

Contagious Caprine Pleuropneumonia

*Pleuropneumonie
Contagieuse Caprine,
Bou-frida,
Abu-nini*

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Importance

Contagious caprine pleuropneumonia (CCPP) is one of the most severe diseases of goats. This disease, which affects the respiratory tract, is extremely contagious and frequently fatal; in some naive flocks, the morbidity and mortality rates may reach 100%. CCPP causes major economic losses in Africa, Asia and the Middle East, where it is endemic. Definitive diagnosis can be difficult, as the causative agent is one of the most fastidious mycoplasmas and can be missed during routine bacteriological analysis. CCPP is now known to also affect some species of exotic ungulates. This has raised concerns for zoos and for the conservation of some endangered species exposed to goats.

Etiology

Contagious caprine pleuropneumonia is caused by *Mycoplasma capricolum* subsp. *capripneumoniae* (formerly *Mycoplasma* biotype F-38), a member of the family Mycoplasmataceae. Epidemiological studies of this organism are still limited; however, genetic analyses have grouped *M. capripneumoniae* isolates into two major clusters representing two evolutionary lines of the organism, five lineages which correspond to geographic regions, or six genotypes (A to F).

M. capripneumoniae belongs to a closely related group of mycoplasmas called the *Mycoplasma mycoides* cluster. Another organism in this group, *M. mycoides* subsp. *capri* (a species now containing both *M. mycoides* subsp. *capri* and the former *M. mycoides* subsp. *mycoides* large-colony type) can cause a disease that resembles CCPP but may have extrapulmonary signs and lesions. Some texts consider *M. mycoides* subsp. *capri* to be a minor cause of contagious caprine pleuropneumonia; however, the World Organization for Animal Health (OIE) defines CCPP as only the disease caused by *M. capricolum* subsp. *capripneumoniae*.

Species Affected

Goats are the primary hosts for *M. capripneumoniae*, and the only domesticated animals proven to be affected by this organism. At present, the significance of infections in sheep is uncertain; however, at least two papers have reported the occurrence of *M. capripneumoniae* in healthy or sick sheep. There is also a possibility that this organism might have been involved in an outbreak of acute respiratory disease among goats and sheep in Ethiopia in 2002. *M. capripneumoniae* has caused clinical cases in some wild ungulates including wild goats (*Capra aegagrus*), Nubian ibex (*Capra ibex nubiana*), Laristan mouflon (*Ovis orientalis laristanica*), gerenuk (*Litocranius walleri*), sand gazelles (*Gazella subgutturosa marica*), Arabian oryx (*Oryx leucoryx*), and Tibetan antelope (*Pantholops hodgsonii*).

Zoonotic potential

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

Geographic Distribution

Contagious caprine pleuropneumonia can be found in many countries in Africa, Asia) and the Middle East. *M. capripneumoniae* is difficult to isolate from clinical material, and its presence has not been confirmed in all affected countries. In some cases, reports of its occurrence are based on clinical signs alone.

Transmission

Contagious caprine pleuropneumonia is highly contagious. This disease is transmitted during close contact, by the inhalation of respiratory droplets. Chronic carriers may exist, but this remains unproven. Some outbreaks have occurred in endemic areas when apparently healthy goats were introduced into flocks, and in one experiment, a goat developed clinical CCPP nearly three months after contact with infected goats and a month after all other animals had recovered. However, one study that followed a large flock of experimentally infected goats for up to 105 days did not find any chronic carriers.

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Disinfection

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

Incubation Period

The incubation period is commonly 6 to 10 days, but is reported to range from 2 days to 4 weeks.

Clinical Signs

Contagious caprine pleuropneumonia is strictly a respiratory disease. Peracute, acute and chronic forms may be seen in endemic areas. Peracutely affected goats can die within 1 to 3 days with minimal clinical signs. In acute disease, the initial signs are a very high fever (41-43°C; 106-109°F), lethargy and anorexia, followed by coughing and labored respiration. The cough is frequent, violent and productive. In the final stages of disease, the goat may not be able to move, and stands with its front legs wide apart, and its neck stiff and extended. Saliva can drip continuously from the mouth, and the animal may grunt or bleat in pain. Frothy nasal discharge and stringy saliva may be seen terminally. Pregnant goats can abort. Acutely affected goats generally die within 7 to 10 days. Subacute or chronic cases tend to be milder, with coughing mainly following activity. Chronic CCPP is characterized by a chronic cough, nasal discharge and debilitation.

Clinical signs in wild or captive wild ungulates have been similar to cases in goats.

Post Mortem Lesions

The lesions of contagious caprine pleuropneumonia are limited to the respiratory system. Acute disease is characterized by unilateral or bilateral pneumonia and serofibrinous pleuritis with straw-colored fluid in the thorax. On cut surface, the lung is granular with copious straw-colored exudate. Pea-sized, yellow nodules may be found in the lungs; these nodules are surrounded by areas of congestion. Varying degrees of lung consolidation or necrosis can be seen, and the regional (bronchial) lymph nodes are enlarged. Some long-term survivors have chronic pleuropneumonia or chronic pleuritis, with encapsulation of acute lesions and numerous adhesions to the chest wall. The interlobular septa are not usually thickened in domesticated goats.

