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CASE REPORT

UNCOMPLICATED CANINE BABESIOSIS WITHOUT PROPHYLAXIS: CASE REPORT AND RETROSPECTIVE ANALYSIS

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Ethical considerations: When reporting experiments on animals Observation of the ARRIVE guidelines 2.0: Updated guidelines for reporting animal research, published on July 14, 2020 (DOI: 10.1371/journal.pbio.3000410), is applied. The authors ensure that all procedures were performed in compliance with the guidelines for animal care of their institutions or with national/international guidelines.

ABSTRACT

Canine babesiosis is a serious disease caused by intraerythrocytic protozoa of the genus *Babesia*, most commonly *Babesia canis* and *Babesia gibsoni*. A four-year-old male Yorkshire Terrier was presented to a private veterinary clinic with anorexia, fever, weakness, vomiting, and hematuria. Microscopic examination of peripheral blood revealed the presence of *Babesia canis*. Further laboratory findings indicated marked thrombocytopenia and elevated total bilirubin levels, suggesting a severe clinical course potentially associated with hematopoietic dysfunction. The aim of this study was to describe a clinical case of uncomplicated babesiosis in a dog without a history of prophylactic antiparasitic treatment and to compare the findings with data from a retrospective group of ten dogs that had been diagnosed with babesiosis. Based on our findings, we strongly recommend the regular administration of antiparasitic supplements to prevent *Babesia* spp. infections, thereby minimizing animal suffering and reducing treatment costs.

Key words: babesiosis; canine; tick-borne disease

INTRODUCTION

The increase in global temperatures in Slovakia was reflected in an increase in the average annual air temperature by 1.1 °C over the last hundred years. In many regions of the country, temperature records that have been valid for more than two decades have already been exceeded. This fact represents the risk of the spread of tick-borne diseases [1]. The first confirmed cases of canine babesiosis in Slovakia were diagnosed in May 2000, when a male Siberian Husky was treated at the Internal-Clinic of the University of Veterinary Medicine in Košice [2]. Babesiosis vectors are ticks, most often from the *Ixodidae* family and in the temperate zone *Dermacentor reticulatus*. In the tropics and subtropics, the vector is *Rhipicephalus sanguineus* and *Haemaphysalis leachi*, making the disease endemic in areas with a high prevalence of these ectoparasites [1].

It is well known that *Babesia* organisms reproduce in the definitive host through multiple fission producing merozoites. Ticks become infected after ingesting parasitized erythrocytes from the host. During this process, multiple fission of merozoites results in the production of sporozoites (infective undeveloped cells) within the salivary glands of the arthropod. These sporozoites are then transmitted into the host's bloodstream via tick saliva. An attachment period of 2–3 days is required for *Babesia canis* transmission to occur [3].

The dog tick *Dermacentor reticulatus*, a vector of *Babesia canis*, is showing a significant expansion of its range, especially in European countries [4]. Similarly, *B. canis* is the most commonly diagnosed species of *Babesia* in erythrocytes of affected dogs in Slovakia. Clinically, babesiosis is characterized mainly by high fever, pale mucous membranes, loss of appetite, anemia, jaundice, enlarged lymph nodes, and splenomegaly. However, the most typical clinical presentation is the sudden onset of high fever with anemia [5]. The severity of babesiosis varies from subclinical infection to extensive organ failure and death. The diagnosis of babesiosis involves the microscopic identification of the parasite in blood smears, serological methods, and particularly PCR tests, which allow for species-specific detection of the parasite. The prognosis depends on the host's immune response, age, clinical condition, and the speed of treatment initiation. Effective prevention is based on targeted tick control and the application of antiparasitic measures [6]. This study presents a case of uncomplicated canine babesiosis and aims to contextualize it within a broader framework by retrospectively comparing hematological data from a cohort of other infected dogs.

CASE PRESENTATION

A 4-year-old, intact male Yorkshire Terrier was presented to a private veterinary clinic with a 2-day history of lethargy and anorexia. The owner reported that five ticks had been removed from the dog approximately five days prior to presentation. The dog was not receiving any antiparasitic treatment and had no previous history of relevant illness.

