

## Pathology of the Trachea and Lungs in Sheep

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Article Received on 04.12.2015

Article Published on 08.01.2016

### Abstract

A survey on occurrence of pathological conditions of trachea and lungs of slaughtered and post mortem cases of sheep were investigated in the present study. A total of 156 cases of trachea and lungs were collected for histopathology from the Jammu region, Jammu & Kashmir state, India with age ranged from 6 months to 2 and a half years. Among them, 8.97% trachea and 37.82% lungs were found to be apparently abnormal in naked eye. In trachea, the gross lesions like congestion and haemorrhages (5.13%), frothiness (3.20%) and foreign bodies (1.92%) and histopathologically, congestion/haemorrhage (8.97%), acute tracheitis (7.05%) and sub-acute fibrinous tracheitis (4.49%) were recorded. Grossly lungs showed emphysema (23.08%), atelectasis (2.56%), cysts (4.49%), congestion (8.97%), haemorrhage (4.49%), red hepatization (10.26%) and grey hepatization (11.53%), adhesion with pleura/ thickening of pleura (0.64%), abscesses (1.28%) and growth (0.64%). Histopathological examination of lungs revealed emphysema (24.36%), atelectasis (3.21%), haemosiderosis (4.49%), congestion (12.18%), edema (8.97%), bronchitis (5.76%) bronchiolitis (9.62%), haemorrhagic pneumonia (7.69%), bronchopneumonia (1.92%), fibrinous bronchopneumonia (3.84%), fibrinous purulent bronchopneumonia (1.92%), suppurative broncho-pneumonia (2.56%),

interstitial pneumonia (8.33%), granulomatous pneumonia (1.28%), verminous pneumonia [parasitic pneumonia (2.56%), and hydatid cysts (6.41%)], bronchiolar cell hyperplasia (0.64%) and bronchiolar-alveolar carcinoma (0.64%). For the morphological descriptions, the lesions were categorized into various types; however a single section showed intermixture of various lesions.

**Key words:** Pathology, lungs, trachea, spontaneous study, Sheep

### Introduction

The pathology of respiratory system in sheep cause debility or death in affected animals leading to great economic loss to farmers. Pneumonia is one of the most important causes of mortality in newborn, feedlot lambs and adult sheep. Pneumonia is caused by a complex interaction between the environment, which produces stress, microorganisms, and the host's immune response. Pneumonic lesions are frequently seen in necropsy in sheep of all ages. It is likely that, either alone or in combination with other disease conditions, pneumonias are a significant cause of loss to the sheep industry

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(Bekele *et al.*, 1992; Rook *et al.*, 1990; Goodwin *et al.*, 2005; Daniel *et al.*, 2006; Oru, 2006). Pneumonia continues to be one of the most important causes of lamb morbidity and mortality. The histological character of pneumonia probably changes according to its etiological character, host immunity, environmental conditions, therapeutic attempts, and disease prognosis (Oru, 2006). The present investigation survey work was carried out in and around Jammu region to determine the incidence of the pathological changes/ lesions in lungs and trachea of lambs and adult sheep with reference to its role in lamb morbidity and mortality.

### Materials and Methods

A survey on the occurrence of pathomorphological lesions in the trachea and lungs of the sheep in Jammu region was carried out. The age of the carcasses were ranged from 6 months to two and a half years. Out of the total 156 tracheas and lungs specimen examined, 129 were collected from the various slaughter houses in Jammu and 27 samples were taken from carcasses of the sheep submitted to the Division of Veterinary Pathology and other governmental sheep farms in Jammu region. The trachea and lungs were examined for the presence of any gross lesions. The gross tissue changes were observed and recorded carefully. The trachea and lungs were examined whole and also by making various incisions vertically and or transversely in all lobes to observe the presence of any lesion. The representative tissue samples from trachea and lungs of all cases were preserved in

10% formal saline for routine histopathological examination.

### Results and Discussion

The different types of tracheal and pulmonary lesions recorded grossly. Among them, 14 trachea (8.97%) and 59 lungs (37.82%) were found to be apparently abnormal when seen with naked eye. In trachea, the gross lesions like congestion and / pinpoint to patchy haemorrhages (5.13%), frothiness (3.20%) and foreign bodies such as ingested materials and grass (1.92%) were recorded. Gross lesions observed in lungs included emphysema (23.08%), atelectasis (2.56%), cysts (4.49%), congestion (8.97%), haemorrhage (4.49%), red hepatization (10.26%), grey hepatization (11.53%), adhesion with pleura/ thickening of pleura (0.64%), abscesses (1.28%) and growth (0.64%). The growth in the diaphragmatic lobe of the lungs was firm in consistency, multifocal whitish yellow in colour with the variable size up to 3.85cm in diameter. The occurrence of different tracheal and pulmonary lesions recorded under microscopic observations.

