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HISTOPATHOLOGICAL FINDINGS OF THE LUNGS IN A BOER GOAT WITH CASEOUS PNEUMONIA: A CASE REPORT

Laporan Kasus: Temuan Histopatologis Paru-Paru Kambing Boer dengan Pneumonia Kaseosa

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Abstract

Pneumonia is a multifactorial disease in which various etiological agents play important roles in its pathology and pathogenesis. Identification of circulating pathogens in a specific area is essential for accurate diagnosis and effective disease control strategies. Bacterial culture remains the gold standard for confirming bacterial infections and can be complemented by histopathological examination to characterize pulmonary lesions. This case report aimed to describe the gross and histopathological changes observed in a Boer goat diagnosed with pneumonia. An approximately 6-year-old male Boer goat was found dead in the goat housing facility at the Faculty of Animal Science, Hasanuddin University. A complete necropsy was performed immediately on site, and lung tissue samples were collected for histopathological examination at the Laboratory of Pathology, Veterinary Medicine Study Program, Faculty of Medicine, Hasanuddin University. Tissue sections were processed and stained with Hematoxylin and Eosin (H&E) and subsequently examined microscopically. Histopathological examination revealed hyaline membrane formation along the alveolar epithelium, pulmonary hemorrhage, and emphysema characterized by alveolar rupture and coalescence. The main lesions consisted of tubular granuloma formation and caseous necrosis, findings consistent with caseous pneumonia. These findings provide important pathological evidence supporting the diagnosis and contribute to a better understanding of pulmonary lesions in Boer goats.

Keywords: Boer goat; caseous pneumonia; granuloma; pulmonary histopathology

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Abstrak

Pneumonia merupakan penyakit multifaktorial dengan berbagai agen etiologi yang berperan dalam patologi dan patogenesisnya. Identifikasi patogen yang beredar di suatu wilayah menjadi penting untuk menunjang ketepatan diagnosis dan strategi pengendalian penyakit. Kultur bakteri masih dianggap sebagai standar emas dalam diagnosis infeksi bakteri dan dapat diperkuat dengan pemeriksaan histopatologi untuk mengkarakterisasi lesi paru secara lebih mendalam. Laporan kasus ini bertujuan untuk mendeskripsikan perubahan patologis secara patologi anatomi dan histopatologi pada kambing yang mengalami pneumonia. Seekor kambing Boer jantan berumur ±6 tahun ditemukan mati di kandang Fakultas Peternakan, Universitas Hasanuddin. Nekropsi dilakukan segera setelah penemuan, dan sampel jaringan paru dikoleksi untuk pemeriksaan histopatologi di Laboratorium Patologi Program Studi Kedokteran Hewan, Fakultas Kedokteran, Universitas Hasanuddin. Jaringan diproses dan diwarnai dengan pewarnaan Hematoksilin dan Eosin (H&E), kemudian diamati secara mikroskopis. Hasil pemeriksaan menunjukkan adanya akumulasi hialin pada epitel alveoli, hemoragi, serta emfisema yang ditandai dengan ruptur dan koalesensi alveoli. Lesi utama yang teridentifikasi berupa pembentukan granuloma tubular dan nekrosis kaseosa yang konsisten dengan pneumonia kaseosa. Temuan ini memberikan bukti patologis yang mendukung diagnosis serta memperkaya pemahaman mengenai karakteristik lesi paru pada kambing Boer.

Kata-kata kunci: granuloma; histopatologi paru; kambing Boer; pneumonia kaseosa

INTRODUCTION

Small ruminants, particularly goats and sheep, play an important role in supporting the livelihoods of farmers in the Mediterranean region, Africa, and Southeast Asia due to their contributions to meat, milk, and wool production, as well as their relatively rapid reproductive and growth performance (Chakraborty et al., 2014). However, the productivity of these animals is highly dependent on their health status, especially respiratory diseases, which significantly contribute to mortality, reduced production performance, and economic losses. Pneumonia is considered one of the most serious respiratory disorders and remains a major cause of death and decreased productivity in small ruminants worldwide (O'Donoghue et al., 2025). Its pathogenesis is multifactorial, resulting from complex interactions among infectious agents, environmental conditions, management practices, and host immune responses (Kamdi et al., 2020).

