



## Evaluation of Gross and Histopathological Lesions in Pneumonic Lungs and Mediastinal Lymph Nodes of Small Ruminants Slaughtered at Mosul Abattoirs

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### Abstract

**P**NEUMONIA is a frequent ailment that affects small ruminants, characterized by inflammation of the lung parenchyma. It is frequently brought on by a confluence of environmental variables, bacteria, viruses, and parasites. male and female sheep and goat, were inspected in this study. Samples from sheep and goat animals at Mosul's slaughterhouse and butcher shops were collected during weekly inspections. The results revealed different types pneumonia and lesions of lungs and mediastinal lymph nodes, bronchopneumonia was the higher evidence of type of pneumonia, followed by interstitial pneumonia 51.33%, then fibrinous pneumonia 46.66%, granulomatous pneumonia 43.33% and verminous pneumonia 25.33%. Based on the lesions', hydrated cysts are the most common 60%, congestion and hemorrhage 45.33%, pulmonary abscesses 36.66%, pulmonary adenomatosis 16.66%. The study concluded that the most prevalent and significant ovine diseases that impaired the lower respiratory system's function and activity were lesions in the lungs and mediastinal lymph nodes, particularly different types of pneumonia and hydrated cyst infestation.

**Keywords:** Lung, mediastinal lymph nodes, Pneumonia, sheep & goat.

### Introduction

Worldwide, farmers and veterinarians are very concerned about respiratory illnesses in sheep. Numerous respiratory illnesses that can impair the health and production of small ruminants as well as increase the expense of medical care and vaccinations might cause financial losses[1]. Numerous factors, including environmental conditions, management practices, and bio-infectious organisms, might lead to these pulmonary diseases [2,3]. To maintain the health and welfare of small ruminants, it is critical to understand the causes, signs, and prevention of respiratory infections in these animals. Pneumonia is a frequent ailment that affects small ruminants, characterized by inflammation of the lung parenchyma [4]. It is frequently brought on by a confluence of environmental variables, bacteria, viruses, and parasites [5]. Pneumonia may significantly impact the well-being and yield of sheep, leading to reduced growth rates, reduced milk yield, and elevated death rates in extreme circumstances [6]. The lymphatic system, which

includes lymph nodes, is one of the body's defensive systems against the spread of infection and cancer [7,8]. The lymph nodes are a collection of specialized tissues that are essential to the immune system's correct operation because they facilitate immunological cell-to-cell contact and stimulate T- and B-lymphocytes, which are cells that are specifically trained to protect the body against various diseases. Similar to the other organs in the body, these lymph nodes are subjected to a wide variety of pathogens, including bacterial, parasitic, and viral infections, which can result in a wide range of clinical diseases [9]. The current study was out to characterize the pathology and frequency of lesions in the lung and mediastinal lymph nodes in small ruminants that were slaughtered in Mosul, Iraq.

### Material and Methods

#### Collection of lung sample

A total of 265 male and female sheep and goat, were inspected in this study from August to December, 2023. Samples from sheep and goat

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animals at Mosul's slaughterhouse and butcher shops were collected during weekly inspections.

### Gross and Histopathological evaluation

The specimens were examined grossly in order to record any abnormal lesion in lung and mediastinal lymph nodes, that appears by naked eye or by palpation and observation, noting any changes in the shape, size, color, or texture of the lung. Specimens were collected from the infected part, and transported to the lab in a clean pack container with 10% neutral buffer formalin. Histopathological sections were carried out through routine paraffin embedding technique, firstly dehydrated with ascending ethanol concentration, clearance with xylol and embedded with paraffin wax [10] finally sectioned by microtome into 5-6 thickness and stained with routine (H & E) staining method [11].

### Results

From 265 slaughtered and examined sheep and goat (male & female) during this survey study, 155 (58.49 %) had gross and microscopic lesions in lung and mediastinal lymph nodes. 53 (35.33%) had pulmonary lesions in male sheep, while 97 (64.66%) had pulmonary lesions in female sheep. According to the type of the lesions and exudate, bronchopneumonia (60%) was the most higher evidence of type of pneumonia, followed by interstitial pneumonia (51.33 %), then fibrinous pneumonia (46.66%), granulomatous pneumonia (43.33%) and verminous pneumonia (25.33%). Based on the lesions, hydrated cysts are the most common (60%), congestion and hemorrhage (45.33%), pulmonary abscesses (36.66%), pulmonary adenomatosis (16.66 %). (Table 1).

