**A REVIEW ON: LUNGWORM INFECTION IN SMALL RUMINANTS****Dr. Tewodros Alemneh Engdaw***

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ABSTRACT

Lungworms are parasitic nematode round worms of the order Strongylida that infest the lungs of vertebrates. The most common lungworms belong to one of the two superfamilies, Trichostrongyloidea or Metastrongyloidea. Of which, *Dictyocaulus* and *Protostrongylus* are causes of lungworm infection in ruminants. The common causes of *verminous pneumonia* in sheep and goats are *Dictyocaulus filaria*, *Protostrongylus rufescens* and *Muellerius*

capillaris. *Dictyocaulus filaria* belongs to the super family Trichostrongyloidea while the latter two belong to Metastrongyloidea, which have direct and indirect life cycles, respectively. Of the two species, goats are more susceptible to lungworm infection. Depending on the severity of infection, age and immunological status of the animal, the clinical sign ranges from moderate coughing with slightly increased respiratory rates to severe persistent coughing, persistent respiratory distress and failure. Diagnosis of the disease is by examination of the faeces with Baermanization to detect the L₁ larvae in the laboratory, and postmortem examination of the lungs of infected animals for adult worms' isolation. Treatment of lungworm necessitates the use of appropriate Anthelmintics which are effective against lungworm infections. The effective Anthelmintics including Benzimidazoles, Levamisols and Ivermectin should be used in the treatment of the disease. The prevention and control of lung worm infection can be achieved most effectively by integration of three interrelated approaches: administration of effective Anthelmintic drugs, immunization and improved management practices.

KEYWORDS: *Dictyocaulus*, *Protostrongylus*, Lungworm infections, Small ruminants.

INTRODUCTION

Livestock production in Ethiopia contributes about 30-33% of agricultural gross domestic product (GDP) and more than 85% of the farm cash income mainly through meat, milk, eggs, wool, hides and skins.^[1, 2] Sheep and goats are the most numerous of man's domestic livestock. Of the world 1.614 million sheep and 475 million goats, 65% and 95% respectively; are located in developing countries.^[3, 4] As reported by International Livestock Research Institute^[5]; Ethiopia contributes 17 million small ruminants.

Small ruminants are especially important in the more extreme climates of the world. In Africa, they are noted for their ability to convert low opportunity cost feed in to high value products including meat, milk, fiber, manure and hides.^[3, 4]

Small ruminants provide 33% of meat and 14% of milk consumption in Ethiopia.^[6] In the central high lands where mixed crop-livestock production system is practiced, small ruminants account for 40% of cash income and 19% of the house hold meat consumption.^[7] Yet these species have received much less attention from research and development agencies.^[8] And the economic benefits to the farmers remain marginal due to prevailing disease, poor nutrition, poor animal production systems and general lack of veterinary care.^[9]

Helminthes parasites of ruminants are ubiquitous and prevalent with many tropical and sub-tropical environments of the world providing nearly perfect conditions for their survival and development. However, the clinical signs they cause in infected animals can be less obvious than signs of other livestock diseases. Partly for this reason, infections with gastro-intestinal and other helminthes parasites are among the most neglected areas of veterinary care in much of the developing world. It has however been established that high prevalence rates of the infection with less obvious sign associate with poor production and unthriftiness.^[10]

Up to half of all sheep deaths and morbidity on farms in Ethiopian highlands are caused by pneumonia and endoparasites.^[8] Endoparasites, including *Dictyocaulus filaria*, are major causes of death and morbidity.^[8] Prevention and control of these parasites is, therefore, critical to enhance the economic benefit from these species of livestock. However, the incidence of parasitic diseases including respiratory helminthosis varies greatly from place to place depending on the relative importance of the factors.^[11] Very few and limited studies were done so far pertaining to respiratory helminthes of small ruminants. Therefore, the objectives of this paper include the following: to review and compile available literature

information on the characteristics of the parasite, about its occurrence in animals, its method of transmission, diagnosis and control of the disease, which will increase our understanding about the disease.