Respiratory tract infections are among the most frequently encountered health problems in goats, affecting both individual animals and entire herds. Pneumonia in goats is multifactorial in nature and has been associated with various infectious agents, with its occurrence influenced by several predisposing factors such as adverse weather conditions, stress, pregnancy, lactation, immunosuppression, and advanced age (Kumar et al., 2015). The pathogenesis of the disease involves complex interactions among infectious agents, environmental factors, husbandry practices, and host responses (Kamdi et al., 2020). Various etiological agents, including bacteria, viruses, parasites, fungi, and allergens, contribute to the development of pneumonia, and disease severity may increase under stressful conditions and poor management practices (Azizi et al., 2013). Among bacterial agents, *Mycoplasma* spp., *Corynebacterium pseudotuberculosis*, *Pasteurella multocida*, and *Mannheimia haemolytica* have been reported as the major causes of bacterial pneumonia in goats (Valsala et al., 2017).

The diagnosis of pneumonia is established through a combination of clinical examination, imaging, serological testing, and identification of etiological agents from samples such as nasal swabs, bronchoalveolar lavage, and feces (Berman, 2024). To strengthen the diagnosis, these findings should be confirmed through postmortem examination of the lungs, either during

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necropsy or at slaughter (Dar et al., 2013). Considering that pneumonia is a multifactorial disease involving a wide range of etiological agents in its pathogenesis, identifying circulating pathogens within a particular region is essential for accurate diagnosis and effective disease control. Bacterial culture is still regarded as the gold standard for diagnosing bacterial infections and is commonly supported by histopathological examination of lung tissue (Adam et al., 2023). Therefore, this case study aimed to evaluate the pathological changes, both grossly and histopathologically, in a goat affected by pneumonia.

RESEARCH METHODS

Case Description

The study sample consisted of an approximately 6-year-old male Boer goat that was found dead in the goat housing facility of the Faculty of Animal Science, Hasanuddin University, on December 3, 2024. The animal was observed with a partially severed tongue. A postmortem examination (necropsy) was immediately performed at the site where the carcass was discovered. Tissue samples collected during the examination were subsequently processed for histopathological preparation at the Laboratory of Pathology, Veterinary Medicine Study Program, Faculty of Medicine, Hasanuddin University.

Necropsy Procedure

The necropsy began with a thorough external examination of the animal from the head to the extremities. The carcass was then placed in dorsal recumbency, and an incision was made through the skin and underlying tissues along the linea alba to open the abdominal cavity. Organs within the abdominal and thoracic regions were examined macroscopically based on their color, size, and texture. The thoracic cavity was opened by incising the diaphragm, after which the visceral organs, including the gastrointestinal tract, liver, spleen, heart, and lungs, were removed and evaluated to identify pathological changes (Goljan, 2014).

Histopathological Preparation

Collected organs were fixed in 10% formalin for 24 hours. The samples then underwent dehydration using graded ethanol concentrations (70%, 80%, 90%, 96%, and 100%), followed by clarification in xylene and embedding in paraffin wax. Tissue blocks were sectioned at a thickness of 5 µm using a microtome. The tissue sections were floated on a tissue bath, mounted onto glass slides, and incubated on a slide warmer. Histological preparations were stained using the hematoxylin and eosin (H&E) method, rinsed, counterstained with eosin, and covered with a coverslip. Microscopic examination was performed using an Olympus CX23 microscope at magnifications of 100× and 400×, followed by photomicrographic documentation.

RESULTS AND DISCUSSION

Results

Gross Pathological Findings

Gross pathological examination (Figure 1) revealed the presence of mucopurulent exudate within the trachea and bronchi, accompanied by tracheal hemorrhage and hyperemia. The lungs exhibited marked morphological changes characterized by swelling and blunt pulmonary margins rather than the normal pointed appearance, indicating pneumonia. In the left lung, one lobe showed caseous necrosis, while another lobe exhibited hemorrhage and ecchymosis. In addition, a partially severed tongue was observed during external examination of the carcass.

Histopathological Findings

Histopathological examination of the lung tissue with caseous lesions (Figure 2) revealed

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hyaline deposition and calcification along the alveolar epithelium, hemorrhage, and emphysema characterized by alveolar fusion and rupture of the alveolar epithelium. Aggregates of macrophages forming tubular granulomas and areas of caseous necrosis were also observed.