### Histopathology

Based on histopathological examination, the trachea revealed congestion/haemorrhage (8.97%), acute tracheitis (7.05%) and sub-acute fibrinous tracheitis (4.49%).

The lungs showed various pathological changes including non inflammatory conditions such as emphysema (24.36%) which had the highest incidence, followed by atelectasis (3.21%) and haemosiderosis (4.49%). The

haemosiderosis in lungs was characterized by the presence of golden yellow coloured hemosiderin pigment in the macrophages and/ histiocytes. The histopathological changes such as congestion or pin point haemorrhages (12.18%) and edema (8.97%) was also recorded . Edema was characterized by presence of pink colored edematous fluid in the lung alveoli. The inflammatory conditions included bronchitis (5.76%) which was characterized by the presence of mucus exudates in the lumen of the bronchus. In and around the bronchial wall and lumen and infiltration of neutrophils, lymphocytes, congestion and haemorrhage in alveoli and septa were found. Bronchiolitis, (62%) was characterized by the infiltration of inflammatory cells in and around the bronchiolar wall and degeneration and necrosis of mucosal epithelia.

Haemorrhagic pneumonia (7.69%) showed diffuse severe dilatation and engorgement of alveolar capillaries and blood vessels along with multifocal severe haemorrhages within the alveoli, inter-alveolar septa and bronchioles.

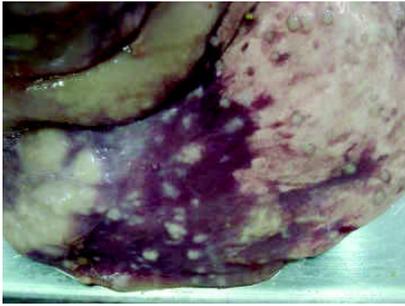
In acute bronchopneumonia (1.92%), hyperemia and linear consolidated areas were grossly visible on cranial lobes. On histopathological examination, diffuse moderate hyperaemia, infiltration of neutrophils and serous exudations were seen within the alveolar and bronchiolar lumina. Some bronchioles revealed presence of multifocal mild lymphoid aggregates while others showed diffuse proliferation of mononuclear cells predominantly

lymphocytes which extended into alveolar walls. Many alveoli were also filled with pink stained fluid.

The fibrinous bronchopneumonia (3.84%) showed fibrino-cellular exudates consisting of meshwork of fibrin, neutrophils and macrophages in the lumen of bronchioles, alveoli and inter-alveolar septa. There was diffuse alveolar necrosis and edema in the inter-alveolar septa and sloughing of bronchial mucosa.

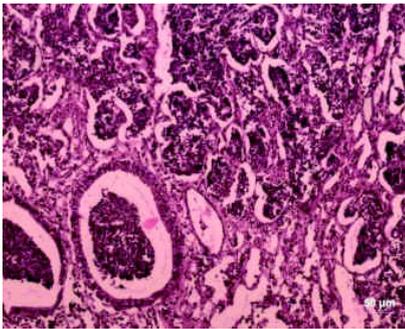
In fibrinous necrotic bronchopneumonia (1.92%), there multifocal areas of neutrophils undergoing necrosis, macrophage mixed with fibrin deposition were found. Inter-alveolar capillaries were enlarged, but hyperemia disappeared in the latest periods. In fibrinous necrotic pneumonia, neutrophilic exudation with necrosis was prominent. Interlobular septa enlarged and pleuritis developed because of fibrinous exudation. Fibrinous pleuritis revealed the presence of edema fluid in the interstitial area and fibrin deposition along with inflammatory cells such as lymphocytes, macrophages and plasma cells in the serosal layer of lungs.

The suppurative bronchopneumonia (2.56%) was classified into the catarrhal suppurative bronchopneumonia and necrotic suppurative bronchopneumonia. The catarrhal suppurative bronchopneumonia grossly revealed multifocal and severely consolidated areas visible on the cranial lobes. There was purulent exudation on the cut surfaces of the lungs (Fig.1.). Histopathologically, moderate neutrophilic exudations were observed in both alveolar and bronchiolar lumina.

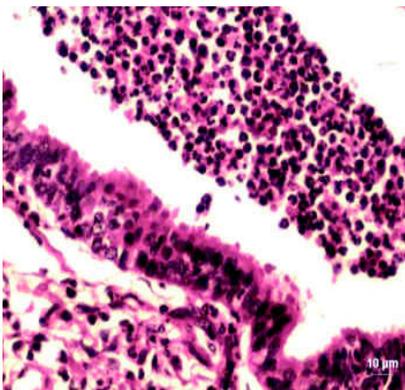


**Fig. 1: Lungs Revealed Reddish Brown Firm Area with Multifocal Whitish Foci**

Alveolar macrophages within the alveoli and epithelial desquamation of the bronchioles were also seen in this area. There was presence of inflammatory cells consisting of neutrophils in large numbers within the lumen of bronchiole and alveoli (Fig.2-3).