LITERATURES REVIEW

Lungworm Infection of Small ruminants

(Verminous Bronchitis, Verminous Pneumonia)

Verminous pneumonia is a chronic and prolonged infection of sheep and goats caused by any of several parasitic nematodes, characterized clinically by respiratory distress and pathologically by bronchitis and bronchopneumonia.^[12,13] It is infection of the lower respiratory tract, resulting in bronchitis or pneumonia, or both.^[14]

Etiology

Lungworms of domestic ruminants are nematodes that belongs to the phylum Nematelminthes commonly named as round worms; classified under the super family Trichostrongyloidea and Metastrongyloidea.^[15] Of which, *Dictyocaulus* and *Protostrongylus* are causes of lungworm infection in ruminants.^[16] The common causes of verminous pneumonia in sheep and goats are *Dictyocaulus filaria*, *Protostrongylus rufescens* and *Muellerius capillaris*. *Dictyocaulus filaria* belongs to the super family Trichostrongyloidea while the latter two belong to Metastrongyloidea, which have direct and indirect life cycles respectively.^[13, 17] Although mixed infection may occur, *D. filaria* predominates in most outbreaks.^[12]

Epidemiology

Epidemiology depends more on pasture contamination by carrier animals. Pasture infectivity is related to rainfall which stimulates the activity of both the larvae and the mollusk.^[18] Moisture is essential for the survival and development of the larvae. The larvae is active at moderate temperature of 10-21°C. Larvae survive best in cool, damp surroundings especially when the environment is stabilized by the presence of long herbage or free water. Under optimum conditions the larvae can persist for over one year.^[19]

Lungworm parasites are host specific and common in areas of mild high rain fall and abundant grass.^[14, 20] The prevalence of infection is low in spring and summer and rises rapidly in the autumn and winter. When most clinical cases are seen, wet summers give rise

to heavier burden in the following autumn and winter.^[20] Over stocking, deficient feeding, previous or concurrent infections predispose to infection.^[18]

Sheep of all age are susceptible, but lambs of 4-6 months of age are severely affected with lungworms.^[21] Generally, only young ruminants in their first grazing season are clinically affected, since on farms where the disease is endemic older animals have a strong acquired immunity. Goats appear to be more susceptible to helminthes than sheep as they appear to develop less immunity. Sheep predominantly graze; pick up more parasites so have higher acquired resistance than goats which mostly consume browse. Goats with their browsing behavior consume uncontaminated matter with parasite larvae, so being less exposed to infective larvae, and may therefore have lower acquired resistance than sheep.^[4]

Life Cycle

Lungworms of domestic ruminants have two forms of life cycle. One form is direct life cycle (Dictyocaulidae) in which the free living larvae undergo two moults after hatching and infection are by ingestion of the free L₃. The other form is indirect life cycle (Protostrongylidae) whereby the first two moults usually take place in an intermediate host (snails or slugs) and infection of the final host is by ingestion of intermediate host.^[15]

Pathogenesis

The pathogenic effect of lungworms depend on their location within the respiratory tract, the number of infective larvae ingested, the animal immune state, and on the nutritional status and age of the host.^[13 22]

The relative pathogenicity of each lungworm depends on its predilection site. *D. filaria* lives in the trachea and bronchi so aspirated eggs, larvae and debris affect a large volume of lung tissue. It is therefore the most pathogenic species. Adult *P. rufescens* are found in smaller bronchioles, so associated lesions are much smaller. *M. capillaris* is found in the lung parenchyma where it becomes encysted in fibrous nodules; lesions are therefore confined to its immediate surroundings. Consequently, this worm is generally considered as involves heavy mixed protostrongyloid infection and impair pulmonary gaseous exchange.^[21] It is suggested that when the larval stages of *M. capillaris* migrated through the walls of small intestine, the resulting damage may predispose to enterotoxaemia.^[10] Infection with more than one species is common and course of infection is usually chronic.^[18]

