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Case study

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Canine monocytic Ehrlichiosis in Alaskan Malamute dog in GloriaVet Pet Health Solution, Bandung, Indonesia

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Abstract

Background Ehrlichiosis is an infection caused by the bacterium *Ehrlichia canis*, which attacks monocytes. Ehrlichiosis is characterized by anemia, lethargy, lameness, pancytopenia, hemorrhage, and weight loss.

Objective This study aimed to describe the clinical findings and treatment of a dog diagnosed with *Ehrlichia canis* infection.

Case A 5-year-old female Alaskan Malamute dog named Salt was brought to the clinic of GloriaVet Pet Health Solution, Bandung, Indonesia, with lameness and weakness, accompanied by high fever and very pale mucous membranes (pallor).

Examination and treatments Dog was examined using a general examination, hematology test, biochemistry test, native smear, and IDExx SNAP© 4dx test kit. The examinations showed a positive result for *Ehrlichia canis* infection, along with severe pancytopenia, hyperglobulinemia, and thrombocytopenia. Diagnosis heavily relied on serology and clinical manifestation, and further PCR testing was not performed. The treatment consisted of doxycycline 10 mg/kg/day for 28 days, a 0.75% ketamine drip infusion, darbepoetin alfa, and a blood transfusion.

Conclusion Dog was infected with chronic Ehrlichiosis with several clinical symptoms including severe anemia. Treatment with doxycycline as the treatment of choice for Ehrlichiosis infection and a blood transfusion for treating severe anemia showed signs of improvement, but were ultimately ineffective due to the poor prognosis associated with chronic Ehrlichiosis and severe pancytopenia.

Keywords blood transfusion | crossmatch | dog | Ehrlichiosis | clinical manifestation

Introduction

Canine Ehrlichiosis is a tick-borne disease caused by *Ehrlichia* spp, which causes infections in dogs and other animals, such as sheep, horse, and cow. There are three *Ehrlichia* species that are known to be involved in canine infection, namely *E. canis*, *E. chaffeensis*, and *E. ewingi*. Out of the three, *E. canis* is known to be the main cause in canine monocytic Ehrlichiosis, while *E. chaffeensis* is known to infect humans, causing human homocytotropic Ehrlichiosis (HME) (Aziz *et al.*, 2023). Therefore *Ehrlichia* spp. has the potential to infect humans, so it has important relevance in one health perspective. Ehrlichiosis is a tick-borne infectious disease which is spread by the brown dog tick (*Rhiphicephalus sanguineus*), as the pri-

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mary vector for *E. canis* as well as by the lone-star tick (*Amblyoma americanum*.), as the primary vector for *E. chaffeensis* and *E. ewingii*. Transmission occurs when a tick feeds on a previously infected host, and then feeds on a susceptible host during its nymph or adult life stages (Alcon-Chino & De-Simon, 2025). There is currently no known evidence that infection passes directly from animals to people, however dogs are suspected to be reservoirs of infected ticks, which makes it a concern for public health (Marshet & Dessie, 2020). In recent years, cases of HME have been documented occurring in the United States, South America, Africa, and Asia (Gygax *et al*., 2024; Adams *et al*., 2025; Alcantara-Rodriguez *et al*., 2020). Although reported case fatality is still low (<5%) (Dahlgren *et al*., 2016), it is known that infection highly occurs in immunocompromised individuals. Individuals who preside in wooded or areas with high grass may be at increased risk for infection, next to those with unprotected dogs (dogs not receiving yearly anti-tick medication). Unprotected dog may serve as hosts for infected ticks which are capable of biting humans, thereby indirectly increasing the risk of transmission of *Ehrlichia* spp. and other tick-borne diseases. Due to their close contact with humans and shared exposure to tick habitats, dogs are considered effective sentinel animals for tick-borne diseases. This highlights the importance of canine Ehrlichiosis not only as a veterinary disease, but also as a sentinel indicator of human exposure risk to *Ehrlichia* spp. from possible tick bites.

