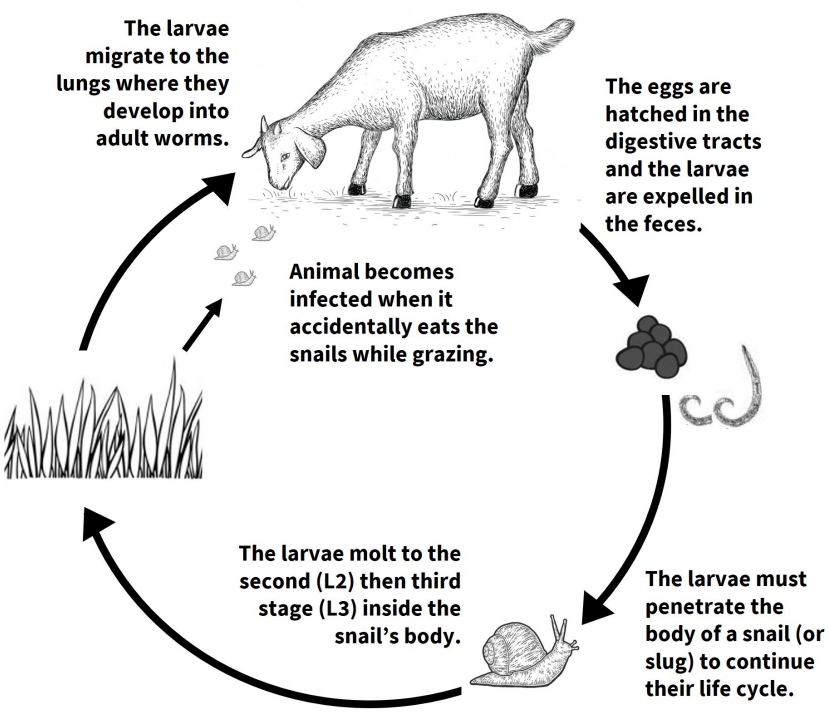
Lungworms

Lungworms are a lesser-known class of internal parasite that reside in the lungs and windpipes of their hosts. There are two types of lungworms that can infect small ruminants: large and small.

Large lungworms (*Dictycaulus filaria*) are the most pathogenic, but least common. Small lungworms (*Muellerius capillaris* and *Protostrongylus rufescens*) are more common, but less pathogenic (disease-causing).

While lungworms occur in most areas of the world, they are not considered to be a widespread problem in the US. However, there can be isolated areas or specific farms that experience problems.

Lungworms are found primarily in areas with high rainfall or intense (surface) irrigation. They prefer cool, moist conditions and are usually a greater risk in more northern climates. Climate change could affect the parasites' geographic range. Moreover, in areas where lungworms are not common, brought-in animals could introduce them.



Indirect life cycle of small lungworms

LIFE CYCLE OF LUNGWORMS

Dictyocaulus filaria is the large lungworm that can infect small ruminants. It is different from the one that infects cattle (*Dictyocaulus viviparus). D. filaria* has a direct life cycle, with a prepatent period (time between ingestion of larvae and appearance of larvae in feces) of about 4 weeks.

Adult worms of *D. filaria* reside in the large bronchi (airways) of their host. The eggs are coughed up and swallowed and the first-stage larvae are expelled in the feces. On the pasture, they molt to the third-stage larvae, and small ruminants get infected when they ingest third-stage larvae during grazing. Once ingested, the larvae travel from the intestinal tract to the heart and then migrate into the lungs.

Muellerius capillaris is a small lungworm and the most common lungworm to infect sheep/goats. It goes by several different names, including the "goat" or "hair" lungworm because it affects mostly goats and is a fine, thin worm. It is also called the "nodule" lungworm due to the lesions it causes in the lung tissue (of sheep).

Unlike large lungworms, *M. capillaris* has an indirect life cycle. This means it requires an intermediate host to complete its life cycle. After the larvae are expelled in the feces, they are ingested by a snail or slug. Small ruminants become infected when they consume the intermediate host during grazing. Once in-

gested, the larvae travel through the tissues from the intestinal tract to the lungs.

Protostrongylus rufescens is another small lungworm that can infect sheep/goats. Like *M. capillaris*, it requires an intermediate host (snail or slug) to complete its life cycle. Adult worms live in the smaller bronchioles. *P. reufescens* is more pathogenic than *M. capillaris*, but less than *D. filaria*. The prepatent period for small lungworms is 5 to 10 weeks.

IMPACT IN THE ANIMAL

Lungworms can cause parasitic (verminous) pneumonia or bronchitis in small ruminants. Coughing and difficult or labored breathing are the most common symptoms. The most severe infections tend to occur in young animals. The impact of lungworms on an individual animal depends upon its immune system and the number of infecting worms.

In many cases, there is no outward sign of illness. However, lungworm infection may be associated with reduced milk production, lower growth rates, and weight loss. Secondary infection by bacteria could cause death.

Only in severe infections do lungworms usually cause clinical disease in small ruminants. Once infected, mature animals generally become immune to further disease; however, some maintain a sub-clinical infection and could be a source of further pasture contamination.

Only in severe infections do lungworms cause clinical disease in small ruminants.

