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# Ovine Lungworms: A Review

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**Abstract:** Livestock production is a major component of the agrarian economy in developing countries and goes well beyond direct food production. Sales of livestock and their products provide immediate cash income to farmers and foreign exchange to the endowed countries. Among the predominant livestock species; sheep play an important role in the socio-economic development of the majority of African countries. Control of these parasites is therefore, essential for releasing the potentials of sheep production. For the proper control to be knowledge of parasitic diseases and their dynamics must dangerous to lay down rigid rules of their control which are applicable for all regions. For these reasons a study of epidemiology of each parasitic disease should limited small areas. Therefore, to increase the potential of small ruminant production and to get the maximum benefits from them prevention and control of lungworm is very important. Although environmental factors are conductive for lungworm infections in sheep and lungworm infection is considered as an important disease.

**Key words:** Livestock Production · Parasitic Diseases · Lungworm Infections

## INTRODUCTION

Livestock production is a major component of the agrarian economy in developing countries and goes well beyond direct food production. Sales of livestock and their products provide immediate cash income to farmers and foreign exchange to the endowed countries [1]. In Ethiopia, agriculture is the mainstay of the country and also the major resources of employment and income. About 85% of population live in rural areas and are primarily engaged in agriculture and related activities. Thus agriculture, directly or indirectly forms an important components of livelihood of more than 60 million people in the country [2]. Among the predominant livestock species, sheep play an important role in the socio-economic development of the majority of African countries. They supply more than 30% of domestic meat consumption and generate cash income from export of meat, mainly as live animals and skin and it also provides wool, milk, manures for the soil and serves as investment for the farmers. Hence an increase in sheep production and also to increase export earnings [3] however, several factors especially constrains their full utilization. Among these diseases, respiratory diseases have been identified as an important problem of sheep in the highlands of Ethiopia for the last two to three decades. It may account for up to 54% of the overall mortality in central highlands of Ethiopia [4]. 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 in much of the developing world. It has however been established that high prevalence rates of infection with less obvious sign associated with poor production and unthriftness [5].

Among the respiratory diseases endoparasites such as *Dictyocaulidae* and/or certain *Metastrongylidae* are known to exist in east Africa (Ethiopia, Kenya and Tanzania) and South Africa.Endoparasites including *Dictyocaulus filarial* are major causes of death and morbidity on farms in Ethiopian highlands. Up to half of all sheep deaths and morbidity on farms in Ethiopia highlands are caused by pneumonia and endoparasites [6]. The production losses due to helminthes is associated

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with direct consequences of clinical and subclinical infections resulting in low productivity due to stunted growth, reduce weight gain, poor feed utilization or loss due to mortality or indirect loss associated with cost of treatment and control measures [7, 8].

Control of these parasites is therefore, essential for releasing the potentials of sheep production. For the proper control to be knowledge of parasitic diseases and their dynamics must dangerous to lay down rigid rules of their control which are applicable for all regions. For these reasons a study of epidemiology of each parasitic disease should limited small areas. Therefore, to increase the potential of small ruminant production and to get the maximum benefits from them prevention and control of lungworm is very important. Although environmental factors are conductive for lungworm infections in sheep and lungworm infection is considered as an important disease [9].

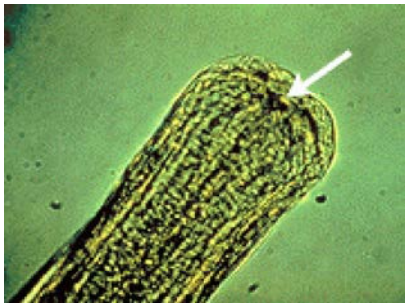
**Lungworm Infection:** The common names of lungworm infection are Verminous bronchitis or Verminous pneumonia. Verminous pneumonia, a chronic and prolonged infection of sheep and goats, is characterized clinically by respiratory distress and pathologically by bronchitis and bronchopneumonia and is caused by nematode parasites [10]. It is the infection of lower respiratory tract, resulting in bronchitis or pneumonia, or both, by any of several parasitic nematodes including: *Dictyocaulus viviparous* in cattle; *D. arifieldi* in donkeys and horses; *D. filaria*, *protostrongylus rufescens* and Muellerius capillaries in sheep and goats: *Metastrongylus apri* in pigs; *Filaroides* (*Oslerus*) *osleri* in dogs; and *Aelurostrongylus abstruse* in cats. Other lungworm infections occur but are less common [11].

