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Clinicopathology of Domestic Pigeon Infected with *Haemoproteus columbae*: A Case Report

(*LAPORAN KASUS: KLINIKOPATOLOGI BURUNG MERPATI DOMESTIK YANG TERINFEKSI HAEMOPROTEUS COLUMBAE*)

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ABSTRACT

INTRODUCTION: Haemoproteosis, or pseudomalaria in pigeons, is a disease caused by the protozoan *Haemoproteus columbae*. This disease is prevalent in subtropical and temperate regions.
OBJECTIVE: The present case report delineates the occurrence of haemoproteosis in a pigeon, with a primary emphasis on describing the clinical condition, gross and histopathological alterations within the trachea, kidneys, and pancreas.
METHODS: A male pigeon with blackish-gray feathers was purchased from Splendid Market, Malang, Indonesia. Physical examination was performed to identify any clinical abnormalities that might not have been noticed by the seller. Inspection showed the presence of ectoparasites across the pigeon's feathers with no external wound.
RESULTS: The ectoparasite *Columbicola columbae* was identified in the plumage through microscopic analysis, although the pigeon displayed no discernible clinical symptoms. Blood samples were obtained from the afflicted pigeon, and subsequent blood smear preparations were subject to Giemsa staining and microscopic observation. Notably, the microscopic examination revealed the presence of the parasite *Haemoproteus columbae*. Subsequently, the affected animal was euthanized through decapitation, and necropsy was conducted. Gross pathology examination revealed signs of inflammation in the trachea, renal punctate lesions, and hemorrhage and enlargement in the pancreas. Histopathological findings indicated necrotizing tracheitis, necrotizing interstitial nephritis, and pancreatitis.
CONCLUSIONS: Based on these findings, the pigeon was diagnosed with haemoproteosis.

Keywords: *Haemoproteus columbae*; pathology; pigeon; pseudomalaria

ABSTRAK

PENDAHULUAN: *Haemoproteosis* atau *pseudomalaria* pada burung merpati merupakan penyakit yang disebabkan oleh protozoa *Haemoproteus columbae*. Penyakit ini umum terjadi pada area subtropis maupun tropis.
TUJUAN: Laporan kasus ini bertujuan untuk melaporkan kejadian *haemoproteosis* pada seekor burung merpati dengan fokus utama untuk mendeskripsikan kondisi klinis, perubahan patologi anatomi, dan histopatologi pada organ trakea, ginjal, serta pankreas.
METODE: Seekor burung merpati jantan dengan bulu berwarna hitam keabu-abuan dibeli dari Pasar Splendid, Malang, Indonesia. Pemeriksaan fisik dilakukan untuk mengidentifikasi kelainan klinis yang

mungkin tidak dijumpai oleh penjual. Inspeksi menunjukkan keberadaan ektoparasit di seluruh bulu, tetapi tidak ditemukan adanya luka-luka.
HASIL: Secara mikroskopis, ektoparasit teridentifikasi sebagai *Columbicola columbae*. Burung merpati tidak menunjukkan gejala klinis saat dilakukan pemeriksaan. Darah hewan kasus diambil kemudian dibuat preparat ulas darah dengan pewarnaan Giemsa. Pada pemeriksaan mikroskopis ulas darah ditemukan adanya parasit *Haemoproteus columbae*. Hewan kemudian dieutanasi dengan cara dekapitasi dan dilakukan nekropsi. Berdasarkan pemeriksaan patologi anatomi, terdapat kemerahan pada trakea, bercak putih pada ginjal, serta hemoragi dan pembengkakan pada pankreas. Secara histopatologi, terjadi *tracheitis necroticans*, *nephritis interstisialis necroticans*, dan *pancreatitis*.
SIMPULAN: Berdasarkan temuan-temuan tersebut, burung merpati didiagnosis menderita *haemoproteosis*.

Kata-kata kunci: burung merpati; *Haemoproteus columbae;* patologi; pseudomalaria

INTRODUCTION

The pigeon (*Columba livia*) is a bird species that has long been domesticated and bred by enthusiasts. As a member of the vertebrate group, pigeons posses feathers and wings. Their primary activity is flying in the air (Kadri *et al*., 2016). In addition to being kept as ornamental or hobby animals, pigeon can also serve as source of animal protein for human food. However, several diseases can affect pigeons, such as bacteria, viruses, fungi, helminths, rickettsia to parasitic diseases, some of which can threaten public health (Mehmood *et al*., 2021). These diseases can also cause reduce meat quality and egg production (Samani *et al*., 2016).