Lungworm prevalence in US goats

As part of the NAHMS Goat 2019 Study, fecal samples were collected to determine the presence of different internal parasites in the US goat population. A total of 5176 samples from 318 goat operations in 25 states were cultured. Lungworm larvae were detected on 36.2% of goat farms and in 36.4% of goats. Prevalence varied mostly by geographic area and herd size, with the Northeast and Northwest having the highest levels of infection; 47 to 48% of farms and 48 to 51% of goats, respectively. Large farms and farms located in the Southwest had the lowest levels of lungworm infection. Only small lungworm (*Muellerius*/*Protostrongylus*) larvae were detected in the fecal samples, and the two were not differentiated.

IDENTIFICATION & DIAGNOSIS

Lungworm infection (called verminous pneumonia) can be difficult to diagnose. While diagnosis can be suggested by clinical signs, other conditions can affect the respiratory tract of small ruminants and need to be ruled out. Laboratory tests are usually necessary to accurately diagnose lungworm infection in small ruminants.

Unlike most other parasites, the diagnostic stage of infection is first-stage larvae rather than the egg. Lungworm larvae cannot usually be detected with regular fecal flotation methods. A special test is needed to diagnose a lungworm infection: the Baermann technique. With the Baermann technique the feces are suspended in water, and the larvae move into water for collection. The FLOTAC technique is another improved method of detecting lungworm larvae in feces. It uses a dual-chambered centrifugation system.

Large lungworms have larger larvae than small lungworms. *D. filaria* also have a knob on their

Muellerius capillaries

The diagnostic stage of infection is first-stage larvae rather than an egg.

head. Small lungworm larvae are differentiated by features at the tip of their tail. *Protostrongyles* spp. have a wavy tail. *M. capillaries* have a kinked tail.

A conclusive (lungworm) diagnosis is usually achieved if larvae are present in the feces and/or if the worms are discovered during a necropsy of a deceased animal. Small greyish nodules on the back of the lungs are a pathological finding for *M. capillaries*.

PREVENTION

For large lungworms, important sources of infection (especially for young animals) are the increased number of larvae in the feces of infected adults (or yearlings) in the spring or infective third-stage larvae that survive over the winter on pasture. Similar to control for other internal parasites, pasture rest and rotation will help to minimize pasture contamination. Fortunately, the survival time on pasture is less for lungworms than other worms.

For the small lungworms, the intermediate hosts are the primary source of infection. Since lungworm larvae prefer cool, moist conditions, keeping small ruminants off wet, poorly drained pastures will help to reduce infections. Elimination of the intermediate host is another option.

Snails and slugs are most active in the mornings when the grass is wet. Delayed grazing may help. Geese and ducks will eat slugs. It is not known if guinea fowl would be effective at helping to control snail/slug populations. Unfortunately, infective larvae may persist in their intermediate hosts for their lifetime.

As with other parasites, the best “treatment” is prevention. Controlling infections with other parasites will help to prevent lungworm symptoms. Keeping animals well-nourished and in good body condition will help to prevent disease outbreaks. Good hygiene is another preventative measure. If feed is supplemented, it should be fed up off the ground in a feeder or rack. Water troughs should be kept clean and free from fecal matter. Highly contaminated areas (“hot spots”) of the pasture should not be grazed.

TREATMENT

In the past, most lungworm infections were kept in check by regular deworming for gastro-intestinal worms, since most broad-spectrum dewormers are effective against lungworms. With the transition to more selective deworming practices, it is possible that lungworms could become more problematic in some flocks/herds.

It is not necessary to treat every animal that coughs or has a snotty nose. If fact, experts advise against it. If you think you have lungworm problem in your animal(s), it is recommended you consult with a veterinarian. A veterinarian will likely do laboratory tests to confirm their diagnosis and make a treatment (or non-treatment) recommendation.

Dewormers in all three chemical classes (Benzimidazoles, Macrocyclic lactones, and levamisole) are effective against large lungworms. However, research suggests that some dewormers may not be effective against the immature stages of the worms, so repeat treatments are usually recommended. Macrocyclic lactones (ivermectin, moxidectin) are often preferred dewormers because they have persistent activity against worms.

Most of the same broad spectrum dewormers are also effective against the small lungworms although efficacy data is more limited. In addition, higher dosages of the drugs may be necessary than are typically used to control strongyle-type worms. In the US, none of the approved dewormers are labeled for

lungworm control in small ruminants; thus, extra label drug use is required.

Secondary bacterial infections caused by lungworms are usually treated with antibiotics and anti-inflammatory drugs. These drugs also require extra label drug use. Only veterinarians have the legal right to use or prescribe drugs extra-label. A valid veterinarian-client-patient relationship is required.

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What about llamas and alpacas?

Llamas and alpacas (sometimes called camelids) can be infected with any of the parasites that infect ruminants. This includes *Dictyocaulus viviparus,* which infects cattle, and *Dictyocaulus filaria* which infects sheep/goats. However, these parasites tend to cause less severe disease in llamas and alpacas than in other ruminant hosts. The small lungworms (*Muellerius capillaris* and *Protostrongyles* spp.) can also potentially infect camelids. Lungworm infections in camelids are more common in South America than in North America and some other parts of the world, but should be considered a possibility, especially if they are living with or sharing pasture with other ruminants. Clinical signs and treatment are similar to other ruminants.

WRITTEN AND EDITED BY

Susan Schoenian, MS, Emeritus
University of Maryland Extension

REVIEWERS:

Steve Hart, PhD (retired)
Langston University
Langston, Oklahoma

James Miller, DVM, PhD, Emeritus
Louisiana State University
Baton Rouge, Louisiana

Seyedmehdi Mobini, DVM, MS, Dipl. ACT
Fort Valley State University
Fort Valley, Georgia

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