Discussion

Macroscopically, the respiratory tract showed mucopurulent exudate within the trachea and bronchi accompanied by tracheal hemorrhage, indicating an inflammatory process associated with bacterial infection (Epstein & Balsa, 2020). The lungs demonstrated morphological alterations in the form of swelling with blunt, non-tapering margins, which are consistent with pneumonia. In the left lung, one lobe exhibited caseous necrosis, whereas another lobe showed hemorrhage and ecchymosis. The combination of caseous necrosis and hemorrhagic lesions may be associated with either viral or bacterial infections that induce progressive damage to the pulmonary parenchyma (Mekibib et al., 2019). Large caseous necrotic lesions accompanied by mineralization and fibrosis, particularly those showing confluent distribution within an organ, are classified as granulomatous tubercles with caseous necrosis (Domingo et al., 2014). In small ruminants, such chronic lesions are commonly found in the lungs or mediastinal lymph nodes and may enlarge considerably over time (Marianelli et al., 2010). In the lungs, progression of chronic lesions is characterized by spread through the bronchioles accompanied by the formation of multifocal caseous necrosis that subsequently coalesces. In advanced stages, these lesions may develop into cavitary lesions within the initially affected pulmonary lobes (Zeng et al., 2022).

Histopathological examination of the lungs revealed hyaline protein deposition and calcification along the alveolar epithelium, hemorrhage, capillary congestion, emphysema, and atelectasis. Hemorrhage was likely associated with edema resulting from vascular vasodilation (Mayer & Donnelly, 2013), whereas capillary congestion may impair tissue perfusion and contribute to pulmonary parenchymal necrosis (Mekibib et al., 2019). Emphysema was characterized by alveolar dilation accompanied by alveolar fusion and rupture of the alveolar epithelium due to an imbalance in protease enzyme activity (Petta, 2014). Atelectasis was identified by narrowing of the alveolar lumen and thickening of the alveolar walls associated with inflammatory cell infiltration (Zeng et al., 2022). In addition, suppurative inflammation characterized by the accumulation of neutrophilic debris, macrophages, bacteria, and fibrin was observed as part of the acute inflammatory response (Haydock et al., 2023). Persistent macrophage infiltration accompanied by cellular fusion forming foreign body giant cells indicated progression toward chronic inflammation and contributed to the formation of tuberculoid granulomas. In advanced stages, granulomas undergo fibrotic connective tissue proliferation and progress to caseous necrosis (Brodbeck & Anderson, 2009). These histopathological findings are consistent with reports of *Pasteurella multocida* infection, which is characterized by intra-alveolar inflammatory exudation, alveolar wall thickening, epithelial proliferation and necrosis, and granuloma formation (Zeng et al., 2022). However, similar lesions may also occur in infections caused by *Mycobacterium* spp. and *Corynebacterium pseudotuberculosis*, which are characterized by vascular congestion, inflammatory cell infiltration, abscess formation, and confluent caseous necrotic masses in the lungs and lymph nodes (Domingo et al., 2014; Singh et al., 2017).

Based on the gross pathological and histopathological findings, the suspected etiological agents involved in this case of caseous pneumonia in the goat included *Mycobacterium* spp., *Corynebacterium pseudotuberculosis*, and *Pasteurella multocida*. Tuberculosis is known to cause granulomatous inflammation accompanied by caseous necrosis, primarily affecting the lungs and lymph nodes (Domingo et al., 2014). The causative agents belong to the *Mycobacterium tuberculosis* complex, which includes several pathogenic species such as *M.*

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tuberculosis, *M. bovis*, and *M. caprae* (Palmer et al., 2022). In addition, *Corynebacterium pseudotuberculosis* infection in goats has been reported to cause abscess formation, congestion, and caseous necrosis in the lungs (Singh et al., 2017), while *Pasteurella multocida* is also known to induce granulomatous lesions and caseous necrosis in pulmonary tissue (Zeng et al., 2022). However, a limitation of this case report was the absence of bacterial culture and molecular examination, preventing definitive confirmation of the etiological agent. Therefore, further investigations including bacterial culture, biochemical testing, and molecular identification methods such as PCR are required to determine the specific causative agent.

