

# Contagious Caprine Pleuropneumonia

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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 naive flocks, the morbidity rate may reach 100% and the mortality rate can be as high as 80%. CCPP causes major economic losses in Africa, Asia and the Middle East, where it is endemic. Definitive diagnosis can be difficult. The causative agent is one of the most fastidious mycoplasmas and can be missed during routine bacteriological analysis. It is also closely related to several other species of *Mycoplasma*, which complicates identification and serological screening. In 2007, CCPP was reported to affect some species of exotic ruminants. This new finding raised concerns for zoos and for the conservation of endangered ruminants exposed to goats.

## Etiology

Contagious caprine pleuropneumonia is caused by *Mycoplasma capricolum* subsp. *capripneumoniae*, a member of the family Mycoplasmataceae. This organism was formerly known as *Mycoplasma* biotype F-38. Genetic studies have grouped *M. capripneumoniae* isolates into two major clusters representing two evolutionary lines of the organism, or into four lineages which correspond to geographic regions.

*M. capripneumoniae* belongs to a closely related group of mycoplasmas called the *Mycoplasma mycoides* cluster. Two other organisms in this group, *M. mycoides* subsp. *capri* and *M. mycoides* subsp. *mycoides* large-colony type, can cause a disease in small ruminants that resembles CCPP but may have extrapulmonary signs and lesions. At one time, some authors also considered these organisms, particularly *M. mycoides* subsp. *capri*, to cause CCPP. However, these diseases are now considered to be distinct.

## Species Affected

Goats are the primary hosts for *M. capripneumoniae*, and the only domesticated animals proven to be affected by this organism. 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. Recently, *M. capripneumoniae* was isolated from an outbreak of severe respiratory disease in captive wild goats (*Capra aegagrus*), Nubian ibex (*Capra ibex nubiana*), Laristan mouflon (*Ovis orientalis laristanica*), and gerenuk (*Litocranius walleri*). Whether it occurs in other wild ruminants is uncertain.

## Geographic Distribution

Contagious caprine pleuropneumonia can be found in many countries in Africa, Asia (including India and Pakistan) and the Middle East. *M. capripneumoniae* is difficult to isolate from clinical material, and its presence has not been confirmed in all affected countries. Countries known to have isolated *M. capripneumoniae* include Kenya, the Sudan, Tunisia, Oman, Turkey, Chad, Uganda, Ethiopia, Niger, Tanzania, Eritrea and the United Arab Emirates. In other affected countries, the occurrence of CCPP may be 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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## Incubation Period

The incubation period is commonly six to 10 days. Some experimentally infected goats develop fever as soon as three days after inoculation and respiratory signs as early as five days, but others become ill up to 41 days after exposure.

## 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 within 2 to 3 days 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 seven to 10 days. Chronic CCPP is characterized by a chronic cough, nasal discharge and debilitation. In addition, mild acute infections with fever, cough or other respiratory signs and recovery have been reported in some experimentally infected goats. It is not known whether mild disease can also occur in naturally infected animals, or if the inoculated organisms had become attenuated during culture.

Peracute, acute and chronic disease, resembling the clinical signs in goats, were reported in captive wild goats, Nubian ibex, Laristan mouflon and gerenuk.

## 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 is not thickened in domesticated goats.

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

## Morbidity and Mortality

CCPP is severe and highly contagious in naive animals. During outbreaks, goat flocks have morbidity rates up to 100% and mortality rates as high as 80%. The

mortality rate can reach 100% in experimentally infected goats. Chronic disease can also be seen in endemic areas, where animals may have pre-existing immunity to *M. capripneumoniae*.

During the only confirmed outbreak in wild ruminants, the morbidity rate was 100% in wild goats and 83% in Nubian ibex. The mortality rates in these two species were 82% and 58%, respectively.

## Diagnosis

### Clinical

Contagious caprine pleuropneumonia should be suspected when severe respiratory disease, with a high morbidity and mortality rate, is seen in goats. The typical necropsy lesions aid diagnosis.

### Differential diagnosis

The differential diagnosis includes pasteurellosis and other forms of bacterial pneumonia, peste des petits ruminants and caseous lymphadenitis. Some other mycoplasmas, particularly *Mycoplasma mycoides* subsp. *capri* and *Mycoplasma mycoides* subsp. *mycoides* large-colony type, can also cause pleuropneumonia resembling CCPP.

