potential

There is no evidence that humans are infected by *M. mycoides* SC.

Species Affected

Cattle (*Bos taurus* and *Bos indicus*) and Asian buffalo (*Bubalus bubalis*) are the primary hosts for *M. mycoides* SC. Clinical cases have also been reported in yak (*Poephagus grunniens*/*Bos grunniens*) and captive bison (*Bison bison*). Sheep and goats can be infected, although they are not thought to be important in the epidemiology of CBPP. White-tailed deer (*Odocoileus virginianus*) have been infected experimentally. There is little published surveillance for *M. mycoides* SC in wildlife, with the exception of two studies conducted before 1970, which reported that African wildlife were unlikely to be infected.

Geographic Distribution

Contagious bovine pleuropneumonia is endemic in parts of Africa. Sporadic outbreaks have been reported in the Middle East, and are probably caused by cattle imported from Africa. There is limited information about Asian countries in the most recent reports to the World Organization for Animal Health (OIE), although some countries have indicated that they are CBPP-free. *M. mycoides* SC is not currently endemic in Europe or the Western Hemisphere.

Transmission

M. mycoides SC is mainly transmitted from animal to animal in respiratory aerosols. This organism also occurs in saliva, urine, fetal membranes and uterine discharges. 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. Carrier animals, including subclinically infected cattle, can retain viable organisms in encapsulated lung lesions (sequestra) for several months or more (one source indicates up to two years). These animals are thought to be capable of shedding organisms, particularly when stressed. Transplacental transmission is also possible.

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Although there are a few anecdotal reports of transmission on fomites, mycoplasmas do not survive for more than a few days in the environment and indirect transmission is thought to be unimportant in the epidemiology of this disease.

Disinfection

Mycoplasma spp. are generally short-lived, fragile organisms in the environment. If disinfection is needed, they are reported to be susceptible to many disinfectants including 1% sodium hypochlorite, 70% ethanol, phenolic disinfectants, iodophores, formaldehyde, glutaraldehyde, and peracetic acid.

Incubation Period

The incubation period for contagious bovine pleuropneumonia can be 3 weeks to 6 months, with most cases becoming apparent in 3-8 weeks. After experimental inoculation of large doses into the trachea, the clinical signs appeared in 2 to 3 weeks.

Clinical Signs

A few cattle with CBPP may die peracutely with no clinical signs other than fever. Acute cases in cattle are characterized by nonspecific signs of 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. Clinical signs can differ in severity between outbreaks, but some cases progress rapidly to dyspnea. Respiration can be painful, and animals may react intensely if pressed between the ribs. Severely affected cattle may stand with their head and neck extended and forelegs apart, breathing through the mouth. The throat and dewlap sometimes swell. Epistaxis and diarrhea have also been reported, and pregnant animals may abort or give birth to stillborn calves. Severely affected cattle often die, typically within three weeks. Animals that recover are frequently weak and emaciated, and may remain chronically infected. Subclinical infections also occur.

In calves up to six months of age, the primary sign may be polyarthritis, especially of the carpal and tarsal joints, often without respiratory signs. The affected joints may be so painful that the animal is very reluctant to bend them.

Chronic CBPP is 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.

The effects of *M. mycoides* SC on small ruminants are still unclear. There have been reports of its isolation from sheep with mastitis and goats with respiratory disease. Other agents, including other mycoplasmas, were also detected in some outbreaks, but not others. Experimentally infected sheep remained asymptomatic, although some animals had a slight cough, and slight lesions of interstitial pneumonia (evident only microscopically) were found in

the lungs. In another study, goats in close contact with experimentally infected cattle did not become infected. One of two experimentally infected white-tailed deer developed a fever and died with severe respiratory lesions; the second deer remained healthy.

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; areas of different color (pale pink, red and dark red) may be 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. Lesions considered to be typical of CBPP, such as marbling of lung tissue and the presence of sequestra, have been absent in some confirmed cases.

In calves with poly-arthritis, affected joints are filled with fluid and abundant fibrin. Infarcts, appearing as chronic fibrotic foci, may be found in the kidneys of these animals.

A fatal case in an experimentally infected deer was characterized by pneumonia with secondary hemorrhages; however, marbling, sequestra, fibrinous adhesions and excessive pleural fluid were absent.