CONCLUSION AND SUGGESTIONS

Conclusion

Based on the gross pathological and histopathological findings in the goat with caseous pneumonia, the suspected causative agents included *Mycobacterium* spp., *Corynebacterium pseudotuberculosis*, and *Pasteurella multocida*. Histopathological examination revealed calcification or hyaline deposition along the alveolar epithelium, hemorrhage, and emphysema characterized by alveolar fusion and rupture of the alveolar epithelium. In addition, suppurative inflammation with the accumulation of macrophage and neutrophil debris was observed. Other characteristic findings included the formation of tuberculoid granulomas and caseous necrosis, indicating chronic granulomatous inflammation.

Suggestions

Further investigations, including bacterial culture and molecular testing, are recommended to definitively identify the etiological agent. Improved biosecurity measures and routine livestock health monitoring should also be implemented to prevent disease transmission, considering the zoonotic potential of several suspected pathogens. Studies involving larger sample sizes are recommended to strengthen epidemiological data and support diagnostic confirmation.

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REFERENCES

Adam, M., Akeem, A. O., Barka, S. A., Olu, S. S. V., Abiodun, A. A., & Ola-Fadunsin, S. D. (2023). Pathological and molecular investigation of some bacteria in the lungs and livers of red Sokoto goats slaughtered at Ilorin, Kwara State, Nigeria. *Media Kedokteran Hewan, 34*(2), 87–101. https://doi.org/10.20473/mkh.v34i2.2023.87-101

Azizi, S., Korani, F. S., & Oryan, A. (2013). Pneumonia in slaughtered sheep in south-western Iran: Pathological characteristics and aerobic bacterial aetiology. *Veterinaria Italiana, 49*(1), 109–118.

Balqis, U., Hambal, M., Rinidar, Athaillah, F., Ismail, Azhar, Vanda, H., & Darmawi. (2017). Cuticular surface damage of *Ascaridia galli* adult worms treated with *Veitchia merrillii* betel nuts extract in vitro. *Veterinary World, 10*(7), 732–737. https://doi.org/10.14202/vetworld.2017.732-737

Berman, J. (2024). Literature review of the principal diagnostic tests to detect bovine respiratory disease in pre-weaned dairy and veal calves. *Animals, 14*(2), 329. https://doi.org/10.3390/ani14020329

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https://doi.org/10.24843/bulvet.2026.v18.i02.p13

Brodbeck, W. G., & Anderson, J. M. (2009). Giant cell formation and function. *Current Opinion in Hematology, 16*(1), 53–57. https://doi.org/10.1097/MOH.0b013e32831ac52e

Chakraborty, S., Kumar, A., Tiwari, R., Rahal, A., Malik, Y., Dhama, K., Pal, A., & Prasad, M. (2014). Advances in diagnosis of respiratory diseases of small ruminants. *Veterinary Medicine International, 2014*, 508304. https://doi.org/10.1155/2014/508304

Dar, L. M., Darzi, M. M., Mir, M. S., Kamil, S. A., Rashid, A., & Abdullah, S. (2013). Prevalence of lung affections in sheep in northern temperate regions of India: A postmortem study. *Small Ruminant Research, 110*(1), 57–61. https://doi.org/10.1016/j.smallrumres.2012.08.006

Domingo, M., Vidal, E., & Marco, A. (2014). Pathology of bovine tuberculosis. *Research in Veterinary Science, 97*, S20–S29. https://doi.org/10.1016/j.rvsc.2014.03.017

Epstein, S. E., & Balsa, I. M. (2020). Canine and feline exudative pleural diseases. *Veterinary Clinics of North America: Small Animal Practice, 50*(2), 467–487. https://doi.org/10.1016/j.cvsm.2019.10.008

Goljan, E. F. (2014). *Rapid review pathology*. Saunders/Elsevier.

