RESEARCH ARTICLE

Pathomorphology Associated with Verminous Pneumonia and Hydatidosis in Goats

Gurjit Singh Bhullar, Nittin Dev Singh*

Abstract

Pneumonia is a significant cause of mortality in goats. This study reports pulmonary parasitic infections with lung worm and hydatidosis as the underlying cause of pneumonia in goats. A total of 11 carcasses with a history of pneumonia were necropsied at Ludhiana, during January 2024 to March 2025. The etiological diagnosis was made using pathomorphological techniques. Out of 11 goats, 7 were found to be positive for parasitic pneumonia, out of which 4 cases were found to be positive for verminous pneumonia and 3 cases for hydatidosis. On post-mortem examination, verminous pneumonia revealed white spots of emphysema that were raised, well-defined, and irregularly bordered and the caudal lobes of the lungs had subpleural, multifocal nodules (2-5 mm) which were clearly visible. Hydatidosis revealed the presence of single to multiple cysts, sometimes covering the whole of the lung. The cysts were irregular or oval in shape, varied in number, and ranged in dimension from 2 to 10 cm. They were often surrounded by a fibrous capsule. On histopathological examination, verminous pneumonia revealed that in the bronchi lumen, a parasite cross-section was surrounded by a thin exoskeleton made of chitin, a considerable number of parasitic eggs, inflammatory cells mostly eosinophils, foreign body giant cells and neutrophils. In case of hydatidosis, the inner cyst wall consisted of a striated, hyalinized, eosinophilic layer (laminated layer) free of epithelial cells. The lung parenchyma around the cyst was distorted and collapsed, the pulmonary epithelium was atrophied, and mononuclear cells infiltrated the lung parenchyma. These findings signify the importance of parasitic control and routine health monitoring to prevent the impact of parasitic pneumonia.

Key words: Goat, Hydatidosis, Parasitic, Verminous.

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Introduction

In India, small ruminants, especially goat and sheep, are among the most prevalent farm animal species that support the livelihoods of smallholders and the rural poor, including households led by women (Sah *et al.,* 2022). Their rapid maturation, minimal capital asset per head, compact size and rapid returns make them ideal for resource-poor farmers. However, high rates of illnesses and parasites are seen as significant barriers that result in both direct costs like reduced productivity and death as well as indirect losses like restrictions on exports (Sah *et al.,* 2020).

One of the leading causes of morbidity and death in goats and sheep is pneumonia, which can have a variety of aetiologies, including bacterial, viral, fungal, or parasitic (Kumar, 2024). Numerous nematodes can cause lungworm infection, commonly referred to as verminous pneumonia or verminous bronchitis, which is an inflammatory condition of the lower respiratory system. The lower respiratory system is colonized by lungworms, which are significant parasitic nematodes of small ruminants that cause significant morbidity and financial loss globally (Asmare *et al.,* 2018). Although several lungworm species can infect small ruminants, *Dictyocaulus filaria, Muellerius capillaris* and *Protostrongylus rufescens* are the most significant ones that can cause respiratory illnesses (Kumar, 2024). However, the pathogenic effects of these parasites depend on their location within the respiratory tract, the number of infective larvae ingested and the immune system of the animals. High humidity is also necessary for larval growth and survival, at least in the microclimate of the herbage and faeces (Qamar *et al.,* 2009). According to several studies, hydatidosis is common in India, especially in animals that produce food, like sheep and goats (Bhattacharya *et al.,* 2007; Pednekar *et al.,* 2009; Singh *et al.,* 2012). The most productive cystic phases for the infection's propagation are found in sheep and goats, making them the most popular and effective intermediate hosts. Domestic animals often exhibit no symptoms of hydatidosis, which is only identified by postmortem examination. Hydatidosis-related economic costs are linked to the condemnation of diseased lungs and liver (Tiwari,

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2024). This study documents pathomorphology associated with verminous pneumonia and hydatidosis in goats

Materials and Methods

Eleven goats with a history of respiratory illness were necropsied in the post-mortem hall of the Department of Veterinary Pathology, GADVASU, Ludhiana (India), between January 2024 and March 2025. Representative tissue samples from the bronchial and mediastinal lymph nodes as well as the affected lungs were obtained in 10% neutral buffered formalin (NBF) after a thorough necropsy examination.

