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Respiratory Infection of Pigs in and around Hassan District Karnataka

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ABSTRACT

Porcine Respiratory Disease Complex is a complex condition that results in economic losses for producers and health problems for growing pigs. The pathogens involved may include viruses, bacteria, or mycoplasmas. Furthermore, environmental stressors associated with farm management can affect the animals' health. Various respiratory diseases can act as triggers either independently or, more frequently, synergistically to produce a compounded effect. The prevalence and distribution of these diseases differ based on the scientific production unit, both within and across various regions. In this study, we examined the respiratory organs (lungs, tonsils, and bronchial lymph nodes) from 108 pigs as our research subjects. A comprehensive gross examination was conducted, and any lesions showing abnormalities were recorded. The most frequently observed microscopic lesions were indicative of interstitial pneumonia, broncho-interstitial pneumonia, and bronchopneumonia, regardless of the underlying cause, particularly in the Hassan region.

HIGHLIGHTS

- To understand the distribution pattern of porcine respiratory disease complex.
- Major microscopic lesions were indicative of interstitial pneumonia, broncho-interstitial pneumonia, and bronchopneumonia.

Keywords: Porcine, Pneumonia, Tonsil, Lymph node, Hassan

Respiratory tract infections are a critical concern in today's intensive swine farming, both domestically and globally. The escalation of pig production heightens the prevalence and economic impact of this illness, independent of the management techniques applied. A range of factors results in considerable financial losses, including direct losses from mortality and required slaughter, lower daily weight gain, increased feed consumption for average daily gain, delayed fattening times, higher treatment costs, and a significant proportion of light pigs in abattoirs (Dosen *et al.,* 2007). The term "porcine respiratory disease complex" (PRDC) denotes a set of respiratory disorders triggered by a range of agents, including bacteria, viruses, environmental conditions, and management techniques. PRDC is primarily observed in fattening pigs aged 13 to 20 weeks, but it can also adversely affect nursery piglets aged 5 to 12 weeks, with mortality and morbidity rates between 4 to 6% and 30 to 70%, respectively. Presently, the pathogens responsible for PRDC encompass viruses such as the pseudorabies virus (PRV), porcine circovirus type 2 (PCV2), and porcine reproductive and respiratory syndrome virus (PRRSV). Furthermore, bacteria such as *Glaesserella (Haemophilus) parasuis(G. parasuis), Actinobacillus pleuropneumoniae (A. pleuropneumoniae), Pasteurella multocida (P. multocida),* and *Bordetella bronchiseptica (B. bronchiseptica*) are also recognized as

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contributors to PRDC. Although, each pathogen can induce disease independently, co-infection with the pathogens mentioned above often results in more pronounced clinical symptoms and lesions (Sun *et al.,* 2022). The objective of this research was to examine the incidence and respiratory infections in pigs, regardless of the underlying cause, in the vicinity of the Hassan region.

MATERIALS AND METHODS

The study was carried out at Hassan Veterinary College, Karnataka Veterinary, Animal and Fisheries Sciences University, in Bidar.This study encompasses both macroscopic and histological assessments of the organs, regardless of the underlying cause. Approximately 108 representative tissue samples were collected from slaughterhouses in the vicinity of Hassan, and postmortem examinations of pigs presented were carried out within the department. Notable gross lesions were identified, and organ samples from the carcasses were retrieved and preserved in 10% neutral buffered formalin (NBF) for histopathological analysis. The samples included lungs, tonsils, and bronchial lymph nodes.

Histopathology

Tissue samples were obtained in 10% neutral buffered formalin. These samples were histopathologicallyanalysed, stained with Harris haematoxylin and eosin (H&E), mounted with Canada balsam, and covered with a cover slip for microscopic examination (Suvarna *et al.,* 2018).