Wild ruminants with CCPP have similar lesions; however, thickening of the interlobular septa has been reported in some animals.

Diagnostic Tests

A definitive diagnosis can be made by detecting *M. capripneumoniae* in lung tissue, exudate from lung lesions,

pleural fluid or regional lymph nodes at necropsy. Samples should be taken from active lung lesions, ideally from the interface between consolidated and unconsolidated areas. Although morphology does not provide definitive identification, *M. capripneumoniae* has a branching, filamentous structure in exudates, impression smears or tissue sections examined under the microscope. Other caprine mycoplasmas usually appear as short filamentous organisms or coccobacilli. *M. capripneumoniae* and other members of the *M. mycoides* cluster cross-react in serological tests and share biochemical and antigenic similarities, making specific identification of this organism difficult and time-consuming unless genetic tests such as polymerase chain reaction (PCR) assays are used.

M. capripneumoniae is one of the most fastidious mycoplasmas, and must be isolated on mycoplasma media such as 'viande foie goat' (VFG), modified Hayflick's or modified Newing's tryptose. Colonies or other evidence of growth (i.e., faint turbidity in broth) may appear in 5-15 days. PCR is generally used for identification of the culture, although biochemical tests and serological assays (growth inhibition, immunofluorescence) 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. Because *M. capripneumoniae* is so fastidious and cultures can be overgrown with other mycoplasmas, it may not be isolated from clinical samples, particularly if the sample has not been conserved adequately. This organism has not been found in lesions from animals with chronic disease.

PCR is more likely to be successful than culture, and can be used to identify *M. capripneumoniae* directly in tissue samples or pleural fluid. Isothermal amplification methods (loop-mediated isothermal amplification, recombinase polymerase amplification) have been reported in the literature. *M. capripneumoniae* antigens can be detected in tissue samples by immunostaining or gel immunoprecipitin tests, and a latex agglutination test to detect antigens has been described in the literature. Cross-reactions can be an issue in antigen detection tests.

Serological tests to detect antibodies to *M. capripneumoniae* include complement fixation, latex agglutination (which can identify early IgM antibodies), and competitive enzyme linked immunosorbent assays (ELISA). Animals with acute CCPP rarely develop measurable titers before death; antibodies usually become detectable 7-9 days after the first clinical signs. Whenever possible, paired serum samples should be collected 3-8 weeks apart. Serological tests are generally used on a herd basis and not for individual diagnosis. These tests do not identify all reactors, and cross-reactivity is an issue. A more specific competitive binding ELISA, described in 2014, was reported not to cross-react with other *Mycoplasma* found in goats.

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Treatment

Some antibiotics, such as tetracyclines, fluoroquinolones (e.g., danofloxacin) and the macrolide family, can be effective if given early. Complete elimination of mycoplasmas is reported to be rare, and treated animals may be potential carriers. The degree of risk from treated animals spreading *M. capripneumoniae* is still uncertain.

Control

Disease reporting

A quick response is vital for containing outbreaks in regions free of contagious caprine 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

Contagious caprine pleuropneumonia is most likely to enter a country in infected animals, due to the poor survival of mycoplasmal organisms in the environment. It is uncertain whether long-term subclinical carriers exist; however, some outbreaks in endemic areas have occurred when apparently healthy goats were introduced into flocks. Outbreaks can be eradicated with quarantines, movement controls, slaughter of infected and exposed animals, and cleaning and disinfection of the premises. Some countries have included vaccination in their eradication procedures.

In endemic areas, care should be taken when introducing new animals into the flock. Flock testing, slaughter, and on-site quarantine may be helpful in controlling the spread of disease. Vaccines help prevent disease in some countries.

Vaccination has also been helpful in ending some outbreaks among captive wild animals. In addition, antibiotic treatment and reductions in animal density (to decrease contact between animals) were sometimes employed. In endemic areas, exotic ungulates that may be susceptible should be kept from contact with goats. Fencing may be helpful; however, there is one report of transmission from sick sand gazelle to an Arabian oryx in the adjacent enclosure, when the animals were separated by a double mesh fence. *Mycoplasma* screening may be considered before animals are released into a zoo or other site, but *M. capripneumoniae* infections can be difficult to detect.

Morbidity and Mortality

Contagious caprine pleuropneumonia is a highly contagious disease in naive animals. Exposure to *M. capripneumoniae* appears to be common among goats in some endemic regions. In some herds, most animals may be seropositive. One recent study, which used a new, more specific, monoclonal antibody-based cELISA, found that the seroprevalence among goats with respiratory signs ranged from <5% to 44% in some parts of Asia. During

outbreaks, the morbidity rate can be as high as 100% and the mortality rate up to 70-100%. These rates can be influenced by previous exposure, and by the amount of contact between animals (close contact facilitates transmission).

High morbidity and mortality rates have also been reported in some exotic ungulates. During an outbreak among captive wild ungulates in 2007, the morbidity and mortality rates were 100% and 82%, respectively, in wild goats, and 93% and 58% in Nubian ibex. During a later outbreak, 34% mortality occurred in one enclosure of sand gazelle. A CCPP outbreak among wild Tibetan antelope resulted in thousands of deaths and the estimated loss of 16% of the population, although it is possible that some deaths were due to other causes.

Internet Resources

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>

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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