

Retrospective study of hematological changes in dogs with blood diseases of parasitic origin: 18 cases

Estudo retrospectivo das alterações hematológicas em cães com doenças sanguíneas de origem parasitária: 18 casos

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ABSTRACT

In the clinical routine, blood tests are of paramount importance for the assessment of the health of animals, as they allow the quantification of red and white blood cells, and thus enable the detection and monitoring of hematological changes caused by diseases of parasitic origin. Because of the above, the objective of this work is to describe the main hematological alterations in canines with blood diseases of parasitic origin. A retrospective study was carried out of the medical records of dogs referred and treated by the outpatient team of the Laboratory of Parasitic Diseases of Animals of the Veterinary Clinic School of the Federal University of Sergipe, Campus do Sertão, from March 2022 to December 2022, all statistical data were analyzed using the *InStat GraphPad* software, with a significance level of $p < 0.05$. As a result, it was observed that 30% (18/60; $p < 0.0001$) of the dogs had blood diseases of parasitic origin. 5,55% (1/18; $p < 0.0001$) of patients were diagnosed with anaplasmosis, 5,55% (1/18; $p < 0.0001$) with ehrlichiosis, 11,11% (2/18; $p < 0.0010$) with babesiosis, 5,55% (1/18; $p < 0.0001$) with hepatozoonosis and 77,77% (14/18; $p < 0.0003$) with leishmaniasis.

Monoparasitism and co-infection were observed in 94.44% and 5.56% of the animals, respectively ($p < 0.0001$). Anemia, anisocytosis, leukocytosis, lymphocytosis and, thrombocytopenia were the main hematological changes observed in parasitized dogs.

Keywords: Blood, Hemoparasites, Small clinic.

RESUMO

Na rotina clínica, os exames sanguíneos são de suma importância para a avaliação de saúde dos animais, visto que permite quantificar os glóbulos vermelhos e brancos, e assim, possibilita a detecção e o acompanhamento das alterações hematológicas causadas por doenças de origem parasitária. Diante do exposto o objetivo deste trabalho é descrever as principais alterações hematológicas em caninos com doenças sanguíneas de origem parasitária. Foi realizado um estudo retrospectivo dos prontuários de cães encaminhados e atendidos pela equipe ambulatorial do Laboratório de Doenças Parasitárias dos Animais da Clínica Veterinária Escola da Universidade Federal de Sergipe, campus do Sertão no período de março de 2022 a dezembro de 2022, todos os dados estatísticos foram analisados utilizando o software InStat GraphPad, com nível de significância de $p < 0,05$. Como resultado foi observado que 30% (18/60; $p < 0.0001$) dos cães estavam com doenças sanguíneas de origem parasitária. 5,55% (1/18; $p < 0.0001$) dos pacientes foram diagnosticados com anaplasiose, 5,55% (1/18; $p < 0.0001$) com erliquiose, 11,11% (2/18; $p < 0.0010$) com babesiose, 5,55% (1/18; $p < 0.0001$) com hepatozoonose e 77,77% (14/18; $p < 0.0003$) com leishmaniose. Monoparasitismo e co-infecção foi observado em 94,44% e 5,56% dos animais, respectivamente ($p < 0.0001$). Anemia, anisocitose, leucocitose, linfocitose e trombocitopenia foram as principais alterações hematológicas observadas nos cães parasitados.

Palavras-chave: Clínica de pequenos, hemoparasitos, sangue.

1 INTRODUCTION

Dogs are domestic animals that have blood cells such as erythrocytes, leukocytes, and thrombocytes, which are produced by the bone marrow, from the process of hematopoiesis, therefore, they are fundamental in maintaining the hemodynamic balance and immune system (THRALL *et al.*, 2015; HOFFBRAND *et al.*, 2019).

In the clinical routine, blood tests are done to evaluate the functioning of the hematological system of animals, having enormous importance to assisting in the monitoring of health status and diagnosis of diseases of parasitic origin such as those caused by hemoparasites such as anaplasmosis, babesiosis, ehrlichiosis, hepatozoonosis and leishmaniasis (FEITOSA, 2020; SIQUEIRA e BASTOS, 2020).

During routine care, clinical signs such as anorexia, pale mucous membranes, lack of appetite, epistaxis, fever, and lymphadenopathy are commonly associated with blood pathologies (BREDA *et al.*, 2018; HOLANDA *et al.*, 2019). Therefore, the blood count is one of the most requested complementary tests for the diagnosis of various hematological changes, since it allows the quantification of red and white blood cells in addition to their morphological evaluation (COSTA *et al.*, 2020).