RESULTS AND DISCUSSION

The study aimed to document the occurrence and pathology of respiratory infections in pigs in and around Hassan District. The current examination, which lasted one year from January 2022 to December 2022,evaluated a total of 108 pig carcasses. The study findings are reported here.

A total of 108 samples were analysed, of which 82 were collected from slaughterhouses in the Hassan region, and 26 were obtained from the Veterinary College, Department of Veterinary Pathology, from samples provided by nearby farms. Detailed analysis of 108 pig carcasses indicated that two (1.85%) had reproductive abnormalities, 19 (17.59%) had digestive lesions, and 87 (80.55%) showed respiratory lesions.

In one analysis, samples were systematically examined, and a standardized diagnostic approach was provided to the Veterinary Diagnostic Laboratory (IZSLER, Brescia) for suspected PRDC cases. In 2014, the percentages of weaned piglets and growing/fattening pigs with PRDC were 42.2% and 57.8%, respectively, and then 53.7% and 46.3% in 2015, and 57.5% and 42.5% in 2016 (Ruggeri *et al.,* 2020).

The large-scale patterns of lung involvement and the histological characterization of lesions serve as the most effective indicators that pathology can offer for making a diagnosis. In order to evaluate causation, these indicators should be combined with epidemiological data, clinical history, and various direct or indirect methods.

Gross lesions

A comprehensive physical examination was conducted on pig carcasses during necropsy, where lesions that demonstrated abnormalities in color, texture, and consistency were observed and recorded. The examination was thorough to ensure all irregularities were captured. These observations were carefully documented for subsequent evaluation.

Among 87 cases, atelectasis was identified as being associated with respiratory lesions in 49 cases (56.32 per cent). The damaged regions appeared depressed and reddish in contrast to the normal areas. In 58 cases (66.66%), emphysema was detected; these lesions were noted for their pale color and the presence of large air-filled bullae within the normal parenchyma (Fig. 1). There were 26 cases (29.88%) of pulmonary hemorrhage, where the lungs displayed patchy areas of reddish discoloration on their surfaces. In 38 cases (43.67%), pulmonary edema was observed, with the lungs appearing thick, edematous, and moist. The cut surface of the parenchyma was oozing a thin fluid (Fig. 2). Pulmonary congestion was noted in 32 cases (36.78%) (Fig. 3). The affected lungs were firm in texture and dark red in color, with blood seen seeping from the incision.

In order for the lesions to advance and exhibit distinct patterns within the lungs, the pathogens responsible for respiratory illnesses enter the body *via* either an aerogenous or hematogenous route (Rose and Madec, 2002). In this research, pneumonic lesions were detected

in 87 (80.55%) out of the 108 lung tissues analysed. Pneumonia lesions were classified as interstitial pneumonia, bronchopneumoniaor broncho-interstitial pneumonia based on gross morphological lesions, the lobes involved, lung consistency, and the presence or absence of exudate. In this study, three cases of bronchopneumonia, 26 cases of broncho-interstitial pneumonia, and 58 cases of interstitial pneumonia were identified from the total of 87 cases. The lungs affected by interstitial pneumonia were tan-mottled, not collapsed, and exhibited a rubbery texture. The lung surfaces were slightly marked by rib impressions, with occasional interstitial edema. Additionally, tracheobronchial lymph node hypertrophy is commonly observed. Pigs with complicated viral infections (PRDC) often show signs of interstitial pneumonia (Pieters and Maes, 2019; Ruggeri *et al.,* 2020). The lungs that were affected exhibited different levels of ecchymotichemorrhage, congestion, and hyperplasia of the interlobular septa.

