

# Diagnosis and treatment of sheep and goat dyspnea - Small ruminant respiratory diseases

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## Abstract

Causes of rapid or labored respiration in small ruminants include normal panting and treatable pathologic conditions such as bronchopneumonia, lungworms, anemia, and hypocalcemia. Several other causes of dyspnea such as caseous lymphadenitis, retroviral interstitial pneumonia, and neoplasia must be differentiated, as they carry a grave prognosis. This article will emphasize diagnosis and control of respiratory diseases, especially at the herd level.

**Key words:** dyspnea, respiratory disease, pneumonia, sheep, goat

## Résumé

Les causes de respiration rapide ou difficile chez les petits ruminants incluent le halètement normal mais aussi des conditions pathologiques traitables comme la bronchopneumonie, les vers pulmonaires, l'anémie et l'hypocalcémie. Il faut pouvoir distinguer plusieurs autres causes de dyspnée comme la lymphadénite caséuse, la pneumonie interstitielle rétrovirale et la néoplasie car elles sont associées avec un pronostic grave. Cette présentation mettra l'accent sur le diagnostic et le contrôle des maladies respiratoires surtout au niveau du troupeau.

## Introduction

Causes of dyspnea in small ruminants may involve the upper respiratory tract or the lungs or may reflect a systemic toxemia or toxicosis, metabolic derangement, or anemia.<sup>4,7</sup> Many problems will not respond to antibiotics and the animal presented for examination may not be the only one affected in the herd. Even with a careful physical examination that includes imaging, it may not be possible to establish the etiology without laboratory testing, sometimes including necropsy.

## Examination of the respiratory tract

The presence of a respiratory disease may be suggested by either the case history or a basic physical exam. The signs that might be noted include "increased respiratory rate, labored breathing, rapid tiring (especially with exercise), cyanosis, abnormal sounds associated with breathing, nasal discharge, coughing, or fever"; many differentials for dyspnea,

cough, and nasal discharge have been listed by Smith and Sherman.<sup>7</sup> Information should be solicited concerning introduction of new animals, attendance at shows, access to the outdoors (relative to the risk of nose bots and lungworms), barn ventilation (including evaluating air quality at animal level), and diet relative to adequacy of energy, protein, trace minerals, and vitamin E. Herd status, if known, relative to retroviral diseases and caseous lymphadenitis will inform testing for these conditions.

The normal adult respiratory rate at rest is approximately 10 to 30 breaths per minute, with lambs and kids being somewhat faster. Panting is the norm for sheep in full fleece in warm or humid conditions, and may also be observed in overheated goats. Panting is rapid and even, whereas dyspneic animals may show more forceful inspiratory or expiratory efforts. The respiratory rate will often increase with fever, endotoxemia, metabolic acidosis, hypocalcemia, or pain. Stertor emanating from the upper respiratory tract suggests the possibility of rhinitis, enzootic nasal tumor, laryngeal or tracheal obstruction, or compression of the upper airway, as by an enlarged retropharyngeal lymph node. An extended head and neck can accompany upper respiratory tract obstruction or severe pulmonary disease, pleuritis, or space-occupying lesion in the chest. However, in late-pregnant or peak-lactation animals, hypocalcemia may mimic pulmonary disease. If the mucous membranes are very pale or cyanotic, the animal must be handled very carefully to avoid killing it before it can be diagnosed and treated. Haemonchosis is a major cause of severe anemia in small ruminants and can be diagnosed by a quantitative fecal examination. Standard textbooks should be consulted for treatment and control of this condition.

Coughing may indicate irritation from ammonia or dust in the environment or result from tracheal compression by pulling on a collar or trying to push across a barrier to reach feed. Upper respiratory mycoplasmal infections can cause a chronic cough in an otherwise healthy animal, and an enlarged retropharyngeal lymph node not only induces coughing, but also markedly reduces feed consumption and thus body condition. If a deep-seated bronchopneumonia is present, the cough may be moist and feeble.

Auscultation of the lungs has serious limitations in small ruminants. Thin but healthy animals may sound harsh, whereas pleuritis, lung tumors or abscesses do not always cause abnormal lung sounds.<sup>5</sup> The right cranioventral lung field, under the elbow, should be ausculted closely, as bron-

chopneumonias often begin here. Obesity, empyema, or space-occupying lesions may result in an absence of normal breath sounds.