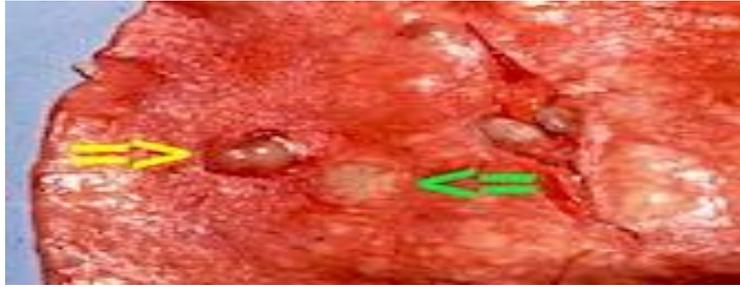


Figure 1: Lodged lungworms in the lung tissues of sheep and goats and their effects.

Clinical Finding

The clinical course of lungworm infection depends on severity of infection, age and immunological status of the animal.^[18] Signs range from moderate coughing with slightly increased respiratory rates to severe persistent coughing, persistent respiratory distress and failure.^[13] The most common signs of *D. filaria* are coughing and unthriftiness which in endemic areas is usually confined to young animals. In more severe cases, dyspnea and tenacious nasal discharges are also present. The signs may be accompanied by diarrhea and anemia due to concurrent gastrointestinal Trichostrongylosis or fasciolosis.^[15] In *M. capillaris* and *P. rufescens* infection, pneumonic signs have rarely been observed and infections are almost always unapparent being identified only at necropsy.^[15]

Diagnosis

The factors that suggest lungworm infection are a history of exposure to previously grazed pasture by animals of the same species, the presence of the disease in the area and failure to respond to standard treatments for bacterial or viral pneumonia.^[14,20]

Laboratory Diagnosis

In laboratory, 25 gram of fresh faeces will be weighed from each sample for the extraction of L₁ larvae using modified Baermann technique. The paste enclosed in gauze fixed on string rod and submerged in clean glass tube filled with fresh water. The whole apparatus will be left for 24 hours. The larvae leave the faeces and migrate through the gauzes and settle at the bottom of the glass. After siphoning of the supernatant, the sediment is examined under the lower power of the microscope.^[13,23]

Dictyocaulus species of lungworms of cattle and sheep are usually seen in the sputum as egg containing larvae rather than larvae in the faeces.^[24] In *Muellerius capillaris*, those larvae which reach the lungs of sheep remain in the parenchyma and become encysted in fibrous

nodules and because such nodules may not contain adults of both sexes, fertile eggs may not be deposited in the air passages. For this reason, the number of larvae in the faeces is often no indication of the degree of infestation.^[21]

During identification of the larvae, the presence of *D. filaria* was confirmed by the finding of the first stage larvae with an anterior protoplasmic knob, and black granular intestinal inclusions in the faeces.^[25] The larvae of *P. rufescens* and *M. capillaris* are differentiated by their characteristic feature at the tip of their tail. *P. rufescens* has a wavy outline at the tip of its tail, but devoid of dorsal spine. On the other hand, *M. capillaris* has an undulating tip and a dorsal spine.^[26]



Dictyocaulus filaria lung worm of sheep and goats



Muellerius capillaris lung worm of sheep and goats

Figure 2: Species of Lungworms in Small ruminants.

Postmortem Examination

Lungs from selected animals were palpated for the presence of Protostrongylidea nodule. If the nodule present they were trimmed off and worms extracted from the tissue by gentle comprising a small non-calcified nodule or part of large nodule between two glass slides and then carefully teasing the worm away from the tissue. Air passages were opened starting from

the trachea to the small bronchi with fine blunt pointed scissors to detect the presence of adult Dictyocaulidae.^[16, 18]