One such diseases is haemoproteosis, also known as pseudomalaria, caused by the protozoa *Haemoproteus columbae* (Borkataki *et al*., 2015; Rosyadi *et al*., 2021). The disease is transmitted by the hippoboscid fly *Pseudolynchia canariensis* (Borkataki *et al*., 2015) and can affect both domestic and wild pigeons (Maharana and Kumar, 2017). Haemoproteosis can be fatal in young pigeons and immunocompromised birds and it commonly occurs in subtropical and tropical areas (Lee *et al*., 2018; Hala *et al*., 2020).

A study by Rosyadi *et al*. (2021) reported a relatively high prevalence of *H. columbae* infection among domestic pigeons in a farm located in Yogyakarta, Indonesia, with 30 out of 35 samples (85.7%) were positive for haemoproteosis. Similarly high prevalence rates have also been reported in India. The prevalence of this disease in pigeons in several regions in India is as follows: Mumbai at 58.3% (35/60) (Shinde *et al*., 2008), while in Uttar Pradesh it was 55.63% (148/266) (Jahan *et al*., 2011). In contrast, a lower prevalence was reported in Baghdad, Iran at 20% (Al-Rubaie *et al*., 2020). Factors such as weather conditions, sex and age of the animal influence the prevalence rate, with infection tending to occur in female pigeons and older age (Samani *et al*., 2013; Adinehbeigi *et al*., 2018). This paper reports the occurrence of haemoproteosis in a pigeon with a focus on describing the clinical condition,

gross changes and histopathology alterations observed in affected organs. The aim is to provide additional insight in establishing the diagnosis of haemoproteosis and the pathological changes.

CASE REPORT

Anamnesis and Clinical Symptoms

A male pigeon, identified as P20225 and characterized by blackish-gray feathers, was purchased from Splendid Market, Malang, Indonesia (7° 58' 39.4824" S, 112° 37' 52.7448" E). According to the seller, the pigeon did not show any symptoms of being sick, because it was remained active at the time of sale. The pigeon was then subsequently acquired for further clinical examination.

Physical Examination

A physical examination was performed to identify any clinical abnormalities that might not have been noticed by the seller. The general condition of the bird appeared alert and active. Inspection showed the presence of ectoparasites across much of the pigeon's feathers, although no external wounds were observed. No signs of pain or discomfort was found in the bird based on the results of palpation.

Blood Smear Examination

A blood smear examination was performed as a supporting diagnostic procedure. The staining used in this examination was Giemsa, which was then observed under a microscope at 1000× magnification.

Euthanasia and Postmortem Examination

The bird was euthanized using the decapitation method and then necropsied for a thorough anatomic pathology examination. The euthanasia was strictly adhered to guidelines by American Veterinary Medical Association (AVMA) to ensure the procedure was performed correctly and humanely to minimize any pain or distress for the animal (Leary *et al.*, 2020).

Histopathology Preparations

Specimens taken during the necropsy process were then stored in 10% formalin at a tissue-to-formalin volume ratio of 1:10. Specimens were stored at room temperature for 24 hours before histotechnic procedure. Several slices were made into the parenchyma because the specimens were quite large, to ensure optimal fixation. The histopathological preparations processing includes several steps, including trimming, dehydration, clearing, paraffin-embedding, sectioning, and routine staining with hematoxylin-eosin (HE) following standard

protocols (Sewoyo *et al*., 2022). Histopathological preparations were then observed under a microscope at magnifications of 40× and 1000×.

RESULTS AND DISCUSSION

Ectoparasites were observed on the majority of the pigeon's feathers during the clinical examination. The ectoparasites were identified as *Columbicola columbae* based on microscopic examination (Figure 1a). Additionally, the blood parasite *Haemoproteus columbae* was identified based on microscopic observation of blood smears (Figure 1b).