Ehrlichia canis is a Gram-negative bacterium that lacks a peptidoglycan and lipopolysaccharide layer in the cell wall, which helps the bacteria in resist the host's immune response for an extended period (Aziz *et al*., 2023). The incubation period of *E. canis* is approximately 8–20 days, which is the time required for the bacteria to infect monocytes and create an intracellular aggregate called morula. The morula then enters the blood circulation and infects other cells, such as macrophages and epithelial cells. Monocyte and macrophage infections cause increased destruction of thrombocytes and suppression of thrombocyte production, causing thrombocytopenia (Ramakant *et al*., 2020; Aziz *et al*., 2023). Animals infected with *E. canis* may show reactive monocytes that have transformed into macrophages, which phagocytose erythrocytes (erythrophagocytosis) and platelets (thrombophagocytosis). Thrombocyte destruction may occur through early removal of platelets by antiplatelet antibodies that are formed as a result of the interaction of B-cell antibody receptors with foreign antigens (Kumar *et al*., 2025).

Ehrlichiosis has three stages of infections: acute, subacute, and chronic. The acute phase last for 3–5 weeks, and is characterized by fever, anorexia, depression, lymphadenopathy, and splenomegaly. This phase may heal on its own without medication, but it might also progress into the subclinical phase (Cote & Cohn, 2020). During the subclinical phase, the animal shows no noticeable symptoms (asymptomatic), and this phase may occur for several years depending on the animal's immune system. When the immune system is weakened, the infection may progress to the chronic phase, with symptoms such as weight loss, depression, petechiae, pale mucous membrane, oedema, and lymphadenopathy (Ramakant *et al*., 2020). Thrombocytopenia, anemia, and pancytopenia are characteristic clinical symptoms of the chronic phase. In severe *Ehrlichia* infection, hemorrhages (epistaxis, melena, hematemesis, petechiae, and ecchymosis hemorrhage of the gingiva and ventral abdomen) and secondary infection may occur (Roopali *et al*., 2018).

Due to the severity of canine Ehrlichiosis cases and the diversity of clinical signs, this case report was written to describe the clinical findings and therapeutic management of a dog diagnosed with *Ehrlichia canis* infection. It outlines the presenting symptoms, diagnostic evaluation, administered treatment, and patient's response to therapy. By documenting this case, the study contributes to better understanding of the clinical course and management considerations of *E. canis* infection in canine patients.

Case

Alaskan malamute named Salt (**Figure 1**), age of 5 years, female neutered, 40 kg, was brought with lameness and lethargy. The medical history showed that Salt had undergone total hip replacement surgery 6 months prior and had a history of pancreatitis. There were no medical records of Salt ever receiving ectoparasite medication.

Figure 1 A 5-year-old female Alaskan Malamute dog named Salt

Examination, diagnose, and treatments

General examination revealed extremely pale mucous membranes (anemia), fever of 40.6°C, and slight pain during abdominal palpation. Blood samples was collected for hematology and biochemistry tests. Hematology test results were unreadable, so a native blood smear was performed, along with the IDExx SNAP© 4dx test kit.

The unreadable hematology test results obtained using the IDExx ProCyte machine indicated that the blood parameters (RBC, WBC, HGB, HCT, and PLT) were below the machine's detectable limits. A native smear was performed out to manually observe the blood condition (**Figure 2**). The native blood smear showed signs of anisocytosis of the red

blood cells (RBC), which is an inconsistency in the size and volume of the RBC. The normal diameter of RBC in dogs is 6.30 – 7.71 µL (Adili *et al.*, 2016). Although reticulocyte counts were not available at the initial presentation, profound anemia in combination with severe pancytopenia was suggestive of severe non-regenerative anemia. This was later confirmed by a subsequent hematological evaluation.