After the first fixation, tissue samples were sliced again and left for at least 24 h. They were then treated with water, xylene, a xylene-benzene mixture, graded alcohol, and melted paraffin. Sections were embedded in paraffin blocks and then sliced to a thickness of 3-4 µm. Normal hematoxylin and eosin (H&E) was used to stain the thin paraffin slices after they were placed on glass slides (Luna, 1972).

Results and Discussion

Macroscopic Parasitic Induced Lesions

Seven of the 11 cases had a parasite aetiology, with 3 presenting as lung hydatidosis and 4 as verminous pneumonia. Gross post-mortem examination of verminous pneumonia showed white spots of emphysema that were raised, well-defined, and irregularly bordered (Fig. 1). The trachea and lungs' cut surfaces showed edematous foam combined with mucus (Fig. 2). According to Kumar (2024), lungworms, which are important parasitic nematodes of small ruminants that cause major morbidity and financial loss worldwide, colonize the lower respiratory system. The results of a postmortem examination of a goat exhibiting similar symptoms were identical to those of Teshale *et al*. (2024) and Kumar (2024). The lungs and trachea were loaded with many thread-like reddish brown worms and had raised emphysematous patches and depressed consolidated sections. The caudal lobes of the lungs had subpleural, multifocal nodules (2-5 mm) that were clearly visible (Fig. 3). According to Hashemnia *et al*. (2019), the texture of these nodules varied from soft and bleeding to solid, grey-green, or even calcified. Crowther (1973) described a "fog-fever" like sickness in adult goats infected with *Muellerius* spp. and *Dictyocaulus* spp. The parasite that lives inside the alveoli is encased in glaringly noticeable nodules (1 mm to several cm in diameter) that are mostly subpleural in position and often on the dorsal portion of the diaphragmatic lobes in sheep and goats (Jubb *et al.,* 2012).

The hydatid cysts revealed that either all of the lung lobes had these cysts, or just one. The cysts were irregular or oval in shape, varied in number, and ranged in dimension from 2 to 10 cm. They were often surrounded by a fibrous capsule (Fig. 4). Similar alterations were seen by Hashemnia *et al*. (2019) and Rashid *et al*. (2019), who found that upon macroscopic examination, the pulmonary parenchyma had firm, oval cysts filled with fluid. The cysts were soft, with the exception of a few individuals having nodular and inspissated cysts. At the dorso-ventral surface of the lungs, pinpoint (petechial) haemorrhages were observed surrounding the fluid-filled cyst. Consolidation patches were seen on the lungs' cranial and diaphragmatic lobes. Congestion, atelectasis, and consolidation were seen close to the cysts (Fig. 5). The formation of bigger cysts is resisted by the compact tissues, including the liver (Torgerson, 2003). Larger embedded cysts can grow in more space as a result (Beigh *et al.,* 2017). The cysts varied in quantity and size, ranging from 2 to 10 cm in diameter, and were often encased in a fibrous capsule. Singh *et al.* (2017) also reported similar lesions, which were either localized to one lung lobe or to all lung lobes. Their diameter varied from approximately 2 to 7 cm, and their shape could be uneven, circular, oblong, or oval.