Lungworm infection of small ruminants: -Nematodes that belong to Dictyocaulidae and Protostrongylidae cause lungworm infections in ruminants. Dictyocaulidae species are located in the bronchial tree in lung while Protostrongylidae species are located in the lung parenchyma mainly in the form of brood and worm nodule. The numbers of these nodules are used to estimate the severity of protostrongylid infection [12].

**Etiology:** The common causes of verminous pneumonia in sheep and goats are *D. filaria, p. rufescens* and *M. capillaries*. Although mixed infections may occur, *D. filaria* predominates in most outbreaks. *Dictyocaulus filaria* belongs to the super family Trichostrongyloidea while the latter two belong to Metastrongyloidea, which have direct and indirect life cycle respectively [13].

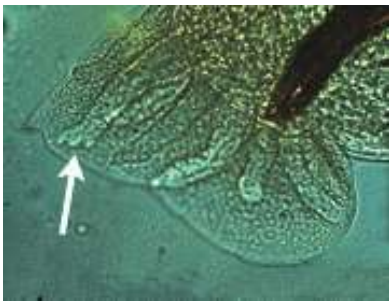
**Morphology of the Parasite:** Members of the family Dictyocaulidae are unusual among the Trichostrongyloidea in that they parasitize the lungs, especially the bronchi of the diaphragmatic lobes and the trachea. They are found throughout the world but are more common and clinically important in temperate areas particularly when summer rainfall is above average. They are thin, thread-like worms, from 3 to 8 cm long. The mouth is surrounded by 4 lips and the mouth opening leads into a small buccal capsule. The males have a prominent copulatory bursa [14].

*Dictyocaulus filaria*, the large lungworm of sheep and goats, is a slender, whitish worm 3–live mainly in the airways (bronchi) in the lung. Verminous (worm-related) pneumonia is mainly a disease of cool, moist climates as further development of first stage larvae passed in 10 cm long. Adults faeces to the infective third stage requires such conditions [15].



Dictyocaulus head end showing the small mouth opening (arrow).

Scanning electron micrograph of Dictyocaulus showing the mouth opening surrounded by lips.



Dictyocaulus male bursa showing the short, fat, dark spicules and one dorsal ray with a trilobed tip (arrow)

Fig. 1: Anatomical characteristics of lungworms

**Epidemiology:** Most outbreaks of verminous pneumonia occur during cool season's especially autumn and early winter, because the larval stages of the causative worms tolerate and prefer low temperature. The larvae of *D. filaria* have considerable ability to resist cold and some will over winter even in extreme climates and it has a worldwide distribution and causes serious losses but outbreaks of infection, often with high mortality, occur in sheep and goats in most temperate areas of the world. The larvae require moisture for development and can withstand moderately dry conditions for few days, but are able to live in moist conditions for several months and are fairly resistant to low temperatures. Animals 2 to 18 months old have higher incidence than do other age groups. Many fifth stage larvae are inhibited in their development during winter in the lungs of older animals but resume the process in the spring [16, 17].

In temperate areas, the epidemiology is somewhat similar to that of *D. viviparous* in the both the survival of over wintered larvae on pasture and the role of the ewe as a carrier are significant factors in the persistence of infection on pasture from year to year in endemic areas. In ewes, it seems likely that the parasites are present largely as hypobiotic larvae in the lungs during each winter and mature in the spring [18]. Development to the $L_3$ only occurs during the period from spring to autumn. In lambs, patent infections first occur in early summer, but the heaviest infections are usually seen in autumn. In ewes, the prevalence of infection is lower and their larval output smaller. As with the other trichostrongyloids, it seems likely that only two cycles of the parasite occur during each grazing season [19].

In warmer climates, where conditions are often unsuitable for larval survival, the carrier animal is nation and outbreaks of disease in lambs and kids are most likely to occur after a period of prolonged rain around the time of weaning. Goats appear to be more susceptible to infection than sheep and are thought to play a prominent role in the dissemination of infection where both are grazed together [20]. Although *D. filaria* is a primary lugworm of sheep, it can infect and grow to maturity in cattle and can, after experimental infection, cause the death of calves [21].

*M. capillaries* is by far the commonest genus and on many temperate areas such as Britain, the eastern states of U.S.A. and the winter rainfall regions of Australia almost all sheep carry the infection; the extensive distribution and high prevalence are partly attributable to its wide range of intermediate hosts. The parasite is usually not found in lambs less than 6 months of age. The larvae of *M. capillaries* can resist a fair amount of drying, are most active at relatively low temperature (17-27°C) and are not killed by freezing. The infective larvae can also live up to 9 a week after the death of the snail [22].