**TABLE 1 . Types of ovine & caprine pneumonia types and lesions .**

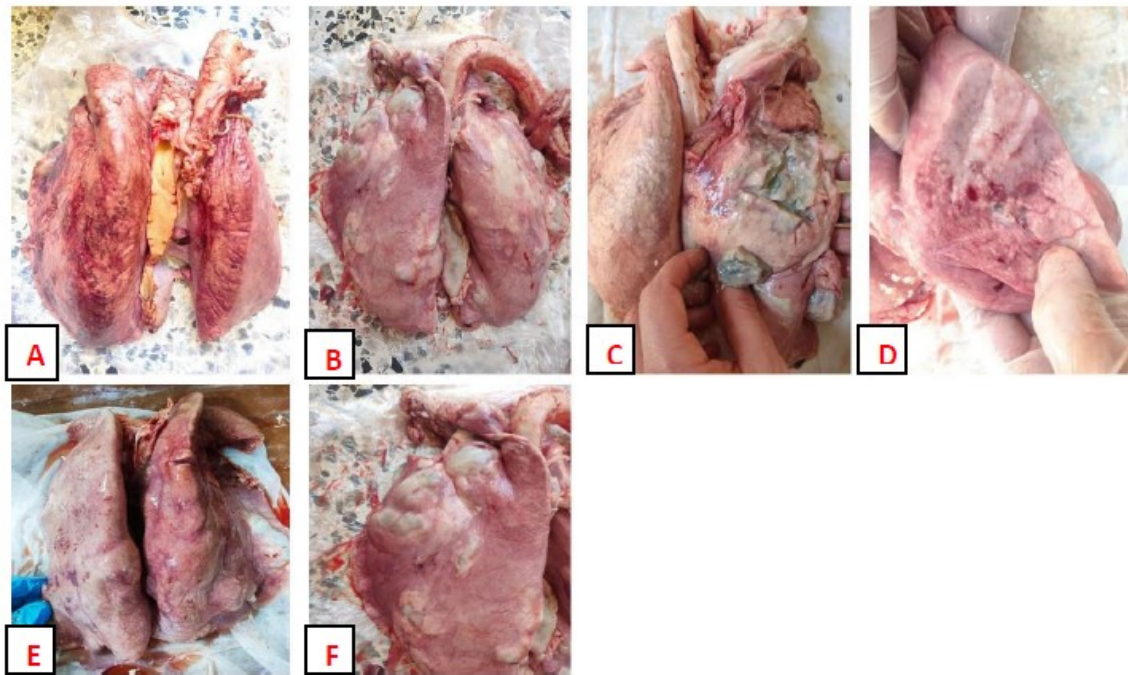
Pulmonary Lesions	Ovine	Caprine	Total
	No (%)	No (%)	(n = 155)
Fibrinous Pn.	70(46.66%)	2(40%)	72(46.5%)
Bronchopneumonia	90(60%)	2(40%)	92(59.35%)
Interstitial Pn.	77(51.33%)	1(20%)	78(50.32%)
Granulomatous Pn.	65(43.33%)	0	65(41.93%)
Verminous Pn.	38(25.33)	0	38(24.51)
Hydrated Cysts	90(60%)	0	90(58.06%)
Tubercular nodules	48(32%)	0	48(30.96%)
Pulmonary abscesses	55(36.66%)	0	55(35.48%)
Pulmonary adenomatosis	25(16.66)	0	25(16.12%)
Congestion & Hemorrhages	68(45.33%)	3(60%)	71(45.80%)
Emphysema	112(74.66%)	3(60%)	115(74.19%)
Disturbance of growth	58(38.66%)	1(20%)	59(38.06%)

The total number of infected samples does not represent the total count due to the presence of multiple lesions in one sample.