The gross examination of the lungs with bronchointerstitial pneumonia showed that the lungs were edematous, non-collapsible, and exhibited mild to severe congestion, along with patchy areas of consolidation.In cases of bronchial pneumonia, the cranio-ventral regions of the lungs appeared reddish-brown, were firm and congested, and had diffuse patches of consolidation. Distinct tan to grey foci were visible on the surface. The lumen contained varying levels of exudate when the bronchi and bronchioles were cut open.Additionally, there was mild to moderate edema of the tonsils, congestion, and hemorrhages (Fig. 4), as well as swollen bronchial lymph nodes with mild to severe congestion (Fig. 5). The attempts to correlate the identified viruses and/or bacteria with the gross lung

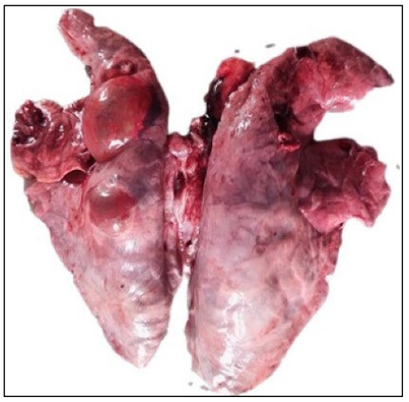

Fig. 1: Lung showing raised areas of emphysematous bullae

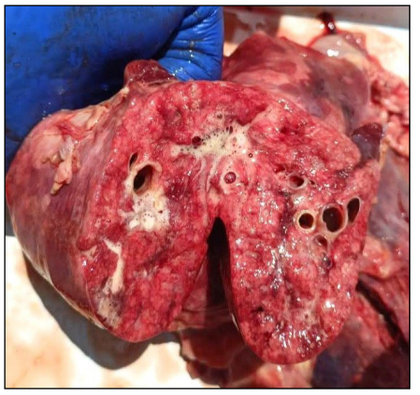

Fig. 2: Lung showing oozing of frothy fluid from cut section

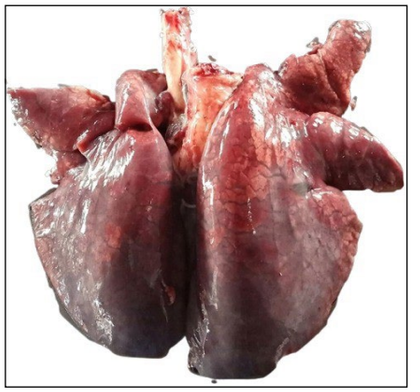

Fig. 3: Lung showing diffuse congestion

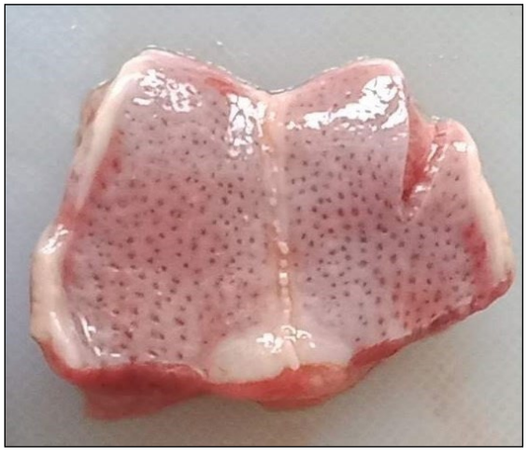

Fig. 4: Tonsil showing swelling along with petechial hemorrhages

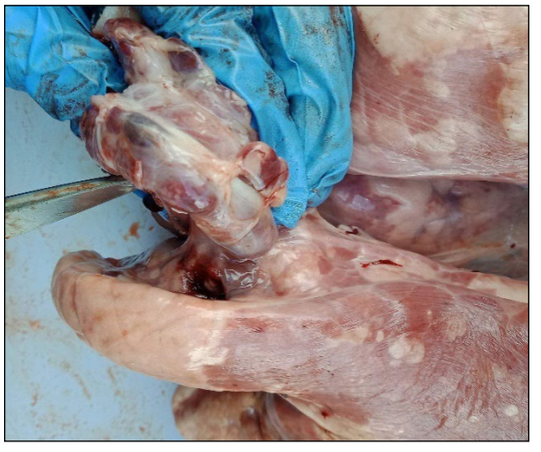

Fig. 5: Bronchial lymph node showing swelling and congestion

lesions classified as pleuropneumonia, pleuritis, interstitial pneumonia, broncho-interstitial pneumonia, catarrhal bronchopneumonia, purulent bronchopneumonia, and pleuropneumonia have yielded noteworthy findings. Nevertheless, a solitary agent has been associated with various types of lesions. This could be influenced by the presence of numerous viruses and/or bacteria during the disease's etiopathogenesis (Ruggeri *et al.,* 2020). The macroscopic characteristics of interstitial pneumonia feature lungs that remain inflated, rib impressions, and patchy, lobular, or diffuse color variations (from red in the acute phases to a pale whitish hue in the chronic stages), alterations in consistency (firm texture), interstitial edema (noted in the acute phase), and absence of airway involvement (Rose and Madec, 2002).

Microscopic lesions

The walls of the alveoli were observed to be parallel and closely spaced, while the area affected by atelectasis exhibited collapsed or slit-like alveoli. The interalveolar septa were ruptured, and the alveoli were distended in regions affected by emphysema. In several instances, the emphysematous regions were found adjacent to compressed alveoli. Examples of pulmonary hematogenous pathology include larvae of Metastrongylus species, which damage the alveolar septa, and the pulmonary invasion by *Ascaris suum*. The presence of parasites and exudate within the small airways is linked to atelectasis and emphysema, respectively, potentially leading to occlusion or blockage (Rose and Madec, 2002). The sections of the lung demonstrated the existence of red blood cells (RBCs) in the inter-alveolar, interlobular septa, and peribronchial areas.Exudates that were rich in erythrocytes were detected inside the alveoli (Fig. 6) and bronchial lumen. Eosinophilic fluid was present in the interstitium, bronchioles, and alveolar lumen of the edematous lung. The blood vessels and capillaries in the lung parenchyma were congested with RBCs.