Ultrasonography, preferably with a sector scanner to more readily penetrate the narrow intercostal spaces,<sup>6</sup> will permit identification of pleuritis, lung consolidation, and abscesses or masses that extend to the pleural surface. Start by scanning intercostal spaces 5 to 7 on the right side, with the front limb pulled forward to get off the chest while the animal is standing. The beating heart makes an excellent landmark. The dorsal lung fields are scanned beginning with intercostal spaces 9 and 10. Saturating the field with alcohol to obtain good probe contact can be done in place of clipping and liberal application of ultrasound gel. Bright linear reverberation artifacts are seen during examination of the lungs of a normal animal.

Radiography can be used to document the presence of cranioventral bronchopneumonia, interstitial pneumonia, pleural effusion, penetrating metallic foreign body, thymoma, tracheal compression or collapse, enlarged mediastinal lymph nodes, or underlying cardiac disease. Multiple radiodense foci in the lungs, be they abscesses, tumors, or areas of interstitial pneumonia, suggest a grave prognosis. A large thymoma may displace the lungs caudally. Because many thymomas in goats are incidental findings at necropsy, an asymptomatic tumor might be identified during radiography of a goat with some other thoracic disease. The physical restraint or tranquilization needed to obtain good radiographs makes this modality more dangerous for the dyspneic patient than ultrasonography.

### Nose bots

In regions where ivermectin use has not yet curtailed parasite numbers, larvae of the nasal botfly *Oestrus ovis* are deposited into the nose of grazing small ruminants. Clinical signs consist of nasal exudate (with eosinophils) and sneezing. Upper respiratory mycoplasmal infections could appear similar. Ivermectin kills all larval instars and mature larvae; 91 mcg/lb (200 mcg/kg) is approved as a drench for sheep and 136 to 181 mcg/lb (300 to 400 mcg/kg) is commonly given orally to goats. Avoid this drug if milk is being used for human consumption, as prolonged withdrawals will be required. Milk withdrawals of 9 days after oral and 40 days after subcutaneous ivermectin administration have been proposed.<sup>1</sup>

### Enzootic intranasal tumor, Enzootic nasal adenocarcinoma

Retroviruses infecting mucosal nasal glands in sheep and in goats can cause tumors that obstruct the nasal passages. Stertorous breathing is noted, and there will be a difference in airflow through the 2 nostrils when the tumor is unilateral. Sometimes exophthalmos or deformation of the

skull is noted. Weight loss develops as obstruction to airflow interferes with feeding. The diagnosis can be made by dorsoventral radiographs; endoscopy is rarely conclusive unless a biopsy is obtained. Surgery is not usually recommended as the virally-induced tumor is expected to return. Euthanasia is indicated to protect the remainder of the flock; virus is passed in nasal secretions and herd outbreaks have been reported. Young animals appear to be most susceptible and a hereditary predisposition is suspected. Serologic tests are not commercially available, but histology and immunohistochemistry can confirm the diagnosis.

### "*Pasteurella*" pneumonia, Enzootic pneumonia

*Mannheimia haemolytica*, previously known as *Pasteurella haemolytica* biovar A, causes septicemia in young lambs and a cranioventral pneumonia in sheep and goats of all ages. The organism produces a leukotoxin that impairs and lyses macrophages and neutrophils that arrive in the lung to fight the infection. Products released by the dying cells compound the injury. *Pasteurella multocida* does not produce the leukotoxin and is not hemolytic on blood agar, but this organism is also associated with pneumonia in both species. Mycoplasmas may also be involved in enzootic pneumonia, and parainfluenza-3 virus and respiratory syncytial viruses may initiate some infections.

Affected lambs or kids are often found dead. If noticed ill, there may be froth at the mouth, dyspnea, and fever. Ultrasonography or radiology (and necropsy) will demonstrate cranioventral consolidation, often more severe on the right side. In addition to death losses, enzootic pneumonia is economically important because of chronic poor-doers. Treatment will require antibiotics. Producers frequently try over-the-counter penicillin or oxytetracycline. Ceftiofur sodium<sup>1</sup> is labeled for pneumonia in sheep and goats in the United States, with no meat or milk withdrawal. Tilmicosin<sup>2</sup> is labeled and safe in sheep, but is not safe in goats. Extralabel tulathromycin<sup>3</sup> at the cattle dose is long-acting and good for pneumonia in both sheep and goats and can be justified under the Animal Medicinal Drug Use Clarification Act if a mycoplasma component is potentially present.

Management is the best way to prevent this form of pneumonia. Good air quality is maintained with proper barn construction and ventilation, and by avoiding overcrowding. Adequate colostrum as an antibody source is invaluable, but cattle vaccines (all that are available in the United States) are not effective; different strains of *Mannheimia* and *Pasteurella* are involved. Vitamin E and selenium are important for avoiding white muscle disease that could lead to aspiration and for improving the immune response. Separation of age groups is important, and animals of different ages should not be mixed after weaning. Extra-label metaphylactic treatment with long-acting oxytetracycline or tulathromycin could be tried in the face of an outbreak. Tilmicosin might also be used in nondairy sheep but not in goats.