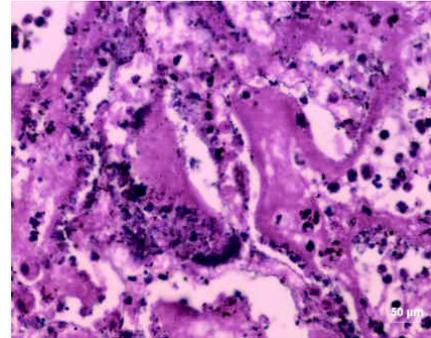
**Fig. 2: Acute Bronchopneumonia: Lungs Revealed Neutrophilic Infiltration in the Alveoli and Brinchiolar Lumen Hex 100X**



**Fig. 3: Lungs Revealed Neutrophilic Infiltration in the Bronchiolar Lumen Hex 400X**

These neutrophils were seen in different stages of disintegration. The

necrotic suppurative bronchopneumonia was more extensive and necrotic changes with large amounts of neutrophils and necrosis were seen, and severe desquamation was detected on bronchial and bronchiolar epithelium (Fig. 4).



**Fig. 4: Lungs Revealed Bronchiolitis with Bacterial Colonies Hex 400X**

Interstitial pneumonia was observed in 8.33% cases which was characterized by thickened alveolar septae due to accumulation of macrophages containing haemosiderin pigments and lymphocytic cells and proliferation of fibrous connective tissue. Exudates and haemorrhage was sometimes seen within the alveoli. Additionally, lesions were characterized by a marked increase in mononuclear cells in the interalveolar septa and presence of varying numbers of macrophages within the alveolar lumina. Peribronchial and peribronchiolar proliferation of lymphocytes was detected in many interstitial

pneumonitis. Peribronchiolar and peribronchial lymphocytic proliferation were prominent however, in a few cases, mononuclear cell and fibrous tissue proliferations were more prominent in interalveolar septa. One case with thickening of the alveolar septa, neutrophilic exudation was also observed within the alveolar lumina, and this type was called atypical

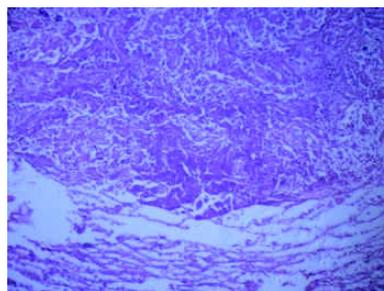
interstitial pneumonia or broncho-interstitial pneumonia. Bronchiolitis obliterans were detected in two lungs.

In 1.28% cases, granulomatous pneumonia was recorded. The lesions were characterised by diffuse multifocal pattern with many different granuloma of various sizes mingling into each other. The granuloma consisted of central area of caseative necrosis surrounded by numerous epithelioid cells with many giant cells and lymphocytes. There was diffuse proliferation of fibroblasts in the entire lung.

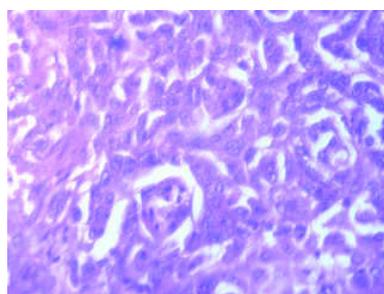
Verminous pneumonia [parasitic pneumonia (2.56%) and hydatid cysts (6.41%)] was also recorded. Histopathologically, stained sections of lungs affected with parasitic pneumonia revealed cut sections of parasites with necrosis and/or rupture of alveolar walls with infiltration of neutrophils, macrophages, giant cells with a few eosinophils. There was mild exudation of fibrin into alveoli and bronchioles. A mild hyperplasia of alveolar histiocytes was also observed. In case of hydatid cyst, the cyst wall was composed of proliferation of fibrous connective tissue with infiltration of mononuclear cells and a few eosinophils.

One case of focal bronchiolar cell hyperplasia (0.64%) with hyperchromatic nuclei was recorded. One case of bronchio-alveolar carcinoma was also recorded in this limited investigation study. On histopathological examination, the growth showed a papillary pattern of well differentiated malignant neoplasia of bronchiolar and or alveolar cells. In alveolar area showed multilayer low

columnar neoplastic cells with moderate stroma. Adjacent areas showed multiple layers of cuboidal cells in the alveoli along with severe congestion/haemorrhages in new blood vessels. The neoplastic cuboidal to pleomorphic cell with scanty cytoplasm are located on delicate stromal septa with continuous folding and occasionally a few papillary pattern and were projecting in to the lumens. The nuclei of the neoplastic cells were hyperchromatic and or vesicular. The vesicular nuclei revealed multiple nucleoli with a few mitotic figures. Some papillary areas, the disintegrate and undergoes various degrees of necrosis and amorphous debris with lymphocytic infiltration (Fig. 5 & 6).