Histopathologically, interstitial pneumonia was characterized by an acute inflammatory response that mainly affected the interstitial spaces, causing thickening due to the accumulation of red blood cells, inflammatory cells, and edematous eosinophilic fluid. The cells observed were predominantly mononuclear. The loss of bronchial and bronchiolar lymphoid tissue was a consequence of lymphocytolysis. The most striking findings were edema, congestion, and, in certain cases, hemorrhage. There were several instances of perivascular lymphocyte infiltration. In the majority of cases, the affected area was accompanied by atelectatic and emphysematous alveoli (Fig. 7). Pneumotropic or endotheliotropic agents that enter the bloodstream from the primary site of replication, for instance, in PCV2 and PRRSV infections, as well as septicemia from Gram-negative bacteria, can result in interstitial pneumonia. The variable thickening of the bronchiolar and alveolar walls serves as an indicator of interstitial pneumonia, which is caused by a virus. With PRCV, PCV2, and PRRSV infections, interstitial pneumonia can vary in severity from moderate to severe. Common indicators of PRRSV infection include intra-alveolar necrotic macrophages and hyperplasia of type 2 pneumocytes. It is often associated with severe rhinitis (Ruggeri *et al.,* 2020).

The notable distension of interstitial spaces caused by the build-up of eosinophilic edematous fluid and the infiltration of inflammatory cells was a defining feature of acute broncho-interstitial pneumonia. The alveolar capillaries were engorged with blood, and in certain instances, eosinophilic proteinaceous exudate was present. Signs of inflammation were also evident in the bronchioles and bronchus (Fig. 8). The lumen contained hemorrhagic exudate, fibrin, and inflammatory cells, while the bronchial and bronchiolar epithelial cells exhibited hyperplasia. In lungs that were severely affected, bronchial epithelial cells displayed degenerative alterations alongside considerable hemorrhage, with hemosiderin present, and the lumen was filled with fibrin-haemorrhagic exudate. Occasionally, the cilia lining the bronchi were missing. In most cases, the bronchus showed an increased quantity of goblet cells. The presence of bronchointerstitial pneumonia and necrosis of the airway epithelium, characterized by leukocytes and cellular debris occupying the lumen, are indicative of SIV infection (Caswell and Williams, 2015).