Clinical examination revealed an apathetic and unresponsive dog with pale mucous membranes and icteric discoloration of the conjunctivae. Dehydration was evident (reduced skin turgor, capillary refill time >3 seconds), the body temperature was elevated (39.0 °C), and hemoglobinuria was observed.

Blood samples were collected for hematological and biochemical analyses. In addition, a rapid CaniV-4 test (Bionote Co., Ltd., Republic of Korea) was used to screen for vector-borne pathogens (*Ehrlichia* spp*., Anaplasma* spp*., Borrelia burgdorferi,* and *Dirofilaria immitis*). Blood was also obtained from a peripheral vessel in the claw area for cytological examination. Blood smears were air-dried, fixed with methanol, and stained using the Diff-Quik staining kit (Siemens Healthineers). Microscopic examination was performed under light microscopy at 40× and 100× magnification.

MANAGEMENT AND OUTCOMES

The result of the CANIV-4 test was negative, which means that the presence of these pathogens was not detected at the time of the examination. On the other hand, the presence of *Babesia* spp. was finally confirmed cytologically in blood smears, where the typical finding of basophilic staining ring-shaped formations inside erythrocytes was observed (Fig. 1). This finding was considered sufficient to establish the diagnosis. In addition, the dog's hematological examination revealed significant abnormalities, most notably thrombocytopenia, which is commonly associated with *Babesia* infections. The clinical finding was accompanied by a lower neutrophil count within the normal reference range and an increase in the number of lymphocytes (lymphocytosis). It may indicate an inflammatory or immune response of the body to the presence of an infection. Other laboratory findings include elevations in liver enzymes such as Alkaline Phosphatase (ALP) and Aspartate Aminotransferase (AST), which in this case reflect concomitant hepatopathy. Bilirubin concentrations are elevated, commensurate with the degree and rapidity of onset of the anemia and the severity of the accompanying hepatopathy (Table 1).

Treatment for babesiosis is aimed at eliminating the parasite, controlling inflammation, and supporting systemic recovery. Due to the owner's limited financial resources, an affordable yet clinically effective protocol was selected. Imidocarb dipropionate (Imizol; MSD Animal Health,

Table 1. Result of hematological and biochemical examination in a dog with babesiosis

Parameter	Result	Units	Reference Range	Conclusion
White Blood Cells (WBC)	**4.22**	**10^9/l**	**6.00 – 12.00**	**Low**
Red Blood Cells (RBC)	5.81	10^{12}/l	5.50 – 8.50	Normal
Hemoglobin (HGB)	140.0	g/l	120.0 – 180.0	Normal
Hematocrit (HCT)	0.38	ratio	0.37 – 0.55	Normal
Mean Corpuscular Volume (MCV)	65.80	fl	60.00 – 77.00	Normal
Mean Corpuscular Hemoglobin (MCH)	**24.00**	**pg**	**17.00 – 23.00**	**High**
Mean Corpuscular Hemoglobin Concentration (MCHC)	**366.0**	**g/l**	**310.0 – 340.0**	**High**
Platelets (PLT)	**14.00**	**10^9/l**	**150.0 – 500.0**	**Low**
Neutrophils (NE)	58.0	%	55.0 - 75.0	Normal
Lymphocytes (LY)	**42.0**	**%**	**12.0 – 30.0**	**High**
Eosinophils (EO)	0	%	0.0 – 6.0	Normal
Monocytes (MO)	0	%	0.0 – 4.0	Normal
Basophils (BA)	0	%	0.0 – 1.0	Normal
Reticulocytes	0.79	%	0.50 – 1.50	Normal
Reticulocytes (absolute count)	47.70	10^9/l	–	Normal
Calcium (Ca)	**1.95**	**mmol/l**	**2.10 – 3.00**	**Low**
Phosphorus (P)	1.16	mmol/l	0.90 – 1.90	Normal
Glucose (Glc)	5.66	mmol/l	3.60 – 6.70	Normal
Urea	**14.64**	**mmol/l**	**3.97 – 8.05**	**High**
Creatinine	55.97	µmol/l	35.0 – 105.0	Normal
Total Protein	**50.63**	**g/l**	**54.0 – 75.0**	**Low**
Total Bilirubin	**23.34**	**µmol/l**	**0.00 – 3.40**	**High**
Aspartate Aminotransferase (AST)	**2.09**	**µkat/l**	**0.00 – 0.60**	**High**
Alanine Aminotransferase (ALT)	0.42	µkat/l	0.00 – 0.95	Normal
Gamma-Glutamyl Transferase (GGT)	<0.12	µkat/l	0.00 – 0.14	Normal
Alkaline Phosphatase (ALP)	**3.38**	**µkat/l**	**0.00 – 1.24**	**High**