**Fig. 5: Bronchiolar Alveolar Carcinoma of Lungs showed Neoplastic Growth Compressing Adjacent Alveolar Tissue Hex 100X**



**Fig. 6: Bronchiolar Alveolar Carcinoma of Lungs Showed Hyperchromatic and Vesicular Nuclei and Multiple Nucleoli. Hex 400X**

## Discussion

An occurrence of pathological lesions both non inflammatory and inflammatory lesions affecting trachea and lungs has been carried out by different workers in small and large ruminants (Sahoo and Mohanty, 1966; Jones *et al.*, 1997; Jubb *et al.*, 1997; Radostits *et al.*, 2002; Akbor *et al.*, 2007). Moreover, the possibility of higher occurrence of the pathological conditions might be due to inclusion of post mortem cases and slaughter of older sheep in the present study. Early worker classified pneumonias into 7 subgroups according to their histological appearances such as acute catarrhal bronchopneumonia, catarrhal purulent bronchopneumonia, purulent necrotic bronchopneumonia, fibrinous pneumonia, fibrinous necrotic bronchopneumonia, interstitial pneumonia and verminous pneumonia. *Mannheimia haemolytica*, *E. coli* and *Pasteurella multocida* were determined to be the most important bacterial agents of lamb pneumonia, and caused different pneumonic lesions, which were dependent upon various factors (Oru, 2006)

The typical gross appearance of bronchopneumonia is of irregular consolidation in cranioventral regions. The cranial and middle lobes are most often affected in those species having well-defined lobulation. Consolidated lungs vary from dark red, through gray-pink, to more gray, depending on the age and nature of the process. Consolidation of the tissue is the single most important gross criterion of pneumonia (Dungworth, 1985). The cut surface of infected lungs

reflects the variability of involvement seen on the pleural surface.

Several histological forms are seen in pneumonic diseases: mild to severe, acute to chronic, and exudative to proliferative interstitial. Traditional bacterial pneumonias are characterized by exudation and consolidation of the lung. The typical gross appearance of bronchopneumonia is of irregular consolidation in cranioventral regions. The cranial and middle lobes are most often affected in those species having well-defined lobation. Consolidated lungs vary from dark red, through gray-pink, to more gray, depending on the age and nature of the process. Consolidation of the tissue is the single most important gross criterion of pneumonia (Dungworth, 1985). The cut surface of infected lungs reflects the variability of involvement seen on the pleural surface.

In catarrhal or suppurative bronchopneumonia, the section of consolidated lobules is moist and mucopurulent or purulent material can be expressed from small airways. The cut surface of fibrinous inflammation has a dull appearance. Histopathologically, bronchioles and immediately adjacent alveoli are filled with neutrophils, and sometimes an admixture of various amounts of cell debris, mucus, fibrin, and macrophages. Depending on the nature and pathogenicity of the causative agent, bronchiolar epithelium varies from necrotic to hyperplastic. Interstitial pneumonias have been thought of as chronic inflammatory conditions in which there is predominantly a proliferative

response involving alveolar walls and the supporting stroma. Acute pulmonary injury can be caused by or is associated with a wide variety of conditions, such as severe viral pneumonia, chemical lung injury, acute pancreatitis, shock, and septicemia. Most interstitial pneumonias in animals are infectious in origin and are caused by viral, bacterial, fungal, or parasitic diseases. The lungs are at the crossroads of parasitic migration, and many parasites that pass through them cause varying degrees of damage according to the nature and intensity of the host-parasite interaction. Severe and possibly fatal pulmonary lesions may develop if the migrating parasites are large in number, large in size, or especially when the host has a hypersensitive reaction to them (Dungworth, 1985; Lehmkuhl et al., 1989; Haziroglu et al., 1994; Oros et al., 1997; Goodwin et al., 2005; Daniel et al., 2006; Oru, 2006).

In the present study, based on histopathological examination, the tumour in the lungs was diagnosed as bronchio-alveolar cell carcinoma. Similar type of lung tumour was also recorded by Moulton, (1990) in domestic animals.

For morphological descriptions, the pathological lesions were categorized into various types, such as non inflammatory, inflammatory, hyperplastic and neoplastic conditions. However, a single pathological condition revealed intermixture of various pathological lesions. Though, the causative agents were not identified from the lesions, the findings of this investigation may help the veterinarian to know the nature and

type of common pathological lesions of respiratory system of sheep.

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