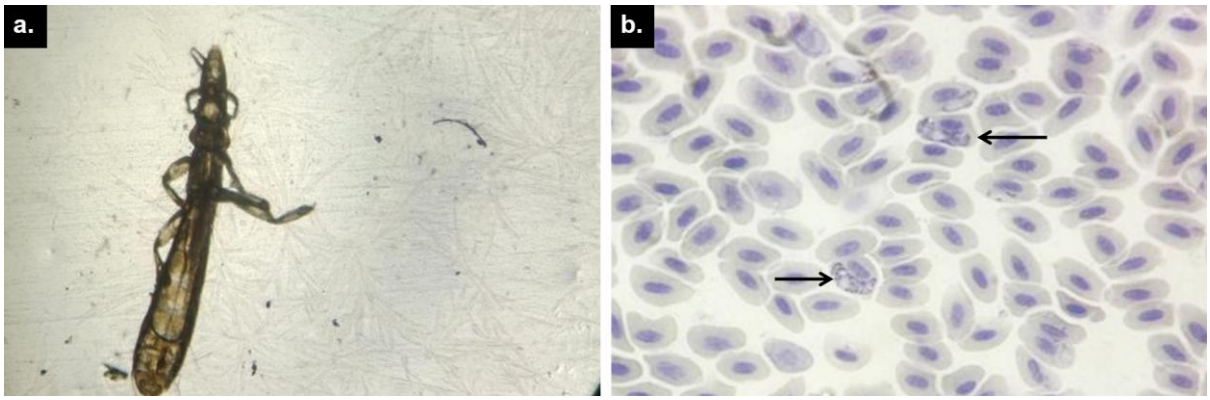

Figure 1. Microscopic examination of ectoparasite and blood smear. (a) Ectoparasite *Columbicola columbae* were identified (b) The presence of crescent-shaped gametocytes of *Haemoproteus columbae* was observed in the surrounding of erythrocytes nuclei (arrow) (Giemsa, 1000×).

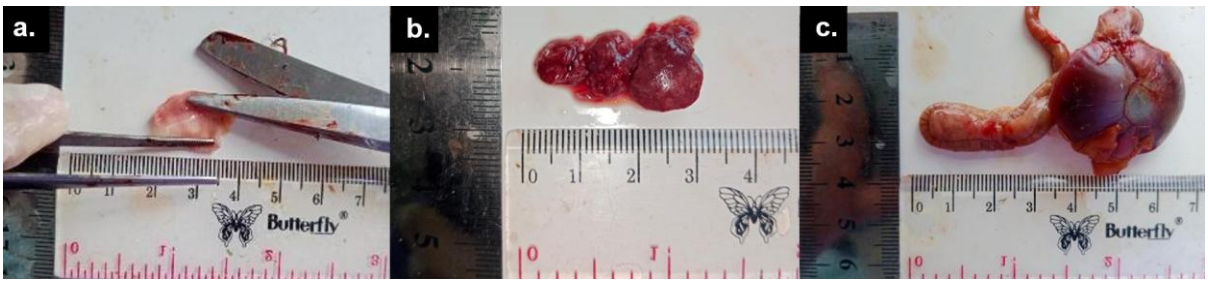

Figure 2. Gross pathological images of the trachea, kidney, and pancreas. (a) Trachea: Redness on the mucosal surface (b) Kidney: Multifocal white spots (c) Pancreas: Hemorrhage and swelling.

Gross pathological changes were observed in the trachea, characterized by a reddish discoloration measuring approximately 9 mm in diameter, with a diffuse distribution, irregular shape, and well-demarcated (Figure 2a). This discoloration was indicative of hemorrhage, evidenced by the redness of the tracheal mucosa. Pathological alterations in the kidneys included the presence of whitish patches ranging from 0.1-0.3 cm in diameter, diffusely distributed, irregular in shape, poorly demarcated, and affecting approximately 85% of the renal surface. The kidneys also appeared darker than normal (Figure 2b). In the pancreas, gross

lesions included red discoloration and swelling. Lesions measured approximately 1 mm and 4 × 1 cm in size, with focal to multifocal distribution, clear demarcation, irregular shape, and soft consistency. These changes were observed in about 40% of the organ, and generalized pancreas swelling was also noted (Figure 2c).