Among the main findings observed in animals affected by hemoparasitosis, anemia, anisocytosis, and thrombocytopenia stand out (GREENE, 2016; SILVA, 2017; LOURENÇO *et al.*, 2021). In the leukogram, leukocytosis, leukopenia, lymphocytosis, and leukopenia are recurrent (GALÁN *et al.*, 2018; PRADO *et al.*, 2019; OLIVEIRA *et al.*, 2021).

Because these are pathologies with high casuistry and of great relevance to animal health (MUNDIM *et al.*, 2008). The present retrospective study aims to describe the main hematological changes in dogs with blood diseases of parasitic origin.

2 MATERIAL AND METHODS

In this work, a retrospective study was carried out of the medical records of dogs referred and attended by the outpatient team of the Laboratory of Parasitic Diseases of Animals of the Veterinary Clinic School of the Federal University of Sergipe, Sertão campus from March 2022 to December 2022. To compile the data, the following information was obtained, analyzed, and grouped: general data, history, clinical signs, requested tests, diagnosed parasitic disease and hematological findings. The medical records with incomplete data were classified as "not worth noting" (NWN) and did not enter this study. All statistical data were analyzed using the *InStat GraphPad* software, with a significance level of $p < 0.05$.

3 RESULTS

In our study, 30% (18/60; $p < 0.0001$) of the dogs treated had blood diseases of parasitic origin. 38.88 (7/18) and 61.11% (11/18) of the sick animals were male and female ($p < 0.0002$), respectively, aged between 5 months and 10 years (average= 4.6 years), weighing from 5 kg to 15 kg (average= 9.7 kg), identified as SRD - No defined race (94.44%; 17/18) and with defined race (5.55%; 1/18) ($p < 0.0008$).

Regarding the clinical history of these animals, it was observed that 77.77% (14/18; $p < 0.0036$) and 22.22% (4/18; $p < 0.0003$) had in their diet commercial food and homemade food, respectively 8.88% (16/18) of the dogs had access to the street and 83.33% (14/18; $p < 0.0010$) had contacts (bovine, canines, cats, chickens and pigs). Vector parasitism was reported in 66.66% (12/18; $p < 0.0213$) of patients, especially the tick *Rhipicephalus sanguineus* (61.11%; 11/18; $p < 0.0080$) and the flea *Ctenocephalides canis* (5.55%; 1/18; $p < 0.0001$).

Clinical changes were observed in 100% of the animals, being described as the increase in lymph nodes (61.11%; 11/18), fever (5.55%; 1/18), hypocolored mucous (22.22%; 4/18), anorexia (16.66%; 3/18), crusts (5.55%; 1/18), multifocal and/or generalized alopecia (22.22%; 4/18),

superficial lesions in the muzzle (27.77%; 5/18) and ataxia of the hind limbs (11.11%; 2/18), prostration (11.11%; 2/18) and apathy (11.11%; 2/18) (Figure 1 a, b and c).

30% (18/60; $p < 0.0001$) of dogs were diagnosed with blood diseases of parasitic origin, caused by protozoa (60%) and bacteria (40%) ($p < 0.0080$). In which 5.55% (1/18; $p < 0.0001$) of the patients were diagnosed with anaplasmosis, 5.55% (1/18; $p < 0.0001$) with ehrlichiosis, 11.11% (2/18; $p < 0.0010$) with babesiosis, 5.55% (1/18; $p < 0.0001$) with hepatozoonosis and 77.77% (14/18; $p < 0.0003$) with leishmaniasis (Figure 1d, e and f). Monoparasitism and co-infection were observed in 94.44% and 5.56% ($p < 0.0001$) of the animals, respectively.

Figure 1: Clinical changes and hemoparasites identified in dogs. a) Enlarged popliteal lymph node, b) Animal presenting prostration and apathy, c) Crusts, d) Amastigotas of *Leishmania* sp., e) *Babesia* sp. in dog red blood cells, and f) *Anaplasma platys* in platelet.



Regarding hematological changes, the results of the blood count (Table 1) showed that in animals with co-infection between anaplasmosis and ehrlichiosis, normochromic microcytic anemia, anisocytosis, thrombocytopenia, and lymphocytosis were observed. In babesiosis, normochromic normocytic anemia, anisocytosis, thrombocytopenia, and leukopenia were identified. In canines with hepatozoonosis, normochromic normocytic anemia, thrombocytopenia, and lymphocytosis. In patients with leishmaniasis, the findings were hypochromic microcytic anemia (14.28%; 2/14; $p < 0.0003$), normochromic anemia (78.57%; 11/14; $p < 0.0019$), anisocytosis (21.42%; 3/14; $p < 0.0019$), thrombocytopenia (64.28%; 9/14; $p < 0.0080$), leukopenia (35.71%; 5/14; $p < 0.0080$), and lymphocytosis (21.42%; 3/14; $p < 0.0019$) (Table 2).