### Pathological characterization of pneumonia

Gross inspection of affected lungs revealed congestion, consolidation and nodules were distributed in the cranioventral area of the lung bilaterally or unilaterally, on palpation the lesions have firm consistency with nodules have dark red or pink red to gray colors and the cut surface of the affected lobes contains visible exudates. Other

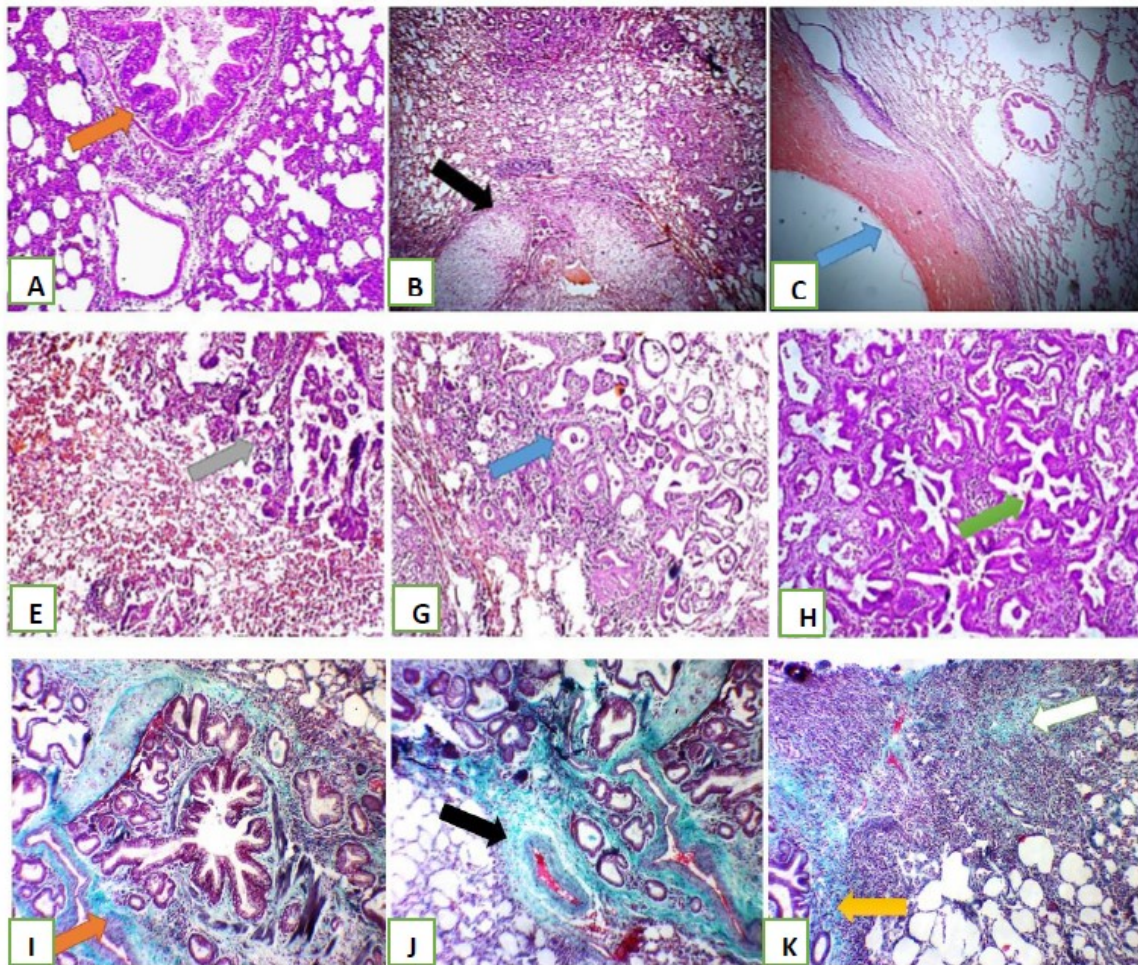
gross lesions revealed the thickened interlobular septa accompanied by notable marbled appearance of the affected lung parenchyma. Presence of hydrated cysts and tubercular nodules on the lungs, were diffusely distributed on the pleural surface. These nodules were numerous with varying size and appeared hard in consistency, oval shaped and white or green colored which were observed in the lobes of affected sheep lungs (Figure 1)