At necropsy, most lesions are found in the respiratory system. With infection by *D. filaria*, the bronchi, especially those of the diaphragmatic lobes, contain tangled masses of worms mixed with frothy exudates. Atelectatic and infected lobules often surround or extend ventrally from infected bronchi. Bronchioles infected with *P. rufescens* often are closed with worms and exudates; consequently, affected lobules may be atelectatic and infected. Lungs infected with *M. capillaris* contain red, grey or green lobules 1 to 2 mm in diameter. These lesions, located in the sub-pleura of the diaphragmatic lobes, vary in consistency, number, and shape.^[12] Lung nodules as a result of *M. capillaris* infection have the feeling of lead shot.^[25]

Infestation of goats by *M. capillaris* leads to a diffuse infection quite different to the nodular reaction in sheep and to the production of an interstitial pneumonia.^[22, 27]



Figure 3: Adult Lungworms isolated from the respiratory tract of small ruminants by postmortem examination

Treatment

Strong acquired resistance against dictyocauliasis of bovine and ovine species by natural infection is well documented fact. However, owing to the undetermined number of infective larvae that could be ingested in the field and the accompanying disease process makes it unreliable.^[28]

Treatment of lungworm necessitates the use of appropriate Anthelmintics which are effective against lungworm infection.^[29] The effective Anthelmintics including Benzimidazoles, Levamisols or Ivermectin should be used in the treatment of the disease since clinical signs

associated with pulmonary pathology are not rapidly resolved by mere removal of adult lungworms.^[15, 22, 29]

Control and Preventions

The objective of prevention and control can be achieved most effectively by integration of three interrelated approaches of anthelmintic drugs, immunization and improved management practice.^[17]

Management practice such as provision of ample nutrition increases the resistance of the host and therefore it is important for the control of Dictyocaulosis. Larvae of *Dictyocaulus* may persist and develop in swampy pastures and may serve as a source of infection; therefore, those susceptible animals should not be allowed to have access to such areas because young hosts of all kinds are more susceptible to *Dictyocaulus* than adults. Animals must be placed on dry pasture and supplied with clean drinking water; moist pasture must be avoided while dry pasture is fairly safe, because the infective larvae are not very resistance to dryness. Young stock should be separated from other stock.^[15]

Extinction of the snail intermediate host is an additional measure important for the control of Metastrongyloidea. This technique enables to control the nude slugs and shelled snails more easily, and spreading of lime has been recommended for this purpose. The snails creep up plants in the early morning and evening and rainy weather, the animals should, therefore, not be allowed to graze at such times, particularly in the autumn when the infection most frequently occur.^[30]

Control of lungworm infection in first year grazing sheep and goats has been achieved by the use of prophylactic anthelmintic regimens either by strategic early season treatment or by administration of rumen bolus.^[15]

The best method of preventing verminous pneumonia is to immunize all young sheep and goats with lungworm vaccine.^[15] Vaccine for *D. filaria* is available where this worm is a particular problem.^[21] This live vaccine, consisting of larvae attenuated by irradiation, is given orally to young's aged 8 weeks or more. Two doses should be administered in order to allow a high level of immunity and to develop resistance. Vaccinated animals should be protected from challenge until two weeks after their second dose.^[15]

CONCLUSIONS

Lungworms of domestic ruminants are nematodes that belongs to the phylum Nematelmenthes commonly named as round worms; classified under the super family Trichostrongyloidea and Metastrongyloidea. Among these, *Dictyocaulus* and *Protostrongylus* are causes of lungworm infection in ruminants. Of the two species, goats are more susceptible to lungworm infection. Female animals, young animals of less than one year of age, poorly conditioned animals, and those managed under extensive system of production are more prone to lungworm infection. The respiratory nematodes, *Dictyocaulus filaria*, *Muellerius capillaris* and *Protostrongylus rufescens*, are the species of lungworms most commonly affecting small ruminants. The clinical picture of the disease ranges from moderate coughing and sneezing to sever respiratory distress and failure. Lungworm infection in ruminants can be prevented and controlled by integration of effective Anthelmintic drug administration, vaccination, and improvement of the management and husbandry system.

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