Microscopic Parasitic Induced Lesions

Histopathological examination revealed that in the bronchus lumen, a parasite cross section was surrounded by a thin exoskeleton made of chitin (Fig. 6), a considerable number of parasitic eggs (Fig. 7), inflammatory cells mostly eosinophils (Fig. 8), a small number of large cells and foreign body giant cell (Fig. 9), and neutrophils. Similar alterations in the lung parenchyma and interstitium surrounding the adult worms, eggs, and larvae of the parasites have been reported by Valero *et al.* (1992) and Dar *et al*. (2012). Peribronchiolar lymphoid hyperplasia was seen (Fig. 10). Furthermore, interalveolar septa, which generate enormous alveoli or bullae, rupture as a result of the movement of juvenile larvae in the lungs, resulting in widespread emphysema (Fig. 11). These alterations include multifocal granules with inflammatory cells forming the next layer, lymphocytes, plasma cells, and giant cells present, as well as a cross section of parasite cuticle at the center. Granulomatous pneumonia, which is caused by dead larvae, aberrant parasites, or parasite eggs; interstitial pneumonia, which is caused by migrating larvae, and chronic bronchitis from intrabronchial adult parasites are among the pulmonary lesions linked to parasitic pneumonias. An "eosinophilic syndrome" in the lung is often characterized by blood eosinophilia, bronchiolar alveolar gaps, and pulmonary interstitium eosinophil infiltrations (Zachary and McGavin, 2012).

Histopathological analyses provided insight into the structure of hydatid cysts. The inner cyst wall consisted of a striated, hyalinized, eosinophilic layer (laminated layer) free of epithelial cells when the germinal layer separated (Fig. 12). The lung parenchyma around the cyst was distorted and collapsed, the pulmonary epithelium was atrophied, and mononuclear cells penetrated the lung parenchyma (Fig. 12). The protocolises and the germinal membrane were

Fig. 1: Lungs showing elevated well demarcated with irregular borders white patches of emphysema

Fig. 2: Lungs showing edematous mucus mixed foam on surface

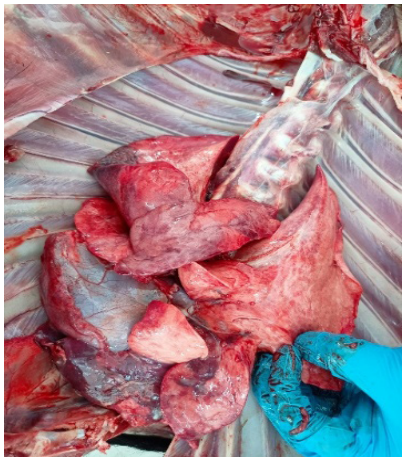

Fig. 3: Lungs showing subpleural nodules, multifocal nodules

Fig. 4: Lung showing round shaped cyst surrounded by fibrotic layer.

Fig. 5: Lung showing marked congestion with oval to round fluid-filled cyst.

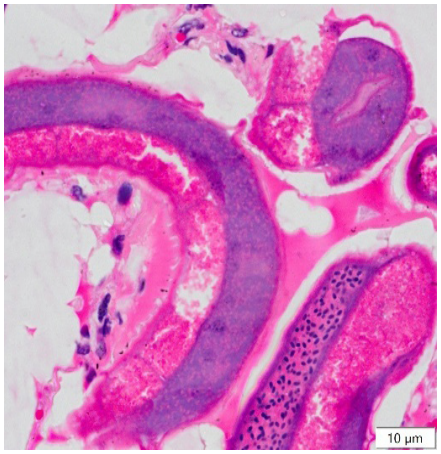

Fig. 6: Lung showing chitinous layer of larvae (H&E x 10µm).

not attached to or embedded in the tissue parenchyma, but the cyst wall retained its normal shape. In infected lungs, sterile cysts resulted in significant inflammatory cell infiltrations and varied degrees of chronic bronchitis (Fig. 13). Emphysema and congestion were also observed in other lung regions. Compression atelectasis (Fig. 14), edema, and alveolar emphysema in the vicinity of the hydatid cyst may be related to the mechanical pressure that cystic echinococcosis (CE) imposed on nearby tissue, which hindered respiratory attempts. But according to Kumar (2024), the location of these parasites in the respiratory tract, the number of infected larvae ingested, and the immune systems of the animals all influence how dangerous they are and the viability of the parasite.