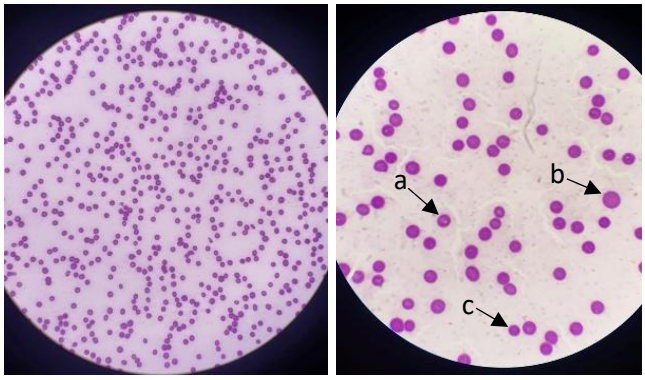

Figure 2 Native blood smear of 5-year-old female Alaskan Malamute dog named Salt. (A) Magnification of 100×, (B) Magnification of 400× showing RBC anisocytosis (arrow a: normal sized, arrow b: large sized, arrow c small sized).

Blood biochemistry tests were performed to understand the condition of the organs. The results of the biochemical tests are presented in **Table 1**. Biochemical tests revealed elevated levels of BUN, creatinine, globulin, amylase, and lipase. According to Cote & Cohn (2020), increased BUN levels, hyperglobulinemia, thrombocytopenia, and cytopenia are clinical characteristics of *Ehrlichia* spp. infection. To further establish this diagnosis, an IDExx SNAP© 4dx test kit was used, resulting in a positive result for *Ehrlichia* spp. infection (**Figure 3**).

Salt's pale mucous membrane and unreadable hematology test results are strong indications of severe anemia, and a blood transfusion is urgently needed. Prior to blood transfusion, a crossmatch is performed by taking the donor's blood sample into an EDTA tube, and then moving it to a plain blood tube to be washed using 0.9% NaCl or phosphate-buffer saline (PBS). The washing was repeated three times using a centrifuge to obtain a 3% RBC sample. A ratio of 2:1 donor sample and recipient serum samples was taken and mixed, and a drop of this mixture was placed on an object glass for examination under a microscope. If the cell distribution is too packed, a drop or two of PBS can be added to evenly spread the RBC for better analysis. Negative results showed the majority of hemolysis or hemagglutination of RBC (rouleaux formation) (**Figure 4A**).

Figure 3 Positive result for Ehrlichiosis detected using an IDExx SNAP© 4dx test kit in 5-year-old female Alaskan Malamute dog named Salt (arrow a: positive control parameter, arrow b: positive parameter for *E. canis* and *E. ewingii*.

Hematological tests were performed again after the first blood transfusion (**Table 2**). The hematology test results showed that Salt was still experiencing anemia, as indicated by the low levels of RBC, HCT, HGB, and MCH. Reticulocyte counts were also below the normal range, at 0.9×103 µL (normal range: 10.0–110.0×103 µL), which was consistent with severe non-regenerative anemia due to impaired bone marrow erythropoiesis. This is indicative of a disorder in the bone marrow, which, along with the kidney, is an important organ for erythropoiesis. This finding aligns with previous reports describing bone marrow hypoplasia in chronic Ehrlichiosis, which may affect the production of multiple blood cell (Tuna *et al.*, 2019). The hematology results also showed leukopenia, as indicated by the low levels of neutrophils, lymphocytes, monocytes, and eosinophils. This condition is commonly

Table 1 Biochemistry test results of 5-year-old female Alaskan Malamute dog named Salt

Parameter (Unit)	Result	Normal Range
BUN (mg/dL)	29*	7–27
Creatinine (mg/dL)	2.1*	0.5–1.8
BUN/Crea	13	
Phos (mg/dL)	4.6	2.5–6.8
ALP (U/L)	<60	15–92
T-Pro (g/dL)	7.8	5.2–8.2
Alb (g/dL)	2.5	2.3–4.0
ALT (U/L)	34	10–125
Globulin (g/dL)	5.3*	2.5–4.5
Alb/Glb	0.5	
Glu (mg/dL)	114	58–120
Amyl (U/L)	>2500*	500–1500
Lipa (U/L)	5653*	200–1800

Increased/decreased results of the parameter compared to the normal range. BUN: Blood urea nitrogen; Crea: Creatinine; Phos: phosphor; ALP: Alkaline phosphatase; T-Pro: total protein; Alb: Albumin; ALT: Alanine aminotransferase; Glb: Globulin; Glu: Glucose; Amyl: Amylase; Lipa: Lipase.

