CONTAGIOUS CAPRINE PLEUROPNEUMONIA

AETIOLOGY

Classification of the causative agent

Family Mycoplasmataceae, *Mycoplasma capricolum* subsp. *capripneumoniae* (*Mccp*)

- Closely related to *M. capricolum* subsp. *capricolum* and more distantly related to other members of the "*Mycoplasma mycoides* cluster" such as *M. mycoides* subsp. capri or *M. leachii*.
- Unlike contagious caprine pleuropneumoniae (CCPP), which is confined to the thoracic cavity, the disease caused by other mycoplasmas of the mycoides cluster is accompanied by prominent lesions in other organs and/or parts of the body besides the thoracic cavity
- Formerly known as *Mycoplasma* sp. type F-38 (5)
- Genetic studies have grouped Mccp isolates into major clusters (2 or 3 depending on the study) that correlate with geographic regions. (4, 7)

Resistance to physical and chemical action (*based on* M. mycoides mycoides *SC*)

Temperature:	Inactivated within 60 minutes at 56°C and within 2 minutes at 60°C, but can survive more than 10 years in frozen, infected pleural fluid.
pH:	No information.
Chemicals:	Inactivated by formaldehyde (0.05%/30 seconds) and a mercuric chloride (0.01%/1 minute)
Disinfectants:	Many of the routinely used disinfectants will effectively inactivate the organism, e.g. phenol (1%/3 minutes).
Survival:	Very fragile and not able to exist long in the external environment. On average only survives outside the host for up to 3 days in tropical areas and up to 2 weeks in temperate zones. Cultures can be inactivated by ultraviolet radiation within a few minutes.

EPIDEMIOLOGY

- CCPP is one of the most severe diseases of goats (9)
- Affects the respiratory tract, and 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 East Africa and the Middle East, where it is endemic
- 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

Hosts

- Goats are the primary hosts.
- Sheep may be affected In CCPP outbreaks affecting mixed goat and sheep herds. *Mccp* has also been isolated from healthy sheep, and their role as a possible reservoir must be considered.
- Recently CCPP was confirmed in wild ruminants kept in a wildlife preserve in Qatar. The disease affected wild goats (*Capra aegagrus*), Nubian Ibex (*Capra ibex nubiana*), Laristan mouflon (*Ovis orientalise laristanica*) and Gerenuk (*Litocranius walleri*) with significant morbidity and mortality in these species. (1)
- Disease indistinguishable from naturally occurring CCPP has been experimentally reproduced with *Mccp* by several groups of workers.

Transmission

- Contagious caprine pleuropneumoniae is contagious.
- 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.
- Outbreaks of the disease often occur after heavy rains (e.g. after the monsoons in India), after cold spells or after transportation over long distances. This may be because recovered carrier animals shed the infectious agent after the stress of sudden climatic or environmental changes.

Sources of agent

- Infectious aerosols.
- A carrier state is likely but not proven.

Occurrence

- Occurs in many countries in Africa and the Middle East. Exact distribution is not well known and could well include Asian countries.
- *Mycoplasma capricolum* subsp. *capripneumoniae* (*Mccp*), originally known as the F38 biotype, was first isolated in Kenya and subsequently isolated in the Sudan, Tunisia, Oman, Turkey, Chad, Uganda, Ethiopia, Niger, Tanzania, Eritrea and the United Arab Emirates
- First reported in mainland Europe in 2004, when outbreaks were confirmed in Thrace, Turkey, with losses of up to 25% in some herds (6)
- The exact distribution of *Mccp* is unknown as CCPP is often confused with other respiratory infections (Pasteurellosis) and isolation of the causative organism is difficult.

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

The incubation period under natural conditions is commonly six to 10 days, but may be prolonged (3–4 weeks). 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.

CCPP should be suspected in the field when a highly contagious disease occurs in goats characterised by pyrexia of 41°C or greater, severe respiratory distress, high morbidity and mortality, and post-mortem lesions of fibrinous pleuropneumoniae with pronounced hepatisation and pleural adhesions.

Clinical diagnosis

Post-mortem examination reveals fibrinous pleuropneumoniae with massive lung hepatisation and pleurisy, accompanied by accumulation of straw-coloured pleural fluid.

- CCPP is strictly a respiratory disease. Peracute, acute and chronic forms occur in endemic areas.
- Peracute: affected goats may die within 1–3 days with minimal clinical signs.
- Acute: initial signs are high fever (41–43°C), lethargy and anorexia, followed within 2–3 days by coughing and laboured 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: there is chronic cough, nasal discharge and debilitation.
- Peracute, acute and chronic disease, resembling the clinical signs in goats, were reported in captive wild goats, Nubian ibex, Laristan mouflon and gerenuk.

Lesions

- Lesions of CCPP are limited to the respiratory system.
- Acute disease is characterised by unilateral pneumonia and serofibrinous pleuritis with straw-coloured fluid in the thorax. On cut surface, the lung is granular with copious straw-coloured

exudates. 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 pleuropneumoniae or chronic pleuritis, with encapsulation of acute lesions and numerous adhesions to the chest wall. The interlobular septa are not thickened in domesticated goats.