Haydock, L. A. J., Fenton, R. K., Sergejewich, L., Veldhuizen, R. A. W., Smerek, D., Ojkic, D., & Caswell, J. L. (2023). Bronchopneumonia with interstitial pneumonia in beef feedlot cattle: Characterization and laboratory investigation. *Veterinary Pathology, 60*(2), 214–225. https://doi.org/10.1177/03009858221146092

Kamdi, B., Singh, R., Singh, V., Singh, S., Kumar, P., Singh, K. P., George, N., & Dhama, K. (2020). Immunofluorescence and molecular diagnosis of bovine respiratory syncytial virus and bovine parainfluenza virus in naturally infected young cattle and buffaloes from India. *Microbial Pathogenesis, 145*, 104165. https://doi.org/10.1016/j.micpath.2020.104165

Kumar, J., Dixit, S. K., & Kumar, R. (2015). Rapid detection of *Mannheimia haemolytica* in lung tissues of sheep and from bacterial culture. *Veterinary World, 8*(9), 1073–1077. https://doi.org/10.14202/vetworld.2015.1073-1077

Marianelli, C., Cifani, N., Capucchio, M. T., Fiasconaro, M., Russo, M., La Mancusa, F., Pasquali, P., & Di Marco, V. (2010). A case of generalized bovine tuberculosis in a sheep. *Journal of Veterinary Diagnostic Investigation, 22*(3), 445–448. https://doi.org/10.1177/104063871002200319

Mekibib, B., Mikir, T., Fekadu, A., & Abebe, R. (2019). Prevalence of pneumonia in sheep and goats slaughtered at Elfora Bishoftu Export Abattoir, Ethiopia: A pathological investigation. *Journal of Veterinary Medicine, 2019*, 5169040. https://doi.org/10.1155/2019/5169040

O'Donoghue, S., Waters, S. M., Morris, D. W., & Earley, B. (2025). A comprehensive review: Bovine respiratory disease, current insights into epidemiology, diagnostic challenges, and vaccination. *Veterinary Sciences, 12*(8), 778. https://doi.org/10.3390/vetsci12080778

Palmer, M. V., Kanipe, C., & Boggiatto, P. M. (2022). The bovine tuberculoid granuloma. *Pathogens, 11*(1), 61. https://doi.org/10.3390/pathogens11010061

Panciera, R. J., & Confer, A. W. (2010). Pathogenesis and pathology of bovine pneumonia. *The Veterinary Clinics of North America. Food Animal Practice, 26*(2), 191–214. https://doi.org/10.1016/j.cvfa.2010.04.001

Petta, A. Di. (2014). Características histopatológicas do enfisema pulmonar em modelo experimental. *Einstein (São Paulo), 12*(3), 382–383. https://doi.org/10.1590/s1679-

Volume 18 No. 2: 490-497
April 2026
https://doi.org/10.24843/bulvet.2026.v18.i02.p13

45082014ai2681

Savic, I., Farver, C., & Milovanovic, P. (2022). Pathogenesis of pulmonary calcification and homologies with biomineralization in other tissues. *The American Journal of Pathology, 192*(11), 1496–1505. https://doi.org/10.1016/j.ajpath.2022.07.015

Singh, R., Kumari, S., Yadav, J. P., Singh, S., Kumar, A., & Kumar, S. (2017). Suppurative pneumonia and lymphadenitis in a goat associated with infection by *Corynebacterium pseudotuberculosis*: A case study. *Advances in Animal and Veterinary Sciences, 5*(10). https://doi.org/10.17582/journal.aavs/2017/5.10.405.409

Valsala, R., Rana, R., Remesh, A. T., & Singh, V. P. (2017). *Mycoplasma arginini*: High frequency involvement in goat pneumonia. *Turkish Journal of Veterinary and Animal Sciences, 41*, 393–399. https://doi.org/10.3906/vet-1604-75

Zeng, C., Lagier, D., Lee, J.-W., & Vidal Melo, M. F. (2022). Perioperative pulmonary atelectasis: Part I. Biology and mechanisms. *Anesthesiology, 136*(1), 181–205. https://doi.org/10.1097/ALN.0000000000003943