Table 1: Hematological parameters in dogs with hemoparasitosis.

Disease Parameter	Anaplasmosis	Babesiosis	Ehrlichiosis	Hepatozoonosis	Reference value
Red cells	2.95 10 ⁶ /uL	4.54 10 ⁶ /UI	2.95 10 ⁶ /uL	3.16 10 ⁶ /uL	5.50-8.50
Hemoglobin	12.1 g/L	15.6 g/L	12.1 g/L	12.7 g/L	12.0 -18.0
M.C.V	55.3 fL	62.6 fL	55.3 Fl	63.3 fL	60.0-77.0
M.C.H.C	620 g/L	549 g/L	620 g/L	635 g/L	320-360
R.D.W	11.6%	15.8%	11.6%	14.9 %	12.0-15.0
Platelets	26 10 ³ /uL	83 10 ³ /uL	26 10 ³ /uL	86 10 ³ /uL	200-500
Leukocytes	6.2 10 ³ /uL	5.6 10 ³ /uL	6.2 10 ³ /uL	8.3 10 ³ /uL	6.0-17.0
Lymphocytes	39.1%	23.1%	39.1%	51.2%	12.0-30.0

M.C.V= Mean Corpuscular Volume

M.C.H.C= Mean Corpuscular Hemoglobin Concentration

R.D.W= Red Cell Distribution Width

Table 2: Hematological parameters in dogs with leishmaniasis.

Animal	Red cells	Hemoglobin	M.C.V	M.C.H.C	R.D.W	Platelets	WBC	LYM
Dog 1	2.68 10 ⁶ /uL	10.4 g/L	62,7 fL	619 g/L	14.3 %	29 10 ³ /UI	3.4 10 ³ /uL	14.6%
Dog 2	2.14 10 ⁶ /uL	8.0 g/L	66.7 fL	571 g/L	13.9%	39 10 ³ /UI	5.6 10 ³ /uL	28.0%
Dog 3	1.51 10 ⁶ /uL	4.7 g/L	66.6 fL	470 g/L	13.0%	27 10 ³ /uL	3.5 10 ³ /uL	31.4%
Dog 4	4.19 10 ⁶ /uL	13.5 g/L	65.9 fL	489 g/L	13.1%	49 10 ³ /UI	4.0 10 ³ /uL	41.5%
Dog 5	3.32 10 ⁶ /uL	10.0 g/L	67.0 fL	450 g/L	10.7%	96 10 ³ /uL	14.8 10 ³ /uL	33.9%
Dog 6	3.29 10 ⁶ /uL	14.3 g/L	67.9 fL	641 g/L	12.0%	78 10 ³ /uL	8.3 10 ³ /uL	23.5%
Dog 7	1.82 10 ⁶ /uL	6.2 g/L	58.3 fL	584 g/L	18.5%	54 10 ³ /uL	10.9 10 ³ /uL	29.1%
Dog 8	3.64 10 ⁶ /uL	13.0 g/L	57.7 fL	622 g/L	15.5%	144 10 ³ /uL	10.5 10 ³ /uL	28.7%
Dog 9	3.13 10 ⁶ /uL	13.0 g/L	65.8 fL	634 g/L	11.7%	223 10 ³ /uL	12.4 10 ³ /uL	26.1%
Dog 10	3.22 10 ⁶ /uL	12.9 g/L	66.7 fL	602 g/L	11.5%	93 10 ³ /uL	6.5 10 ³ /uL	24.1%
Dog 11	3.08 10 ⁶ /uL	14.5 g/L	71.5 fL	659 g/L	12.3%	50 10 ³ /uL	6.9 10 ³ /uL	34.3%
Dog 12	2.61 10 ⁶ /uL	10.4 g/L	71.4 fL	559 g/L	15.1%	23 10 ³ /uL	5.8 10 ³ /uL	42.9%
Dog 13	3.21 10 ⁶ /uL	9.3 g/L	52.9 fL	462 g/L	14.3%	31 10 ³ /uL	16.6 10 ³ /uL	26.4%
Dog 14	4.54 10 ⁶ /uL	15.6 g/L	62.6 fL	549 g/L	15.8%	83 10 ³ /uL	5.6 10 ³ /uL	23.1%
Average	3.02 10 ⁶ /uL	11.1 g/L	64.5 fL	565 g/L	13,6%	72 10 ³ /uL	8,2 10 ³ /uL	29,1%
REF	5-50-8-50	12.0-18.0	60.0-77.0	320-360	12.0-15.0	200-500	6.0-17.0	12.0-30.0

HGB – Hemoglobin, PLT – Platelets; WBC – With Blood Cells, LYM – Lymphocytes, REF – Reference value.