## Mycoplasma upper respiratory infections and pneumonia

*Mycoplasma conjunctivae* can cause upper respiratory infections and nasal discharge in addition to pinkeye, but other mycoplasma species induce pneumonia. *Mycoplasma mycoides* subsp *mycoides* Large Colony type (some say synonymous with *M. mycoides* subsp *capri*) has caused serious problems in goats in California. *Mycoplasma ovipneumoniae* is usually less severe, but commonly implicated in sheep and goats in the United States with a chronic cough and isolated from pneumonic lungs. Contagious caprine pleuropneumonia, caused by *Mycoplasma capricolum* subsp *capripneumoniae*, is an exotic disease. Special culture media will be required to isolate mycoplasmas.

Treatment is with tetracyclines or macrolides, including newer macrolides such as tulathromycin (at the cattle dosage). Treated animals may remain carriers. Pasteurization of colostrum and milk has been very helpful in preventing mycoplasma pneumonia in kids.

### Inhalation pneumonia

Improper drenching can result in the deposition of medications into the lungs. White muscle disease, due to a deficiency of vitamin E or selenium, can also lead to an aspiration pneumonia as the result of impaired function of the muscles of deglutition. Lambs and kids with this problem may cough after drinking or have milk appear at the nose. They should be examined to rule out a cleft palate. Note that an overdose of selenium can cause dyspnea because of heart failure, and ribs fractured during the birth process can also lead to difficult breathing in the neonate.

Consumption of plants of the heath family such as *Rhododendron*, *Kalmia*, and *Pieris* leads to vomiting/regurgitation and aspiration of rumen contents. Clinical and postmortem findings will resemble those of *Mannheimia* pneumonia but may look "hotter". The right apical (cranioventral) lobe is first involved in either situation, because of a separate bronchus to that lobe.

### Caseous lymphadenitis, CLA

Most animals with *Corynebacterium pseudotuberculosis* have abscesses in external lymph nodes but are otherwise healthy. A cough, stertor, and decreased feed consumption can result from involvement of the retropharyngeal lymph node, putting pressure on the trachea. Wasting, dyspnea, and cough are typical of pulmonary abscesses if the organism is inhaled or reaches the systemic circulation through the thoracic lymph duct. Ultrasonography or radiology will demonstrate consolidated lesions in the lungs, indistinguishable from retroviral pneumonia or neoplasia. The etiologic diagnosis is made by culture of a transtracheal wash. In regions where tuberculosis occurs, *Mycobacterium bovis* or *M. avium* can be differentiated by acid-fast stain or culture.

Animals with only external abscesses can be treated by draining or removing affected lymph nodes, but if the retropharyngeal node is involved marsupialization will be required. When CLA abscesses are identified in the lungs, slaughter or euthanasia will usually be the correct course of action. A pet animal might be treated with long-term tulathromycin, combined with penicillin. Prevention begins with biosecurity, so that infected animals are not introduced to the herd. The flock of origin may be screened by palpation for external abscesses combined with serologic screening using the synergistic hemolysin inhibition test from University of California-Davis. This test is not adequately sensitive or specific for ongoing infection to use on an individual animal basis but a completely negative herd test suggests that the disease is not present. Two vaccines are currently available in the United States, one labeled for sheep<sup>4</sup> and the other for goats,<sup>5</sup> but will preclude the future use of serology. Vaccination typically is begun at about 3 months of age. Other control measures include culling sheep and goats with wasting and shearing the youngest animals first, with dispersal immediately after shearing.

### Retroviral pneumonia - Ovine progressive pneumonia (OPP) and caprine arthritis-encephalitis pneumonia (CAE)

These two closely related but distinct retroviruses that cross react serologically (and can potentially cross infect) can cause an interstitial pneumonia in sheep and goats. Ovine progressive pneumonia is known as maedi visna in Europe and Canada. The most important means of transmission of CAE in goats is through colostrum and milk; heat treatment (1 hour at 56 °C) and pasteurization will destroy the virus, such that kids can be artificially reared free of the virus. Horizontal transmission through secretions that contain live macrophages and monocytes can also occur but is slower. The OPP virus is less commonly transmitted by udder secretions and dam reared lambs may still be virus free at weaning. Transmission via respiratory secretions is very effective in sheep. Once infected, the animal remains infected for life but often does not develop the potential clinical signs which include encephalomyelitis, arthritis, interstitial mastitis, and interstitial pneumonia. Bacterial or parasitic infections may up-regulate the virus. Incurable respiratory signs of dyspnea and weight loss may develop in adult (> 1 year) sheep or, less commonly, goats. Serology documents herd infection but does not prove an individual clinical diagnosis. In general, ELISAs are more sensitive for infection than AGID tests. Radiology will reveal an interstitial pattern, especially in diaphragmatic lobes. Culling of thin dyspneic animals with necropsy confirmation of the diagnosis is appropriate. Control programs include test and cull, artificial rearing on pasteurized colostrum and milk, and two herd approaches. Recently genetic mutations have been identified that modify the susceptibility of sheep to OPP,<sup>3</sup> and genetic testing is available commercially.