Pathohistologically, swine influenza is characterized by necrosis and diffuse degenerative changes in the epithelium of the bronchi and bronchioles. The lumen of the bronchi, bronchioles, and alveoli is filled with exudates that include neutrophilic granulocytes and desquamated cells. Microscopic characteristics of lung tissue consist of inflammatory cell infiltration in the alveolar septa, hypertrophy and hyperplasia of type II pneumocytes,

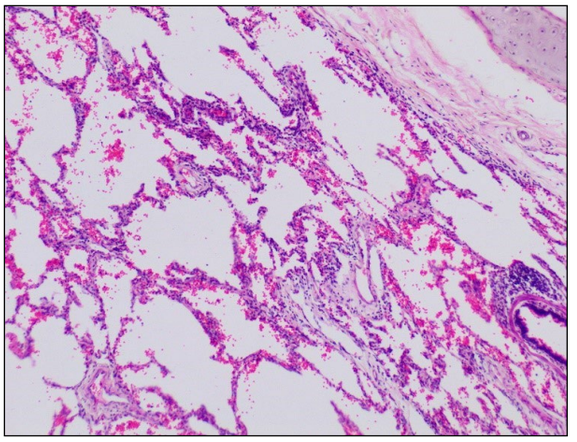

Fig. 6: Section of lung showing hemorrhages in the alveoli. (H&Ex100x)

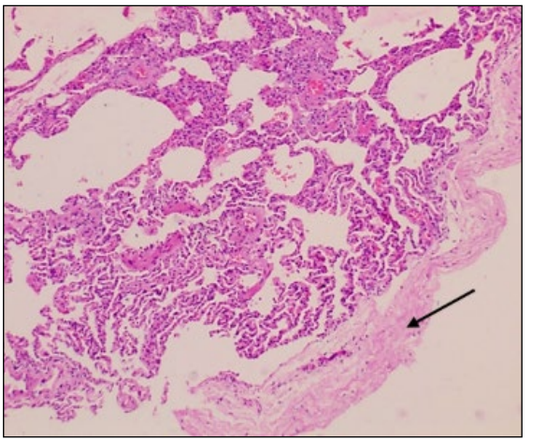

Fig. 7: Section of lung showing interstitial pneumonia along with atelectic and emphysematous area. Note the thickened pleura (arrow). (H&Ex100x)

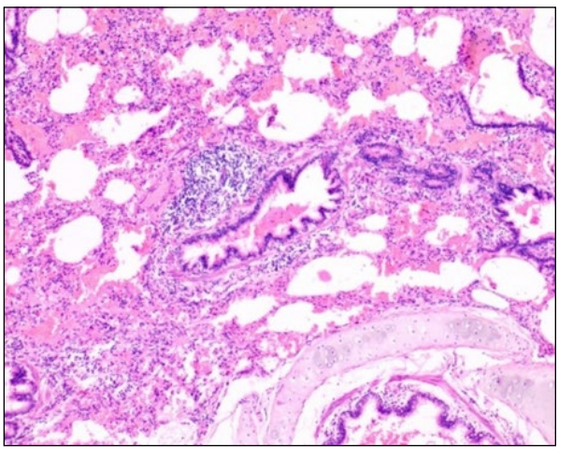

Fig. 8: Section of lung with broncho-interstitial pneumonia showing inflammatory changes in interstitial spaces, bronchus and bronchioles. Also note haemorrhage and BALT depletion. (H&Ex100x)