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

Differential diagnosis

The diagnosis of outbreaks of respiratory disease in goats, and of CCPP in particular, is complicated, especially where it is endemic. *Mccp* is readily contagious and fatal to susceptible goats of all ages and both sexes, rarely affects sheep, and does not affect cattle.

- Peste des petits ruminants, to which sheep are also susceptible;
- Pasteurellosis, which can be differentiated on the basis of distribution of gross lung lesions;
- Contagious agalactia syndrome, also known as Mastitis, arthritis, keratitis, pneumonia and septicaemia syndrome (MAKEPS). As the latter name implies, the pneumonia is accompanied by prominent lesions in other organs, and is caused by other mycoplasmal organisms.

Laboratory diagnosis

- *M. capripneumoniae* and other members of the *M. mycoides* cluster cross-react in serological tests and share biochemical and genetic similarities. Classical tests such as biochemical tests and growth inhibition tests are time consuming and not specific.
- 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
- Biochemical, immunological and molecular tests can be used for identification of the culture
- Polymerase chain reaction (PCR) is the preferred assay to identify *M. capripneumonia* cultures, and to directly identify the organism in tissue samples. There are two specific PCR assays as well as a recently developed quantitative PCR assay. (2, 3, 11)
- Immunohistochemistry can identify *M. capripneumoniae* antigens in tissue samples, but it is not routinely used in diagnostic laboratories

Samples

- 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, exudates 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 ice packs. 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.
- Paired serum samples should be collected 3–8 weeks apart.

Procedures

Identification of the agent

Definitive diagnosis requires culture of the causative organism from lung tissue samples and/or pleural fluid taken at post-mortem. After cloning and purification, isolates can be identified by several biochemical, immunological and molecular tests. Isolating the causative agent is a difficult task. Recently polymerase chain reaction based tests have been described and shown to be specific and sensitive, and can be applied directly to clinical material, such as lung and pleural fluid.

- Microscopy of lung exudates, impression smears or sections: a branching filamentous organism may be observed by dark-field microscopy or by light microscopy when stained by May–Grünwald–Giesma method.

- Polymerase chain reaction (PCR) assays for the specific identification of *Mccp* nucleic acids are available. Due to the difficulty in isolating *Mccp*, PCR is the technique of choice for the diagnosis of CCPP. However, isolation of *Mccp* remains the confirmatory test.
- Gel precipitin tests to detect antigen released by *Mccp* in tissue specimens
- Isolation of mycoplasmas: necropsy samples of choice are lung lesions, particularly from the interface between consolidated and unconsolidated areas, pleural fluid, and mediastinal lymph nodes. If microbiological examination cannot be performed immediately, samples or whole lungs can be stored at –20°C for considerable periods (months) with little apparent loss of mycoplasma viability. During transport, samples should always be kept as cool as possible, as mycoplasma viability diminishes rapidly with increasing temperature. Lung samples can be dispatched to other laboratories in frozen form. Send swabs in 2–3 ml of Mycoplasma media and 1 g of tissue sample minced in 9 ml of medium.
- Identification of *Mccp* strains by PCR (and sequencing) has now superseded all other techniques because of its rapidity and reliability. Sequencing is used to type the strain at a finer level.

Serological tests

Complement fixation test (the prescribed test in the OIE *Terrestrial Manual*)

Serology has not been widely applied to identify the cause of outbreaks of pleuropneumoniae in goats and Sheep, due to occurrence of false positive results and that acute cases caused by *Mccp* rarely show positive titres before death. Such tests are best used on a herd basis rather than for diagnosis in individual animals.

- Complement fixation test (CFT) remains the most widely used serological test for CCPP.
- Latex agglutination test is being increasingly used in diagnostic laboratories and as a pen side test. It can used to test whole blood as well as serum.
- Indirect hemagglutination (IHA) is also used.
- Competitive ELISA has been developed, but is not widely available. As with the other serological tests, it does not detect all reactors, but its specificity and suitability for large-scale testing make it an appropriate test for epidemiological investigations. It should be available commercially in the near future. (10)
- Seroconversion to the IHA and CFT in experimentally infected animals begins at 7–9 days after the appearance of clinical signs, peaks between days 22 and 30, and declines rapidly thereafter. Serology should be applied on a herd basis, and paired serum samples collected 3–8 weeks apart whenever possible.

For more detailed information regarding laboratory diagnostic methodologies, please refer to Chapter 2.7.6 Contagious caprine 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

Sanitary prophylaxis

- Contagious caprine pleuropneumoniae 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 tetracycline 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.

Medical prophylaxis

- The current CCPP vaccine contains inactivated *Mccp* suspended in saponin, has a shelf life of at least 14 months, and provides protection for over 1 year (8). It is available commercially.

For more detailed information regarding vaccines, please refer to Chapter 2.7.6 Contagious caprine pleuropneumonia in the latest edition of the *OIE Manual of Diagnostic Tests and Vaccines for Terrestrial Animal*s 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 OIE *Terrestrial Animal Health Code*.

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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.