*Protostrongylus rufescens*, whose intermediate host range is restricted to certain species of snail, has lower prevalence though its geographic range is just as wide. Additional factors which play a part in insuring the epidemiology of these worms are, first, the ability of $L_1$ to survive for months in the faecal pellet and secondly the persistence of the L3 in the intermediate host for the life time of the mollusk. Also important in this respect are the long period of patency and the apparent inability of the final host to develop acquired immunity so that adult sheep have the heaviest infections and the highest prevalence [23].

**Economic Importance:** Verminous pneumonia is caused by *Dictyocaulus filaria* of small ruminants is ubiquitous of small parasitosis which has considerable economic repercussion all over the world. It is known that heavy infection by *Dictyocaulus filaria* caused unthriftness, coughing, loss of weight or reduced weight gain and respiratory system damage can be so severe to lead to the death [24].

Heavy infection weakened the lungs and assists in reducing the general health and resistance of the host. The cost of retarded growth diminished utility of infected pastures and cost of prevention, diagnosis and treatment of the disease are so important [25].

**Life Cycle:** The life cycle of *D. filaria* is direct. The eggs may hatch in the lungs, but are usually coughed up and swallowed and hatch while they pass through the alimentary tract of the host. Some eggs may be expelled in the nasal discharge or sputum. The L1 migrate up the trachea, are swallowed and pass out in the fasces. The larvae are unique in that they are present in fresh faeces, are characteristically sluggish and their intestinal cells are filled with dark brown food granules. In consequence the periphrastic stages do not require feed. Under days, but usually takes longer in the field. $L_3$stage is reached within five days, but usually takes longer in the field. The $L_3$ leave the faecal pat to reach the herbage either by their motility or through the agency of

the fungus pilobolus. After ingestion, the $L_3$ penetrate the intestinal mucosa and pass to the mesenteric lymph nodes where they moult. Then the $L_4$ travel via the lymph and blood to the lungs and break out of the capillaries into the alveoli about one week after infection. The final moult occurs in the bronchioles a few days later and the young adults then move up the bronchi and mature. The prepatent period is 5 weeks [26].

The lifecycle of Metastorongyloidea is indirect, since larvae can only mature in an intermediate host. The eggs develop in the lungs of the host and the first stage larvae are passed in the faeces. For further development they require a snail intermediate. The development to the infective stage requires 12 to 14 days and two ecdyses are the larva pass to the lungs of the host via the mesenteric lymphatic glands, in which the third ecdysis takes place. In P*rotostrongylus rufescens* Tran placental transmission occurs and larvae can be found in the liver and lungs of fetuses and newborn lambs [27].

**Pathogenesis:** he pathogenesis effect of lungworm depends on their location within the respiratory tract, the number of infective larvae ingested, the animals immune state and on the nutritional stats and age of the host [28]. Larvae migrating through the alveoli and bronchioles produce an inflammatory response, which my block small bronchi and bronchioles with inflammatory exudates. The bronchi contain fluid and immature worms; latter adult worms and the exudates they produce also block the bronchi. Secondary bacterial pneumonia and concurrent viral infections are often complications of Dictyocaulosis [29]. Inflammatory process spreads to the surrounding per bronchial tissues and the exudates pass back in to the bronchioles and alveoli causing atelectasis and catarrh or pneumonia. The young larvae passing through the intestine may irritate the mucosa and cause diarrhea. *D. filaria* is the most pathogenic of ovine lungworms [30].

The smaller importance of the protostronglines derives from the nature of the lesions, which they produce. These tend to be local, small and accompanied by a swift local reaction by the host, which limits their extension. In *P. rufescens* infection the affected alveolar and bronchiolar epithelium is desquamated, a blood vessel takes place in the area. The result is a small focus of lobular pneumonia roughly conical in shape and yellowish grey in colour. It is suggested that when the larval stages of *M. capillaries* migrated through the will of the small intestine, the resulting damage may predispose to enterotoxaemia [31].

**Clinical Finding:** Clinical disease is most frequently seen in young animals. The clinical manifestations of verminous pneumonia vary with the number of infecting worms. The most common signs are coughing and unthriftness which in endemic areas, is usually confined to young animals. In more severe case dyspnea and tenacious nasal discharge are also present. The signs may be accompanied by diarrhea or anaemia due to concurrent gastrointestinal Trichostrongylosis or Fasciollosis [32]. Young sheep heavily infected with *D. filaria* show febrile episodes, coughing, nasal discharge, rapid breathing retarded growth, physical weakness and emaciation. Some animals develop diarrhea. Deaths may result from accompanying bacterial infections. Protostrongylyus infections cause few clinical signs and Muellerius none [33].