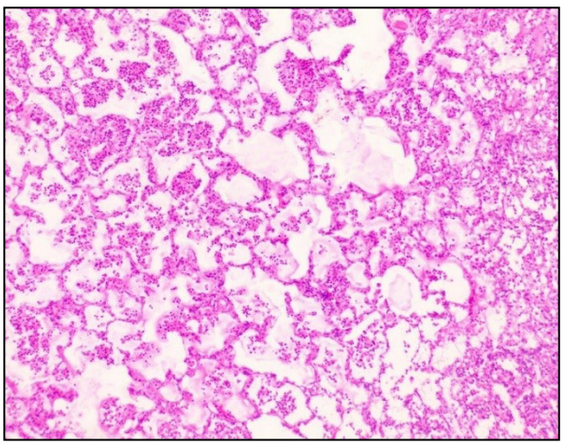

Fig. 9: Section of lung with bronchopneumonia showing serous exudate and inflammatory cells infiltration in the alveolar lumen. (H&Ex100x)

broncho-interstitial pneumonia with necrotic bronchitis and bronchiolitis, along with the filling of alveolar spaces and airways with a liquid containing proteins and various inflammatory cells (Bojkovski *et al.,* 2022). If pigs are infected with the coronavirus, clinical symptoms and macroscopic lesions may vary from being undetectable to showing extensive lung changes that ultimately lead to complete consolidation. A microscopic evaluation of the lungs indicates bronchointerstitial pneumonia, which is marked by an increase in neutrophil granulocytes and macrophages in the alveolar spaces, as well as necrosis, metaplasia, and proliferation of the bronchiolar epithelium (Šamanc, 2009). Bronchointerstitial pneumonia has often been observed and connected to both *M. hyopneumoniae* and Influenza A Virus (Schaefer *et al.,* 2013).

In cases of bronchopneumonia, inflammatory alterations were observed in the alveoli, bronchioles, and bronchus.

Inflammatory cells, predominantly neutrophils along with a few lymphocytes, were detected at the bronchoalveolar junction, as well as in the bronchi, bronchioles, and the alveolar lumen (Fig. 9). Type II pneumocytes exhibited proliferation within the alveoli, accompanied by perivascular infiltration of lymphocytes. There were varying levels of congestion and hemorrhage. Adult Metastrongylus is exclusively located in the small bronchi of the dorsal lung regions, where it induces catarrhal purulent bronchitis, which is further aggravated by bacterial infections. The resulting lesions are further complicated by parasite-specific granulomatous and interstitial pneumonia (Rose and Madec, 2002). Studies have demonstrated that occurrences of *M. hyopneumoniae* were notably more likely to present with purulent and catarrhal bronchopneumoniae. When compared to weaned piglets, the lesions were observed to be more frequent in fattening pigs. As one of the key respiratory pathogens, *M. hyopneumoniae* can lead to disease either on its own or in combination with other ailments (Opriessnig *et al.,* 2004).

There have been reports of *M. hyopneumoniae* coexisting with PRRSV or *S. suis* (Halbur *et al*., 2000; Thanawongnuwech *et al.,* 2004). While *B. bronchiseptica* is commonly known to be the most common lung pathogen in young pigs, causing hemorrhagic bronchopneumonia, it is primarily known to be an opportunistic pathogen that contributes to the PRDC in older pigs (Brockmeier *et al.,* 2019). A significant mortality rate can result from fibrinohemmorrhagic necrotizing bronchopneumonia and fibrnous pleuritis, which are symptoms of pleuropneumonia in animals infected with this Gram-negative bacterium (Sassu *et al.,* 2018). *Streptococcus suis* is the primary cause of swine bronchopneumonia, vaginitis, arthritis, and meningitis (Reams *et al.,* 1994).