### Laboratory tests

*M. capripneumoniae* and other members of the *M. mycoides* cluster cross-react in serological tests and share biochemical and genetic similarities, making specific identification of the organism difficult and time-consuming.

A definitive diagnosis can be made by isolating *M. capripneumoniae* from lung tissue and/or pleural fluid at necropsy. This organism has a branching, filamentous morphology in exudates, impression smears or tissue sections examined under the microscope. Other caprine mycoplasmas usually appear as short filamentous organisms or coccobacilli. *M. capripneumoniae* is one of the most fastidious mycoplasmas, and must be isolated on mycoplasma media; suitable media include Thiaucourt's medium, modified Thiaucourt's medium, 'viande foie goat' (VFG), modified Hayflick's and modified Newing's tryptose. Colony morphology varies with the medium, the passage level and the age of the culture; although small, irregular colonies may occur in early passage, the classic 'fried egg' colony morphology can be seen in older cultures. 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. *M. capripneumoniae* has not been found in lesions from animals with chronic disease.

Biochemical, immunological and molecular tests can be used for identification of the culture. Biochemical tests are helpful in preliminary screening and as supporting tests for serology, but are unable to unequivocally identify the members of the *M. mycoides* cluster. Serological tests

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used to identify mycoplasmas include growth inhibition, growth precipitation and immunofluorescence. Because members of the *M. mycoides* cluster are closely related and cross-react in these tests, isolates thought to be *M. capripneumoniae* should if possible, be identified serologically by at least two of the three tests. Metabolism inhibition and tetrazolium reduction inhibition may also be helpful in identification.

Polymerase chain reaction (PCR) assays are used to identify cultures of *M. capripneumoniae*, as well as to identify this organism directly in tissue samples. Immunohistochemistry can identify *M. capripneumoniae* antigens in tissue samples, but it is not routinely used in diagnostic laboratories. Antigens can also be detected with gel immunoprecipitin tests

Serological tests include complement fixation, latex agglutination, indirect hemagglutination and enzyme linked immunosorbent assays (ELISA). Serological tests are generally used on a herd basis and not for individual diagnosis. These tests do not identify all reactors, and cross-reactions occur with other species in the *M. mycoides* cluster. In addition, animals with acute CCPP rarely develop measurable titers before death.

## 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.**

At necropsy, samples from active lung lesions should be collected for culture and histopathology. These samples should be taken from the interface between consolidated and unconsolidated areas. Samples of pleural fluid, exudate from lung lesions, and regional lymph nodes should also be collected. Tissue samples for virus isolation should be collected aseptically, placed in a transport medium, kept cold, and shipped to the laboratory on wet ice. Samples should be frozen if they will not reach the laboratory within a few days; if necessary, samples can be stored at -20°C for months with little apparent loss of mycoplasmal viability.

PCR can identify *M. capripneumoniae* in tissue samples and pleural fluid. PCR can also be performed on dried samples, such as pleural fluid on filter papers.

Serology is generally used as a herd test rather than to test individual animals; samples should be collected from several animals in the flock. Whenever possible, paired serum samples should be collected 3-8 weeks apart. The latex agglutination test can be used with whole blood or serum in the field.

## Recommended actions if contagious caprine pleuropneumonia is suspected

### Notification of authorities

State and federal veterinarians should be immediately informed of any suspected cases of contagious caprine pleuropneumonia.

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>

## Control

Contagious caprine pleuropneumonia is most likely to enter a country in infected animals. 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. Some antibiotics, such as tetracyclines or tylosin, can be effective if given early.

The outbreak of CCPP in wild goats, ibex, mouflon and gerenuk suggests that this disease could be a threat to some wildlife and/or captive wild animals. Vaccination was helpful in ending this outbreak. In endemic areas, susceptible species should be kept from contact with goats. *Mycoplasma* screening should also be considered before animals are released into a zoo or other site, but *M. capripneumoniae* infections are difficult to detect.

## Public Health

Humans are not susceptible to infection with *M. capripneumoniae*.

## Internet Resources

Food and Agriculture Organization of the United Nations (FAO). Manual for the Recognition of Exotic Diseases of Livestock

<http://www.spc.int/rahs/>

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)

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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