Scavenger dogs in rural places are infected after eating tainted offal from open-air, non-gazetted slaughterhouses. The grazing fields are contaminated by these diseased dogs' feaces, which contain eggs. Because of the way they eat, small ruminants are significantly more likely than large ruminants to get cystic echinococcosis. Small ruminants, which are surface grazers, may consume the eggs from polluted pastures in agreement with the study of Nyero *et al.* (2015). Similarly, Hashemnia *et al.* (2019) and Rashid *et al.* (2019) observed that the cyst wall had fibrous connective tissue, a thin syncytial germinal layer, and a lamellar hyaline layer. CE in the lungs was identified by the trilaminar cyst wall, which is composed of the inner germinal layer, middle lamellated/laminated layer, and outside fibrous layer. From a very slight inflammatory response to a substantial infiltration of mononuclear cells and, in certain instances, fibroplasia that led to the formation of a fibrotic capsule, the lung tissue around the cysts displayed a variety of reactions. A trilaminar inflammatory response was frequently observed around the cyst, with scarce macrophages, mononuclear cells, and fibroblasts dispersed throughout the inner zone.

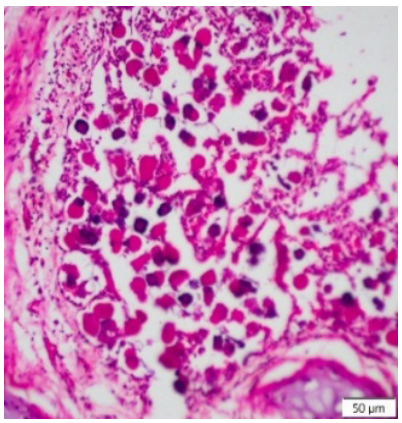

Fig. 7: Lung showing numerous no. of eggs surrounded by inflammatory cells (H&E x 50 µm).

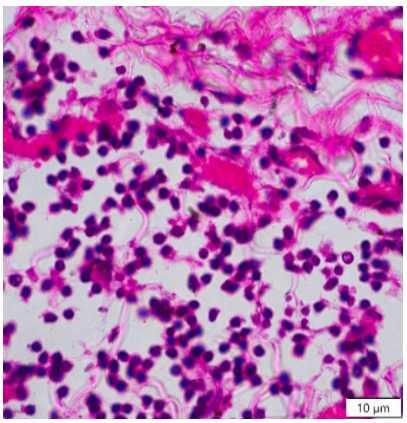

Fig. 8: Lung showing extensive eosinophils infiltration around the area of larvae (H&E x 10 µm).

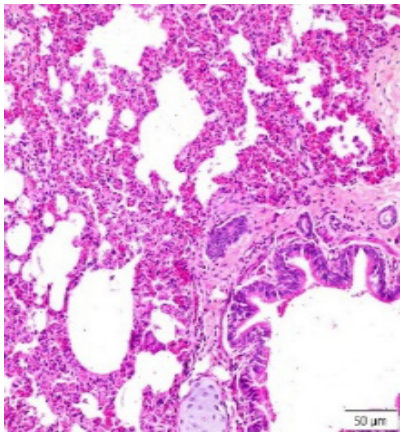

Fig. 9: Lung showing thickening of interstitium along with foreign body giant cell (H&E x 50 µm).

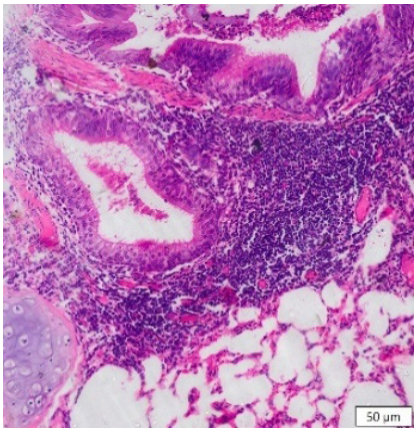

Fig. 10: Lung showing lymphoid hyperplasia (H&E x 50 µm).