The thorough histopathological evaluation of lymphoid organs demonstrated that the tonsillar lymphoid follicles showed different degrees of congestion and a reduction in lymphoid cells as a consequence of lymphocytolysis (Fig. 10). The crypts of the tonsils were thickened, exhibiting degenerative changes in the epithelial cell lining, numerous areas of necrosis, and the growth of fibrous tissue. A small number of affected tonsils presented with giant and epithelioid cells scattered throughout the lymphoid follicles, along with histiocytes. The pulmonary lesions linked to *Haemophilus pleuropneumonia* are characterized by hemorrhage, necrosis, infiltration of lymphocytes and macrophages, vascular thrombosis, and fibrin accumulation in lymphatics and blood vessels (Schiefer and Greenfield, 1974; Bertram, 1985). Occasionally, syncytial development was detected in the germinal core of the tonsillar lymphoid follicle as well as within the tonsillar crypts.Various levels of lymphocytic depletion were recorded in the bronchial lymphoid follicles, with the germinal core and the follicle periphery displaying the most significant depletion. An increased presence of mitotic cells was found in the germinal centre of the lymphoid follicles. There was evidence of granulomatous inflammation, along with a notable number of scattered macrophages, particularly in the medullary region. The emergence of syncytia and a reduction in lymphoid cells around the blood vessels were observed in the medullary region. Subcapsular hemorrhages were noted in a few instances. In the hematogenous spread of systemic diseases (PCV2 and PRRSV), some lesions target additional areas, mainly lymphoid organs (Caswell and Williams, 2015).

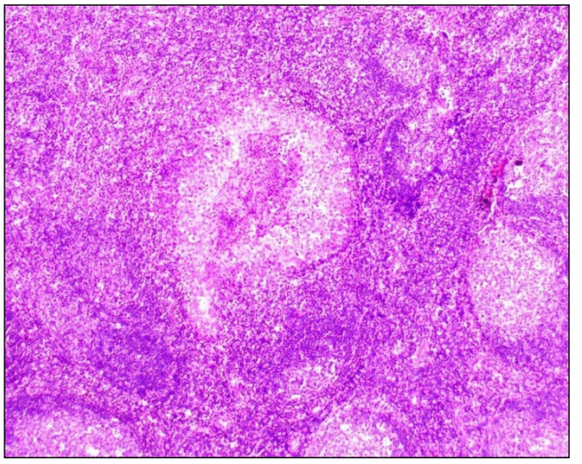

Fig. 10: Section of tonsil showing depletion of lymphoid follicles along with necrosis in the germinal centre. (H&Ex100x)

The significance of *B. bronchiseptica* in pig pneumonia is still unclear. It is evident that this organism has the potential to cause pneumonia, bronchitis, and tracheitis. However, like some other bacteria, it can also be located in the nasal mucosa and tonsils of healthy pigs. Moreover, Pasteurella is occasionally identified in the tonsils and nostrils of healthy fattening pigs (Baskerville, 1981). Hematogenous pathogenesis-related pulmonary inflammatory disorders allow the disease to extend beyond the lungs to other

organs, which are often more accessible for sampling to obtain vital diagnostic information. In these cases, while the primary focus should be on the lungs, it is also essential to pay attention to lymphoid organs (such as PCV2 and PRRSV) and extrapulmonary septic processes in various regions. Collectively, these findings, along with the results from lung samples, offer greater value for etiological assessments (Rose and Madec, 2002).

CONCLUSION

The most consistent indicators for a diagnosis as outlined by pathology comprise the macroscopic patterns of lung involvement and the histologic characterization of lesions. Nonetheless, both indicators should be integrated with clinical history, epidemiological data, and other direct or indirect techniques to evaluate etiology in a comprehensive manner. Pneumonias that exhibit a variety of clinical manifestations, characterized by a combination of hematogenous and aerogenous forms with variable etiology, which is generally multi-microbial and influenced by environmental and managerial factors, are encompassed within the Porcine Respiratory Disease Complex (PRDC). It is broadly acknowledged that the airways of pigs are home to a wide array of etiological agents that contribute to respiratory disease.

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