4 DISCUSSION

In this work, hematological changes are described in wandering canines with blood diseases of parasitic origin. According to Badawi and Yousif (2020), street animals or animals with free access to this environment are more predisposed to acquire hemoparasites. Studies conducted in Brazil have shown the occurrence of hemoparasitoses with infections between *Anaplasma platys*, *Ehrlichia canis*, *Babesia canis*, *Hepatozoon canis* and *Leishmania infantum* (SANTOS *et al.*, 2018).

In the clinical evaluation, in most canine patients, lymphadenopathy was one of the changes that drew attention to the performance of the physical examination. According to Obeta *et al.*, 2018, this clinical sign suggests a suspected picture of parasitic diseases. In addition, Breda *et al.*, 2018

and Silveira *et al.*, 2019 show that animals may have the hematopoietic system affected, due to the damage to blood cells caused by hemoparasites, which infect mature and immature cells.

Hematological changes are quite common in dogs with anaplasmosis, ehrlichiosis, babesiosis, hepatozoonosis, and leishmaniasis, due to disorders in the production and hemolysis of hematopoietic cells at the bone marrow level. As a result of medullary hypoplasia, caused by the destruction of white and red blood cells, the clinical sign of a pale mucosa can be seen in the physical examination (THRALL, 2007; NELSON and COUTO, 2015).

In the patients in this study, the diagnosis of anaplasmosis, ehrlichiosis, and leishmaniasis was performed by rapid tests and confirmed by parasitological examination. According to Ribeiro *et al.*, 2019 the immunochromatographic tests SNAP 4Dx® Plus and DPP (Dual Path Platform, Biomanguinhos®) are used in veterinary routines due to the practicality in the execution and speed in obtaining the results, as well as have a greater sensitivity. According to Zhu *et al.*, 2020, the blood smear can be considered a confirmatory test, since it allows the microscopic visualization of the parasites. The complementary test used was the blood count, which associated with the data obtained in the clinical examination, demonstrated a medical condition compatible with hemoparasitosis (ALMOSNY, 2002; VIEIRA *et al.*, 2021).

However, it is worth mentioning that other methods of confirmatory diagnosis are molecular techniques, such as Polymerase Chain Reaction, which is used for the detection of DNA and/or RNA fragments, and serological ones, such as Enzyme Linked Immuno Sorbert Assay (ELISA), Detect specific antigens and antibodies, which are of paramount importance to prove infection by hemoparasites (ARONSON, 2019; FERREIRA and MONTICELLI, 2022).

In the blood count, the main hematological findings in canines with hemoparasitosis are anemia (normocytic, microcytic, macrocytic, normochromic and hypochromic), leukocytosis, lymphocytosis, and thrombocytopenia, which are observed in canine patients (SCHERER and MERGENER, 2014; NELSON and COUTO, 2022). These changes may be due to these parasites affecting blood cells, such as red blood cells, leukocytes, or platelets, removing white blood cells and red blood cells from the blood circulation or through hemolytic action (SANTOS *et al.*, 2019).

Regarding treatment, the drugs that demonstrate the greatest therapeutic efficacy of ehrlichiosis are tetracyclines, such as doxycycline chloridate (MACHADO *et al.*, 2010; JERICÓ *et al.*, 2015). In turn, imidocarb dipropionate is used in cases of anaplasmosis and babesiosis, which is associated with Atropine 1% and is also useful against hepatozoonosis (ALMEIDA *et al.*, 2020). For canine visceral leishmaniasis, Milteforan™ (Miltefosine 2%) is the main drug used in the treatment of dogs (MIRÓ *et al.*, 2009; BANETH *et al.*, 2022).

Regarding control and prophylaxis, in the management carried out by the guardians with the animals, the zoonotic potential of hemoparasitosis should be taken into account, except of hepatozoonosis, since in the others, infected ticks and mosquitoes can transmit to humans (GARCIA *et al.*, 2018; KATAGIRI, 2021; CAPASSO and SUPURAN, 2023). In this way, ectoparasiticides and repellent collars must be used in dogs (COURTENAY *et al.*, 2019).

5 CONCLUSION

Dogs with diseases of parasitic origin may present hematological changes such as anemia, anisocytosis, leukocytosis, lymphocytosis, and thrombocytopenia, and it is recommended to perform screening and parasitological tests periodically to obtain an early diagnosis. More studies are needed on the pathophysiology of hematological changes related to hemoparasitosis, addressing health education to tutors, linked to control and prevention measures.

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