Table 2 Hematology result after blood transfusion of 5-year-old female Alaskan Malamute dog named Salt

Parameter (Unit)	Result	Normal Range
RBC (M/µL)	2.94*	5.65–8.87
HCT (%)	18.6*	37.3–61.7
HGB (g/dL)	6.2*	13.1–20.5
MCV (fL)	63.3	61.6–73.5
MCH (pg)	21.1*	21.2–25.9
MCHC (g/dL)	33.3	32.0–37.9
RDW (%)	17.0	13.6–21. 7
%RETIC (%)	0.0	
RETIC (103/µL)	0.9*	10.0–110.0
RETIC-HGB (pg)	21.3*	22.3–29.6
WBC (103/µL)	0.21*	5.05–16.76
%NEU (%)	9.5	
%LYM (%)	38.1	
%MONO (%)	52.4	
%EOS (%)	0.0	
%BASO (%)	0.0	
NEU (sel/µL)	0.02*	2.95–11.64
LYM (sel/µL)	0.08*	1.05–5.10
MONO (sel/µL)	0.11*	0.16–1.12
EOS (sel/µL)	0.00*	0.06–1.23
BASO (sel/µL)	0.00	0.00–0.10
PLT (sel/µL)	22*	148–484
MPV (fL)	11.6	8.7–13.2
PDW (fL)	9.6	9.1–19.4
PCT (%)	0.03*	0.14–0.46

*Increased/decreased result of the parameter compared to the normal range; RBC: red blood cell; HCT: hematocrit; HGB: hemoglobin; MCV: mean corpuscular volume; MCH: mean corpuscular hemoglobin; MCHC: mean corpuscular hemoglobin concentration; RDW: red cell distribution width; Retic: reticulocyte; WBC: white blood cell; Neu: neutrophil; Lym: lymphocyte; Mono: monocyte; Baso: basophile; PLT: platelet; MPV: mean platelet volume; PDW: platelet distribution width; PCT: plateletcrit.

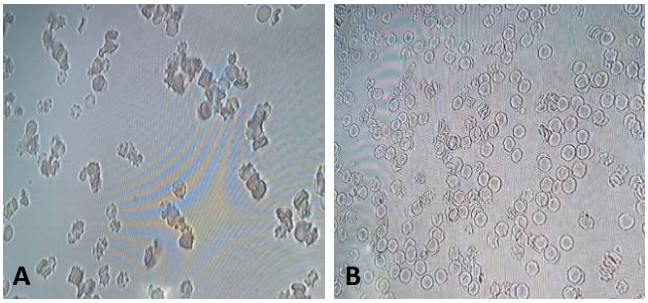

Figure 4 Crossmatch of donor-recipient before blood transfusion. (A) A negative crossmatch result. (B) A compatible crossmatch result.

found in chronic infections, which is a result of increased leukocyte usage to fight infection without sufficient new leukocyte formation due to bone marrow damage. The presence of severe leukopenia, non-regenerative anemia, and thrombocytopenia is indicative of advanced bone marrow suppression, which is a well-recognized poor prognostic factor for canine monocytic Ehrlichiosis.

Discussion

Physical examination of Salt revealed extremely pale mucous membranes, which is an indication of anemia. Hematology tests using the IDExx Procyte machine showed unreadable results, indicating that Salt was experiencing pancytopenia. Pancytopenia is a significant decrease in the majority of blood cell volumes (cytopenia singular). Thrombocytopenia is a condition that occurs due to destruction of thrombocytes and decreased platelet production, resulting in bone marrow hypoplasia and the production of antiplatelet antibodies (Tuna *et al.*, 2019). Monocyte infection by *E. canis* causes the production of antibodies that bind to thrombocytes and erythrocytes, causeing their destruction by the body's immune system. Ehrlichiosis is known to cause multisystemic disorders, such as renal dysfunction, liver disorders, and immune and hematopoietic dysfunction (Alcon-Chino & De-Simon, 2025).