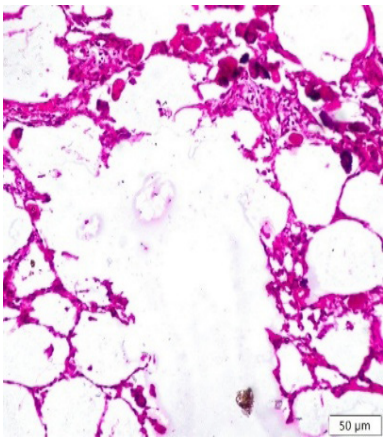

Fig. 11: Lung showing extensive emphysema along with eggs (H&E x 50 µm).

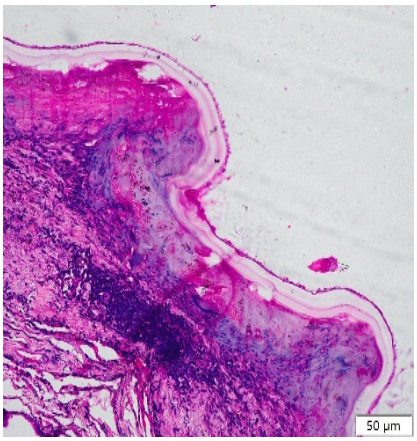

Fig. 12: Lung showing mononuclear cells invaded around the cyst in lung parenchyma (H&E x 50 µm).

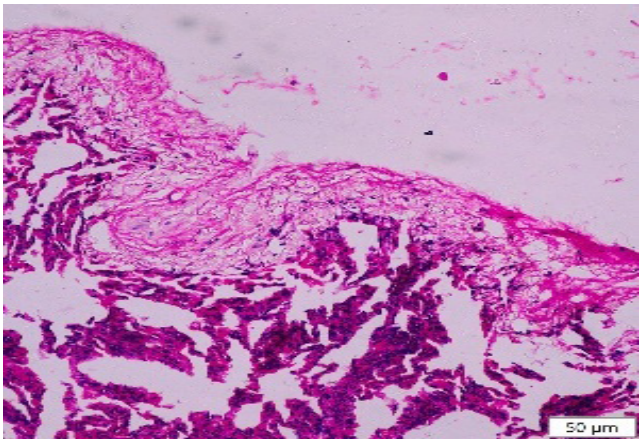

Fig. 13: Lung showing severe degree of inflammatory cell infiltration (H&E x 50µm).

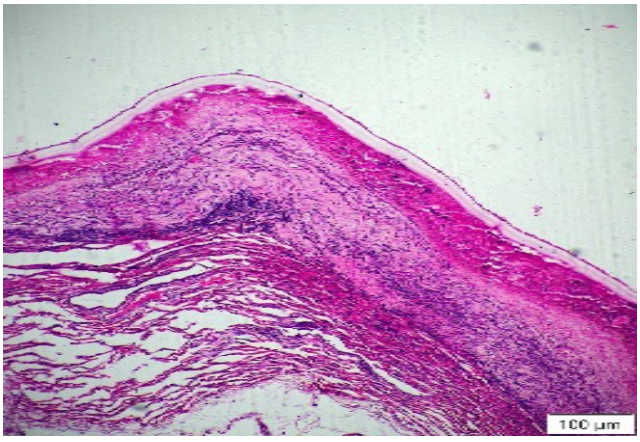

Fig. 14: Lung showing compression atelectasis adjacent to hydatid cyst (H&E x 50µm).

Conclusion

The findings signify the importance of parasitic control and routine health monitoring to prevent the impact of parasitic pneumonia.

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