**Fig. 1. Ovine lung showing congestion and consolidation with mediastinal lymph node cassation (A), multiple pulmonary nodules (B) , green necrotic nodules (C) , marbled appearance(D), multiple caseated and hydrated nodules scattered on lungs surface (E & F).**

Microscopically, bronchopneumonia was characterized by bronchitis and bronchiolitis, characterized by hyperplasia of the bronchioles epithelium lining with peri-bronchial inflammatory cell aggregation, mainly neutrophils and lymphocytes. Congestion of pulmonary blood vessels with thickened wall, as well as thickening of alveolar septa with infiltration of the leukocytes (macrophages , lymphocyte, and less number of neutrophils) and presence of edema and emphysema in the alveolar interstitium. Tubercular pneumonia was recognized by the presence of granulomatous reaction , characterized by layer consists of chronic various inflammatory cells with fibrosis zone, surrounding the central caseous

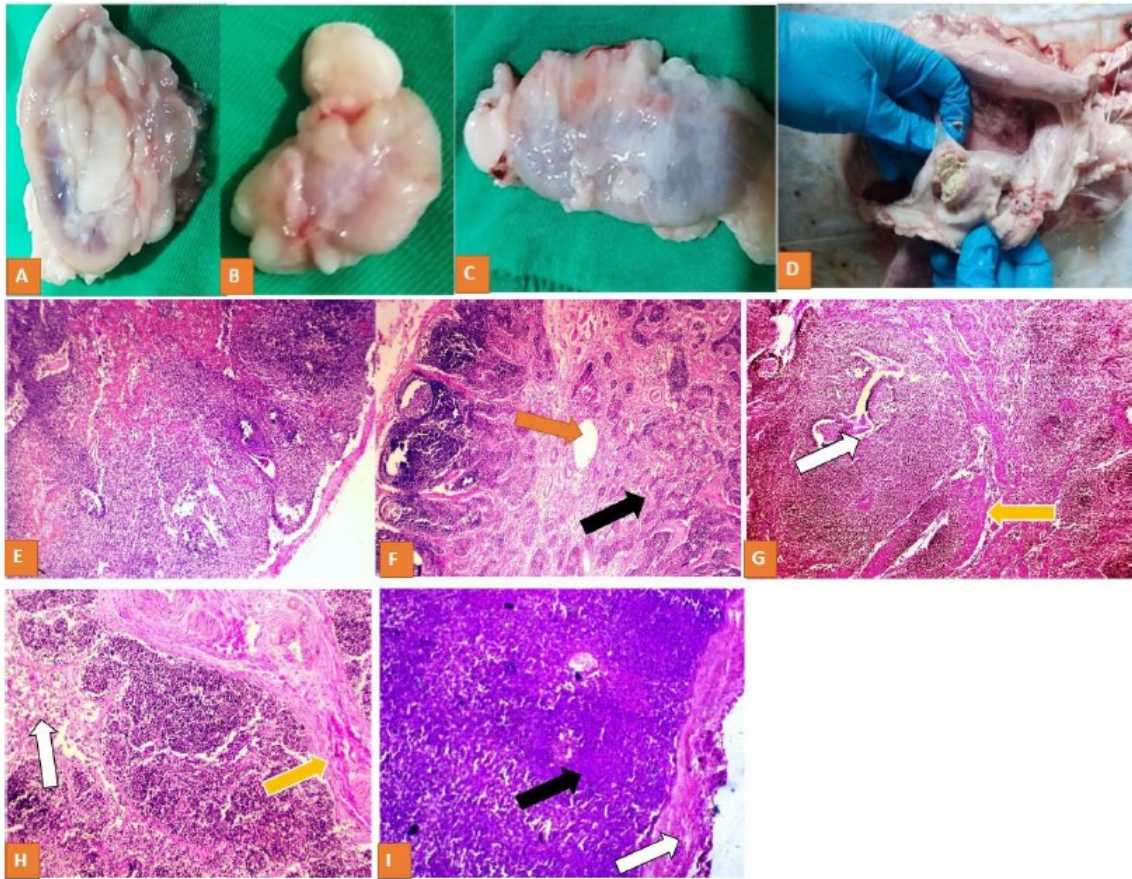
necrosis. Histological section of lung infested with hydatid cyst illustrates the outer fibrous capsule surrounding the cyst, that consist of germinated and laminated layer, with presence of inflammatory cells and the adjacent compression of the air spaces alongside the cyst. The verminous pneumonia characterized by present of different stages of parasitic infestation inside the alveolar space , with hyperplasia of alveolar epithelium as well as eosinophilic infiltration. As for adenomatosis in lung , there is hyperplasia of alveolar and bronchial epithelium like a finger projection with sloughing inside the lumen of alveoli as well as thickening of the alveolar wall (Fig. 2)