**Necropsy Finding:** 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 form infected bronchi Bronchioles infected with *P. rufescens* often are closed with worms and exudates and consequently, affected lobules may be atelectatic and infected. Lungs infected with *M. capillaries* contain red, gray or green nodules 1 to 2 mm in diameter. These lesions, located in the sub pleura of the diaphragmatic lobes, vary in Consistency, number and shape [34]. The nodules in the long as the result of *M. capillaries* infection have the feeling of leads hot. Infestation of goats by *M. capillaries* leads to a diffuse infection quite different to the nodular reaction in sheep and to the production of an interstitial pneumonia [35].

**Diagnosis:** Diagnosis is based on clinical signs, epidemiology, presence of first-stage larvae in faces and necropsy of animals in the same herd or flock. Larvae are not found in the faeces of animals in the prepatent or post patent phases and usually not in the reinfection phenomenon or may be few in number in the early stages of an outbreak. First stage larvae or larvated eggs can be recovered using most faecal flotation techniques with the appropriate salt solutions. A convenient method for recovering larvae is a modification of the Baermann technique in which feces (25g) are wrapped in tissue paper or chese cloth and suspended or placed in water contained in conical flask. The water at the bottom of the flask is examined for larvae after four hours, in heavy infection; larvae may be present within 30 min [36].

The presence of *D. viviparus* confirmed by the finding of the L1 larvae, with an anterior protoplasmic knob and black granular intestinal inclusions, in the feces [37]. Adults of *D. filaria* are easily found in the trachea and bronchi at necropsy but finding immature stages usually necessitates dissection of the pulmonary tissue and either allowing it to set in physiological saline or using the Baermann technique with physiological saline. The larvae of *P. rufescens* and *M. capillaries* are differentiated by their characteristic feature at the tip of their tail. *P. reufescens* has a wavy outline at the tip of its tail, but devoid of dorsal spine, on the other hand *M. capillaries* have an undulating tip and a dorsal spine [38].

In *M. capillaries*, 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 esces, 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 [39].

**Prevention and Control:** Where it is necessary to apply specific control measures, it is suggested that the flock should be annually treated with a suitable anathematic in late pregnancy. The ewes and lambs should them be grazed on pasture which, in temperate areas at least, should not have been used by sheep during the previous year [40]. Animals must be removed from infected ground, placed on dry pastures and supplied with clean drinking water. Draining and resting of pasture during dry summer kill many larvae that readily survive cold winter. Their faeces should not be used for fertilizing lands on which crops for green feeding are grown. Moist pastures must be avoided, while dry pastures are fairly safe, because the infective larvae are not very resistant to dryness [41].

The larvae rarely live through the winter in cold climates and older animals, which show no symptoms, usually carry on the infection. Adults should therefore not be grazed together with the young stock [42]. Grazing management should be improved, especially to provide clean pasture for Youngs. Artificial immunization has been markedly successful using X-irradiated infective larvae and a commercial vaccine is now available. This vaccine which consists of two doses of 1000 irradiated larvae given at an interval of a month has been used in hundreds of thousands of animals in Great Britain and various countries in Europe and U.S.A with outstanding success [43].

## CONCLUSION AND RECOMMENDATIONS

Livestock production is a major component of the agrarian economy in developing countries and goes well beyond direct food production. Sales of livestock and their products provide immediate cash income to farmers and foreign exchange to the endowed countries The respiratory nematodes identified are *Dictyocaulus flaria, Mullerius capillaris* and *protostrongylus rufescens*. Control of these parasites is therefore, essential for releasing the potentials of sheep production. For the proper control to be knowledge of parasitic diseases and their dynamics must dangerous to lay down rigid rules of their control which are applicable for all regions. For these reasons a study of epidemiology of each parasitic disease should limited small areas. Therefore, to increase the potential of small ruminant production and to get the maximum benefits from them prevention and control of lungworm is very important.

Therefore, based on the present findings, the followingrecommendations are forwarded;

- Regular strategic deworming of the whole flock with broad spectrum antihelimentics should be undertaken.
- Animals should not be allowed to have access to moist and swampy area.
- Additional shed should be provided to sheep to make well-nourished and good body condition.
- Farmers who keep small ruminants should advise not to keep their sheep in extensive management system.
- In the rainy weather conditions are intermediate host, snails and slugs, become active.

Therefore, there should be prohibition of sheep to graze early in the morning and evening.

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