## Jaagsiekte (“Driving sickness”), Sheep pulmonary adenomatosis

A retrovirus (distinct from enzootic intranasal tumor viruses and OPP/CAE viruses) causes multifocal tumors to develop in the lungs of small ruminants, especially at 2 to 4 years of age. Weight loss and dyspnea occur, and the classic disease description is of fluid running out the nose if the animal is wheelbarrowed, although this may not be pathognomonic. Metastasis to lymph nodes in the thoracic and abdominal cavities is possible. The disease is rare in the USA, but killed Dolly, the first cloned sheep in the United Kingdom. No serologic test is available. A polymerase chain reaction test is available in the United Kingdom for proviral DNA in leukocytes. Control measures include biosecurity, screening with thoracic ultrasonography, and prompt culling of thin animals.

### Respiratory syncytial virus

Goats attending fairs frequently develop a high fever, cough, and a drop in milk production that can be traced to a respiratory syncytial virus by paired serology for the bovine virus. It is not known if a distinct caprine strain is involved. Virus activity is widespread in the United States some years, and lack of appropriate post-show quarantine procedures facilitates spread. Ceftiofur sodium, which is labeled for sheep and goats with no meat or milk withdrawal, would be an appropriate treatment for secondary bacterial pneumonia. A monovalent bovine respiratory syncytial virus vaccine might be used in show animals.

### Lungworms

*Dictyocaulus filaria* with a direct life cycle and *Protostrongylus rufescens* with intermediate snail or slug hosts live in the trachea and bronchi. *Muellerius capillaris* has an indirect life cycle and lives in the alveoli. *Muellerius* is common in pastured sheep and goats in the Northeast. The lungworms can cause a cough and sometimes a secondary bacterial bronchopneumonia. Chronic weight loss has been reported in goats, which don’t develop age immunity to *Muellerius*. Diagnosis is by demonstration of larvae in the feces on a fecal flotation or by a Baerman exam. *Muellerius* larvae have a dorsal spine. At necropsy, white (*Dictyocaulus*) or red (*Protostrongylus*) worms may be found in bronchi. *Muellerius* lesions are dorsal and relatively round and often greenish, and the worms are microscopic. Treatment is with anthelmintics such as levamisole (*Dictyocaulus* only (3.6 mg/lb or 8 mg/kg sheep, 5.4 mg/lb or 12 mg/kg goats), ivermectin (91 mcg/lb or 200 mcg/kg sheep, 136 mcg/lb or 300 mcg/

kg goats), fenbendazole (6.8 mg/lb or 15 mg/kg several days in a row for goats) or albendazole (3.4 mg/lb or 7.5 mg/kg for sheep for *Dictyocaulus*). *Muellerius* are probably not all killed by available treatments.

### Thymoma

This tumor is a sporadic but not rare space occupying lesion in the thorax of older sheep and goats, especially Saanen goats.<sup>2</sup> The tumor can cause dyspnea, and will be diagnosed if radiology or ultrasound is performed. Theoretically, in a valuable animal, the mass could be removed by thoracotomy. Often it is an incidental finding at necropsy. Lymphosarcoma is a differential for a mass in the chest.

### Conclusions

This brief overview of causes of dyspnea in small ruminants is meant to encourage the practitioner to take a thorough history and do a full physical examination instead of reaching automatically for an antibiotic. If an infectious or parasitic disease is identified, standard resources should be consulted to develop a herd control program.

### Endnotes

<sup>a</sup>Naxcel®. Zoetis, Parsippany, NJ

<sup>b</sup>Micotil®. Elanco, Greenfield, IN

<sup>c</sup>Draxxin®, Zoetis, Parsippany, NJ

<sup>d</sup>Case-Bac®. Colorado Serum Co., Denver, CO

<sup>e</sup>*Corynebacterium pseudotuberculosis* bacterin. Texas Vet Lab, Inc., San Angelo, TX

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