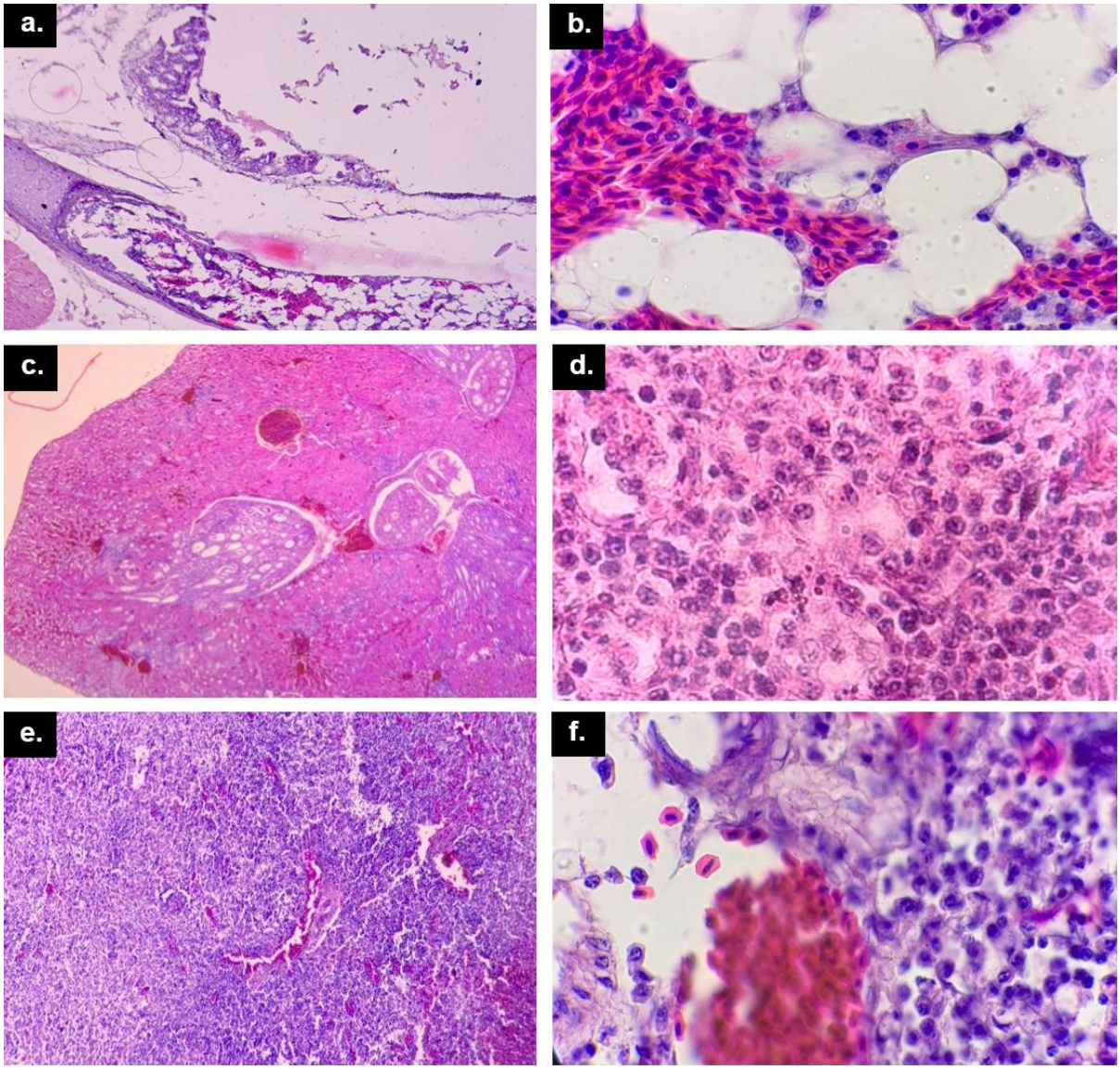

Figure 3. Photomicrographs of trachea (a,b), kidney (c,d), and pancreas (e,f) of the domestic pigeon infected with *Haemoproteus columbae*. (a) Mucosal erosion accompanied by mild inflammatory cell infiltration in the submucosa. Fat necrosis observed in the cartilaginous layer. (b) Presence of vacuolated space with eosinophilic content and fragmented, anucleated cells. (c) Congestion in capillaries and blood vessels in the renal cortex, accompanited by inflammatory cell infiltration and multifocal necrosis. (d) Infiltration of polymorphonuclear inflammatory cells and lymphocytes in the interstitial tubules. (e) Congestion and inflammatory cell infiltration. (f) Infiltration of eosinophils and lymphocytes. (HE, 40× & 1000×).