**Fig. 2.** Histological section of Ovine lung showing (A) bronchopneumonia with Bronchitis(orange arrow) (H & E stain, 10X) . (B) Tubercular pneumonia, presence of tubercle (black arrow (H & E stain, 10X). (c ) Histological section of Hydatid cyst with germinal layer (blue arrow) (H & E stain, 10X). (E) Histological section of Ovine lung showing hyperplasia and sloughing of alveolar epithelium (gray arrow) (H & E stain, 10X). (G) verminous pn. showing presence of parasite stages inside the alveolar space (blue arrow) (H & E stain, 10X). (H) Pulmonary adenomatosis. showing a finger like projection due to hyperplasia of alveolar epithelium of parasite stages inside the alveolar space(green arrow) (H & E stain, 10X).( I ) ovine Pulmonary bronchitis, showing hyperplasia of bronchial epithelium with infiltration of inflammatory cells and fibrosis. (Masson's Trichrome stain , 10x). (J) thickening of blood vessels wall and alveolar septa. (Masson's Trichrome stain , 10x). (K) thickening of alveolar septa with focal aggregation of inflammatory cells.(Masson's Trichrome stain, 10x).

The results of the gross examination of the mediastinal lymph nodes revealed various evident pathological changes, including the presence of inflammation indicated by the observation of edema, enlargement of some lymph nodes containing inflammatory exudate, as well as hemorrhage, congestion, and the presence of hemorrhagic and necrotic spots on the surface of the lymph nodes. Additionally, there was evidence of fibrotic changes indicated by the hardness of the texture and the accumulation of fibrous materials, along with thickening of the outer capsule. The histopathological examination results of the mediastinal lymph node samples revealed various pathological changes, including lymphadenitis

characterized by inflammatory exudate and edema, as well as necrosis of lymphoid cells within the lymphoid follicles. Additionally, there was an increase in fibrous septa thickening between the lymphoid follicles. Other sections revealed severe lymphoid cell necrosis within the follicles, forming cystic spaces within the parenchyma. Furthermore, and other tissue sections from the mediastinal lymph nodes exhibited significant lymphoid cell hyperplasia within the follicles, extending into the medullary region of the lymph node, along with hemorrhagic spots and deposition of hemosiderin pigment within the lymphoid tissue. Fibrotic changes and calcium deposition were also noted in some of these tissue sections (Figure 3).



**Fig. 3. Macroscopic and Microscopic mediastinal lymph nodes showing (A) congestion and necrotic area in cortex , (B) Atrophy and fibrosis , (C) Lymph node enlargement with increase thickness of capsule. (D) casseated lymph node(D). Histological section of a mediastinal lymph node showing (E) lymphadenitis with intraparenchymal hemorrhage and necrosis of lymphocytes within the lymphatic follicles (H & E stain, 10X). (F) Histological section of a mediastinal lymph node showing intra-parenchymal cystic structure (orang arrow) with replacement of the lymphatic tissue by an area of fibrosis and the presence of residual lymphocytes.(Black arrow) (H & E stain, 10X). (G & H)Histological section of a mediastinal lymph node showing severe thickening of the fibrous septa (yellow arrow) with the observation of necrosis in the lymphocytes (whit arrow) (H & E stain, 40X). (I ) Histological section of a mediastinal lymph node showing thickening of capsule(white arrow) and hyperplasia of lymphoid follicles (black arrow) (H & E stain, 10X).**