Elevated BUN-creatinine levels in this case indicate the beginning of glomerular dysfunction, likely due to decreased immune complex function. The marked hematologic reduction may have increased the renal workload and contributed to progressive renal damage. Elevated globulin levels may result from the increased response of B cell lymphocytes to chronic antigen stimulation by *E. canis* infection (Roopali *et al.*, 2018). This case may indicate that the infection has been occurring for an extended period.

Elevated amylase and lipase levels indicate pancreatic dysfunction, leading to the overproduction of these two enzymes. Elevated levels of these two enzymes are commonly associated with pancreatitis but may also occur in cases of gastroenteritis parvovirus, babesiosis, and monocytic Ehrlichiosis (Cridge *et al.*, 2021). Further evaluation of the pancreas can be assessed through the levels of canine pancreatic lipase immunoreactivity (cPLI) assays, however in this case it was not performed.

Several differential diagnose were considered based on the clinical findings of this case, including immune-mediated hemolytic anemia (IMHA), aplastic anemia, hemophagocytic syndrome, and potential co-infection with other tick-borne

pathogens (*Rickettsia* and *Anaplasma*). Immune-mediated hemolytic anemia involves the destruction of mature red blood cells, which may trigger a regenerative bone marrow response, as well as aplastic anemia, which is a failure of the bone marrow to produce new blood cells. Co-infection with tick-borne pathogens, such as *Rickettsia* spp., *Anaplasma* spp., *Bartonella* spp., and *Borrelia* spp. was also considered; therefore, a serological test kit with a combined feature for detecting these diseases was chosen.

Identification of Canine Monocytic Ehrlichiosis is usually performed using a serological test kit, such as the IDExx SNAP© 4dx test kit, although other brands may also provide this. However, this test kit is unable to differentiate between current and past exposure; therefore, diagnosis must still be done according to the patient's clinical manifestations. Other methods of identification include blood smear, which was not performed in this case. In the acute phase, there is a greater opportunity to find infected leukocytes in the blood smear because of the higher degree of parasitemia; however, in the subclinical and chronic phases, the chances of finding infected leukocytes decrease, often resulting in false negatives (Angkanaporn *et al*., 2022). Another limitation was that PCR testing was not performed.

The treatment of choice for Ehrlichiosis is doxycycline or minocycline for 28 days. Doxycycline is a tetracycline-class antibiotic that works by inhibiting the binding of aminoacyl-tRNA and the bacteria's 30S ribosome during protein synthesis (Plumb, 2018). Doxycycline was chosen as the treatment of choice because it has a low minimum inhibition concentration (MIC) (Mylonakis *et al*., 2019). However, several studies have shown that doxycycline treatment for chronic infection may require a second phase of treatment after the initial 28 days of treatment (Fourie *et al*., 2015). In this case, Salt died before the treatment period was completed, therefore the effectiveness of the therapy could not be determined definitively.

Salt was administered doxycycline 10 mg/kg/day, Baytril 5%, and a 0.75% Ketamine drip infusion. A 0.75% Ketamine drip infusion was administered to alleviate pain and Baytril 5% was administered as a secondary antibiotic to help prevent possible secondary infections considering severe leukopenia and immunosuppression. Although broad-spectrum antibiotics administered without proper bacterial confirmation may pose a concern for antimicrobial resistance, their administration in this case was due to the high risk of opportunistic secondary infection. A low-dose of 0.75% Ketamine drip infusion was administered to alleviate visceral pain, as Salt showed signs of pain when first brought to the clinic. Although Ketamine is partially renally excreted, its use in this case was limited and closely monitored because of the patient's critical condition. Further supplementation was also prescribed, such as Nonemi©, Fufang, and Renal N and P. Nonemi© was given as a vitamin B and Fe mineral supplement. Supplements Renal N and P contain *Lactobacillus acidophilus* and phosphorous binders that helps increase kidney function, as a precaution to Salt's poor kidney function levels.

The severe anemic condition in Salt warrants immediate blood transfusion. Before the transfusion, Salt was first given an injection of Darbepoetin Alfa and Fufang to stimulate erythropoiesis until a matched blood donor was found. Darbepoetin Alfa is an erythropoietin recombinant analog that increase erythropoiesis in the kidneys (Baranidharan *et al*., 2019). Fufang is an herbal medication with multiple functions, including increasing erythropoiesis and immune response. However, its efficacy may be limited in this case because of the impaired bone marrow condition.