Figures

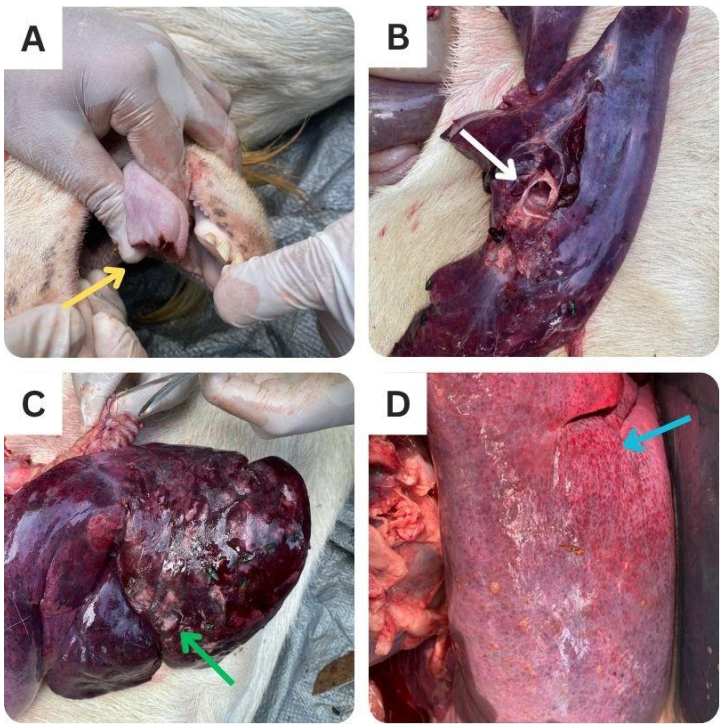

Figure 1. Gross pathological findings of the (A) tongue, (B) trachea, (C) right lung, and (D) left lung. A partially severed tongue (yellow arrow), mucopurulent and foamy exudate within the trachea and bronchi (white arrow), caseous lesions in one pulmonary lobule (green arrow), and hemorrhage with ecchymosis in another pulmonary lobule (blue arrow) were observed.

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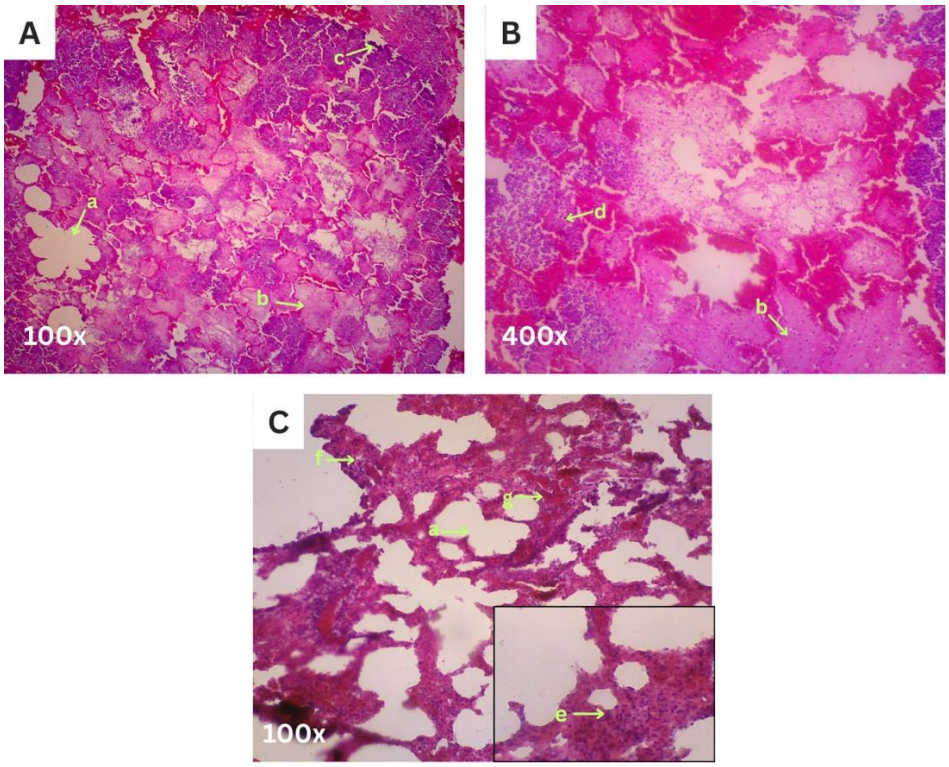

Figure 2. Histopathological findings of (A) and (B) lungs with caseous lesions and (C) lungs affected by pneumonia and hemorrhage. (a) emphysema, (b) caseous necrosis, (c) calcification, (d) tubular granuloma, (e) inflammatory cell infiltration, (f) atelectasis, and (g) congestion. (Magnifications: 100× and 400×; H&E staining).

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