Histopathological examination of the trachea revealed fat necrosis in the tunica adventitia (cartilaginous layer). The submucosa was markedly thickened due to infiltration of inflammatory cells (Figure 3a). In the kidneys, congestion was observed in both capillaries and larger blood vessels, was along with multifocal necrosis (Figure 3c). Necrosis was characterized by karyorrhexis and karyolysis in the distal and proximal convoluted tubular cells nuclei. The interstitial tubules were also infiltrated by inflammatory cells such as lymphocytes and polymorphonuclear cells (Figure 3d). In the pancreas, tissue architecture appeared disrupted, with several blood vessels showing marked congestion and areas of inflammation (Figure 3e). Inflammatory cells infiltration, predominantly lymphocytes and eosinophils, was observed within the acinar regions (Figure 3f). Based on these findings, the morphological diagnosis was as follows: necrotizing tracheitis, necrotizing interstitial nephritis, and pancreatitis.

Columbicola columbae is a common ectoparasite frequently found in pigeons. Several studies indicate a high prevalence of *C. columbae* among pigeon populations. A study by Chaechi-Nosrati *et al*. (2018) showed a prevalence rate of 88.3% in wild pigeons in Lahijan City, Guilan, Iran. Similarly, Ahmed *et al.* (2017) found a prevalence rate of 90.5% in pigeons from in Pakistan. The population of this louse varies, depending on the season. In Egypt, the higher infestation rate was observed in autumn, followed by summer, winter, and spring (Soliman *et al*., 2023). *C. columbae*, like other members of the *Phthiraptera* order, exhibits a dorsoventrally flattened body adapted for living among the feathers of their avian hosts. The head of this louse is adapted for its parasitic lifestyle, with specialized mouthparts for feeding on feathers and skin debris (Zelazowska and Jaglarz, 2004).

Haemoproteus columbae is a haemosporodian parasite that primarily infects pigeons (*Columba livia*). Its life cycle involves both vertebrate and invertebrate hosts (or as a vector). The vector of this parasite is the hippoboscid fly *Pseudolynchia canariensis* (Borkataki *et al*., 2015). This parasite undergoes sexual reproduction in the vector, where the sporogony cycle is completed within 13-16 days at a temperature of 12-15^{o}C (Cepeda *et al*., 2019). Flies that have been infected with this parasite then transmit it to pigeons through their bites. Diagnosis can be established through microscopic examination of blood smears by finding the presence of crescent-shaped gametocytes surrounding the cell nucleus of erythrocytes (Maharana and Kumar, 2017). In cases that are not detected by microscopic examination due to low parasitemia, the diagnosis can be confirmed by polymerase chain reaction (PCR) examination targeting the cytochrome b (cytB) gene (Tabaripour *et al*., 2017; Iri *et al*., 2023).

In pigeons, *H. columbae* infects red blood cells, with peak parasitemia typically occurring between 27-32 days post-infection. Nearly 70% of red blood cells will be infected by this parasite during the acute phase (Cepeda *et al*., 2019). In the chronic phase, when the long-term duration of parasitemia occurs, this parasite can cause extensive damage to the lungs, kidneys, and spleen. Clinical symptoms associated with *H. columbae* infection include anorexia, depression, inability to fly, and torticollis (Joshi *et al*., 2017; Hala *et al*., 2020). However, in this case, the pigeon did not show any clinical signs, suggesting that the infection was still in the acute phase. Nonetheless, pathological changes were observed in the trachea, kidneys, and pancreas.

Previous reports have linked *H. columbae* infection to hepatic congestion, pulmonary damage, and cardiac and renal hypertrophy (Lee *et al*., 2018; Cepeda *et al*., 2019; Hala *et al*., 2020). In this case, the pigeon showed histopathological lesions including necrotizing tracheitis, necrotizing interstitial nephritis, and pancreatitis. The renal damage observed may have been directly caused by *H. columbae* infection or could be a secondary complication of pancreatitis. The pancreas plays a key role in regulating blood glucose levels through the secretion of insulin and glucagon. Inflammation of this organ can cause insulin secretion insufficiency, leading to hyperglycemia. Prolonged hyperglycemia can result complications, inducing oxidative stress and systemic inflammation in other organs, such as the kidney (Samokhvalov *et al*., 2015).

CONCLUSIONS

Based on the necropsy findings in this case report, gross lesions were observed in several organs, such as the trachea, kidneys, and pancreas. Histopathological examinations revealed necrotizing tracheitis, necrotizing interstitial nephritis, and pancreatitis. These findings indicate the presence of significant pathological changes potentially associated with *Haemoproteus columbae* infection.

SUGGESTION

Further studies are recommended to determine the prevalence rate of *Haemoproteus columbae* infection in pigeon populations to better understand its distribution and potential impact on avian health.

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