Canine blood typing uses the dog erythrocyte antigen (DEA) system. There are 12 blood types in dogs, with DEA 1, 3, 4, 5, and 7 (Creedon & Davis, 2023; Herter *et al*., 2022). In DEA 1, there is further classification into DEA 1(+) and DEA 1(-), with DEA 1(+) being the most common blood type. Salt has a DEA 1(+) blood type, but because donors come from multiple breeds, crossmatching is performed prior to blood transfusion to ensure compatibility.

Crossmatching is a recommended step in blood transfusion because it's a method used to observe the agglutination reaction between the donor's plasma alloantibody and the recipient's RBC alloantigen (Creedon & Davis, 2023). The objective of this method is to prevent acute immune-mediated hemolytic transfusion reactions, such as allergic reactions, acute hemolysis, sepsis, and transfusion-related acute lung injury (TRALI) (Cote & Cohn, 2020).

A fully compatible crossmatch, defined by the absolute absence of visible hemolysis or agglutination is ideal (Herter *et al*., 2022), but is not always achievable in critically ill patients. In this case, donor blood was considered suitable for transfusion with minimal and clinically significant hemolysis or agglutination observed during crossmatching, as shown in **Figure 4B**. After compatible blood sample is identified, blood is collected from the donor, ensuring that the volume of blood collected does not exceed 10% of the donor's body weight.

Donor blood is collected through the jugular vein because it has a strong blood circulation flow that can speed up and better facilitate the blood collection process. The collected blood was stored in a blood bag containing 14 mL of citrate phosphate dextrose adenine (CPDA-1) for a 100 mL blood collection. After blood collection, donors are given a normal saline (NaCl 0.9%) infusion and a HemaBio injection to maintain electrolyte balance and boost immunity.

Prior to transfusion, Salt was first administered a premedication of dexamethasone injection to prevent an inflammatory reaction to the blood being administered. An infusion of normal saline (NaCl 0.9%) was administered between the administration of each new blood bag to give the body time to adjust to the blood transfusion process.

Salt was found dead on day 9 of treatment, despite showing signs of recovery for several days. On the previous day (day 8), Salt showed signs of persistent fever, and on day 7 she experienced an allergic reaction (panting, hypersalivation, and lethargy) to the blood transfusion performed on that day. Blood transfusion was immediately stopped. An adverse hypersensitivity reaction occurs when pre-existing antibodies in the recipient bind to an allergen (antigen, protein) in the donor plasma, causing a hypersensitivity reaction similar to the one manifested in Salt (Cote & Cohn, 2020). Although crossmatching and preventive premedication were

performed, transfusion-associated risk may not be fully eliminated. Such reactions may still occur in critically ill or immunocompromised patients. In this case, profound hematologic compromise may have increased susceptibility to adverse transfusion reactions.

Due to the prominent decrease in leukocytes, the possibility of a secondary infection could not be ruled out, however, diagnostic testing had not been performed prior to Salt's death to confirm this. Chronic Ehrlichiosis with symptoms of profound pancytopenia, severe leukopenia, or anemia predict a poor prognosis and the risk of mortality, mainly due to severe hemorrhage or secondary infections (Mylonakis *et al.*, 2019; Ramakant *et al.*, 2020; Espino-Solis *et al.*, 2023). Moreover, dog breeds of Siberian huskies and German shepherds have been found to exhibit severe clinical symptoms, causing infections in these breeds to have the worst prognosis (Aziz *et al.*, 2023; Mylonakis *et al.*, 2019).

Conclusion

This case shows the clinical manifestation of chronic canine monocytic ehrlichiosis, particularly complicated by severe pancytopenia. Despite receiving appropriate antibiotic treatment and supportive blood transfusion, and the dog showing signs of improvement, the outcome was fatal, highlighting the poor prognosis of this disease. This case reinforces the critical role of routine ectoparasite control as a preventive strategy to reduce the incidence of ehrlichiosis and other tick-borne diseases in dogs.

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Availability of data and materials All data are available in the manuscript.

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