Diagnostic Tests

In live animals, a definitive diagnosis can be made by detecting *M. mycoides* SC in nasal swabs or discharges, bronchoalveolar lavage or transtracheal wash fluid, pleural fluid, or synovial fluid from swollen joints. At necropsy, the organism is most likely to be found in lung lesions, pleural fluid and regional lymph nodes of the respiratory tract. Ideally, lung samples should be collected at the interface between diseased and normal tissue. Recent European isolates have sometimes been recovered from the lungs of animals without typical CBPP lesions. Isolation from blood or the kidneys may also be successful. Members of the *Mycoplasma mycoides* cluster cross-react in serological tests and share biochemical and antigenic similarities, complicating the identification of CBPP unless genetic tests such as polymerase chain reaction (PCR) assays are used.

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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. Culture can be performed on standard mycoplasma media. This organism is usually identified by PCR, although biochemistry and serological methods (growth inhibition, immunofluorescence, dot immunobinding on a membrane filter [MF-dot] test, agar gel immunodiffusion) can also be employed and were used more frequently in the past. Biochemical tests are unable to unequivocally identify the members of the *M. mycoides* cluster, and serological identification is hampered by cross-reactivity. There have been reports of unusual field isolates (e.g., M375 from Botswana) that were more fastidious than expected and had altered colony morphology, unique polymorphisms following immunoblotting, and altered properties in growth-inhibition and biochemical tests.

PCR assays are more likely to be successful than culture, and can be used to identify *M. mycoides* SC directly in clinical samples. At least one isothermal loop-mediated amplification method has also been published. Various antigen detection tests (e.g., immunofluorescence/immunohistochemistry, antigen-capture ELISA, agar gel immunodiffusion, interface precipitin test, lateral flow assay) have been described or used in diagnosis.

Serology is generally employed at the herd level (i.e., in screening and eradication programs), rather than as a diagnostic test in individual animals. Animals may not develop measurable titers in the early stages of CBPP, and few animals with chronic disease are seropositive. Serological tests include complement fixation (CF), ELISA, immunoblotting (generally as a confirmatory test for CF or ELISA), and a rapid slide agglutination test (SAT). The SAT is relatively insensitive and can only identify animals in the acute stage of disease. Other mycoplasmas, particularly other members of the *M. mycoides* cluster, can result in false positive reactions in serological assays.

Treatment

Tetracyclines, macrolides and fluoroquinolones are reported to be useful in treatment, but individual drugs may differ in their effects. Complete elimination of mycoplasmas is reported to be rare. The degree of risk from treated animals is still uncertain; however, treatment is controversial, and some countries do not permit antibiotics to be used. Antibiotics are reported to be ineffective in chronic cases.

Control

Disease reporting

A quick response is vital for containing outbreaks in regions free of contagious bovine pleuropneumonia. Veterinarians who encounter or suspect this disease should

follow their national and/or local guidelines for disease reporting. In the U.S., state or federal veterinary authorities should be informed immediately.

Prevention

CBPP is most likely to be introduced in an infected animal or embryo, as the organism does not survive for long periods on fomites. Quarantines and serological testing of imported animals are helpful. Outbreaks are eradicated with quarantines, movement controls, slaughter of infected and in-contact animals, and cleaning and disinfection.

Vaccines are used to control CBPP in endemic areas. On-farm quarantine of CBPP suspects (both clinically affected and carrier animals) and contact animals is helpful in controlling the spread of disease.

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. Morbidity increases with close confinement, due to the increase in transmission, and infection rates can be as high as 50-80% in some situations. The mortality rate ranges from 10% to 80%, although mortality greater than 50% is reported to be uncommon. The severity of the illness can also be affected by the virulence of the strain, and secondary factors in the animal, such as nutrition and parasitism. There may be breed-related differences in susceptibility.

African and recent European isolates may differ in virulence. When they are first introduced into a naïve herd, African isolates 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. Much milder illnesses were reported during the recent outbreaks in Europe, and affected animals usually developed subacute or chronic disease. The morbidity rate was generally low (for example, less than 5% in one Italian herd), and few animals died. The decreased severity of CBPP in Europe might also be related to animal husbandry and the availability of antibiotics and anti-inflammatory drugs

For More Information

FAO. Recognizing Contagious Bovine Pleuropneumonia.
<ftp://ftp.fao.org/docrep/fao/005/y4142E/y4142E00.pdf>

The Merck Veterinary Manual
<http://www.merckvetmanual.com/mvm/index.html>

United States Animal Health Association.
Foreign Animal Diseases
http://www.aphis.usda.gov/emergency_response/downloads/nahems/fad.pdf

World Organization for Animal Health (OIE)
<http://www.oie.int>

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OIE Manual of Diagnostic Tests and Vaccines for Terrestrial Animals

<http://www.oie.int/international-standard-setting/terrestrial-manual/access-online/>

OIE Terrestrial Animal Health Code

<http://www.oie.int/international-standard-setting/terrestrial-code/access-online/>

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*Link defunct as of 2015