### **Discussion**

The main aim of sheep farming in Iraq is to use their meat as a protein source as well as for their milk, wool and leather. Environmental factors like heat and humidity contribute to respiratory diseases, which can reduce the productivity of these animals and cause economic losses for breeders. Stress factors, in addition to infections from bacteria, fungi, viruses, and mycoplasma, are part of the complex, multiple causes of respiratory dysfunction [12,13]. This study focused on detecting respiratory diseases in sheep through macroscopic and microscopic identification of lung and mediastinal lymph node lesions. This study has identified different types of pneumonia through the examination of 265 sheep, 155 (58.49 %) had gross and microscopic lesions in lung and mediastinal lymph nodes , Classified based on the type of

lesions, the distribution of the lesions, and the type of inflammatory exudate. Bronchopneumonia was recognized in 60%(n = 90/155) of the affected lungs, the gross evidence shows irregular consolidation with a lobular pattern. Consolidation was further in the left lobe than the right. Affected regions and frequently different sizes purulent, greenish foci were disseminated throughout pulmonary lobes particularly the middle, cranial, and accessory lobe. Microscopically, there were different types of inflammatory exudates rich with neutrophil, lymphocytes and macrophages in the lumens of the bronchioles and bronchi with hyperplasia of the epithelium lining , and in alveolar spaces. Neutrophil migration to the alveolar cavity and airways is induced by the release of chemical mediators, which prompt movement towards inflammatory sites(14), resulting in the accumulation of high neutrophil

counts in the alveolar cavity and airways, along with exudative cell presence, leading to purulent exudate(15). Bronchitis and inflammatory exudate lead to bronchial diameter constriction, potentially causing obstruction and subsequent atelectasis in the terminal airways of the obstructed region, ultimately resulting in adjacent emphysema formation due to the difference in air ratio within and outside the lung, with a higher air ratio within the lung. (16,17). Hydrated cysts infestation, accounting for 60%. The key role in the spreading and transmission of larvae, cysts, and eggs of tapeworms such as *Echinococcus spp*, was the introduction of animals from various places (18, 19), pollution of the urban environment as well as the large inhabitants of free-roaming dogs, which have indirect interaction with other animals like ovine and bovine without any boundaries, that spreading the infection and contaminating the soil, were shown to be important factors contributing to pulmonary diseases. Microscopically, the accumulation of inflammatory cells and their infiltration into the tissue surrounding the hydrated sac, as well as the pressure generated when some cysts rupture and their contents are released, collectively lead to fibrosis and atelectasis in the lung tissue. Pulmonary tubercular nodules and abscessation were identified (32% and 36.66%). The abscesses varied from 3 to 10 cm in diameter and appeared as single or occasionally multiple incidences in one or more lobes. pulmonary nodules containing thick, white-yellow, pus existed in the affected lung as well as in the mediastinal lymph nodes. The study found visible and tissue pathological lesions in mediastinal lymph nodes from slaughtered sheep. Inflammation was observed in many samples, with the highest percentage of visible pathological changes(20). These changes included lymph node enlargement and the presence of inflammatory exudate as well as abscessation. Inflammation and swelling result from bacterial or viral infection, leading to immune response within the lymph nodes as a reaction to these pathological agents, especially in the lungs, mediastinum, and airways(21, 22). The results showed the presence of numerous tissue pathological lesions, represented by severe necrosis, particularly the caseous type, in the lymphoid tissue, as well as fibrous thickening and replacement of necrotic debris with fibrous tissue.

### Conclusion

After conducting this investigation, we concluded that the most prevalent and significant ovine diseases that impaired the lower respiratory system's function and activity were lesions in the lungs and mediastinal lymph nodes, particularly different types of pneumonia and hydrated cyst infestation. The diagnosis was further supported by the fact that a significant percentage of the lungs

displayed the typical macroscopic look of various forms of pneumonia as well as all or some of the typical histological abnormalities associated with the lesions.

### Conflicts of interest

The authors declare that there is no conflict of interest regarding the research data and tools used in this study.

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