Table 2. Result of hematological and biochemical examination in a dog with babesiosis after treatment

Parameter	Result	Units	Reference Range	Conclusion
White Blood Cells (WBC)	6.63	10^9/l	6.00 – 12.00	Normal
Red Blood Cells (RBC)	6.57	10^{12}/l	5.50 – 8.50	Normal
Hemoglobin (HGB)	159.0	g/l	120.00 – 180	Normal
Hematocrit (HCT)	0.43	ratio	0.37 – 0.55	Normal
Mean Corpuscular Volume (MCV)	65.10	fl	60.00 – 77.0	Normal
Platelets (PLT)	391.0	10^9/l	150.0 – 500.0	Normal
Urea	**2.91**	**mmol/l**	**3.97 – 8.05**	**Low**
Total Proteins	68.15	g/l	54.0 – 75.0	Normal
Total Bilirubin	<3	µmol/l	0.00 – 3.40	Normal
AST	0.28	µkat/l	0.00 – 0.60	Normal
ALT	0.35	µkat/l	0.00 – 0.95	Normal
ALP	0.52	µkat/l	0.00 – 1.24	Normal

Table 3. Mean hematological parameters in a group of 10 dogs with confirmed babesiosis (retrospective analysis)

Parameter	Result	Units	ReferenceRange	Conclusion
White Blood Cells (WBC)	**3.03 ± 3.22**	**10^9/l**	**5.05 – 16.76**	**Low**
Red Blood Cells (RBC)	**5.07 ± 0.63**	**10^{12}/l**	**5.65 – 8.87**	**Low**
Hemoglobin (HGB)	13.43 ± 1.46	g/dl	13.1 – 20.5	Normal
Hematocrit (HCT)	**33.8 ± 3.97**	**%**	**37.3 – 61.7**	**Low**
Mean Corpuscular Volume (MCV)	63.21 ± 3.65	fL	61.6 – 73.5	Normal
Mean Corpuscular Hemoglobin (MCH)	24.2 ± 1.35	pg	21.2 – 25.9	Normal
Mean Corpuscular Hemoglobin Concentration (MCHC)	**39.1 ± 1.11**	**g/dl**	**32.0 – 37.9**	**High**
Platelets (PLT)	**15.6 ± 20.03**	**10^9/l**	**148 – 484**	**Low**
Neutrophils (NEU)	**2.145 ± 1.46**	**10^9/l**	**2.95 – 11.64**	**Low**
Lymphocytes (LYM)	2.82 ± 0.76	10^9/l	1.05 – 5.10	Normal
Monocytes (MONO)	1.1 ± 1.11	10^9/l	0.16 – 1.12	Normal
Eosinophils (EOS)	**0.007 ± 0.009**	**10^9/l**	**0.06 – 1.23**	**Low**
Basophils (BASO)	0.013 ± 0.02	10^9/l	0.00 – 0.10	Normal
Reticulocytes (RETIC)	39.42 ± 26.77	K/ml	10.0 – 110.0	Normal
Reticulocyte Hemoglobin Content (RETIC-HGB)	**20.05 ± 1.71**	**pg**	**22.3 – 29.6**	**Low**
Mean Platelet Volume (MPV)	**16.9 ± 2.45**	**fL**	**8.7 – 13.2**	**High**
Plateletcrit (PCT)	**0.02 ± 0.03**	**%**	**0.14 – 0.46**	**Low**

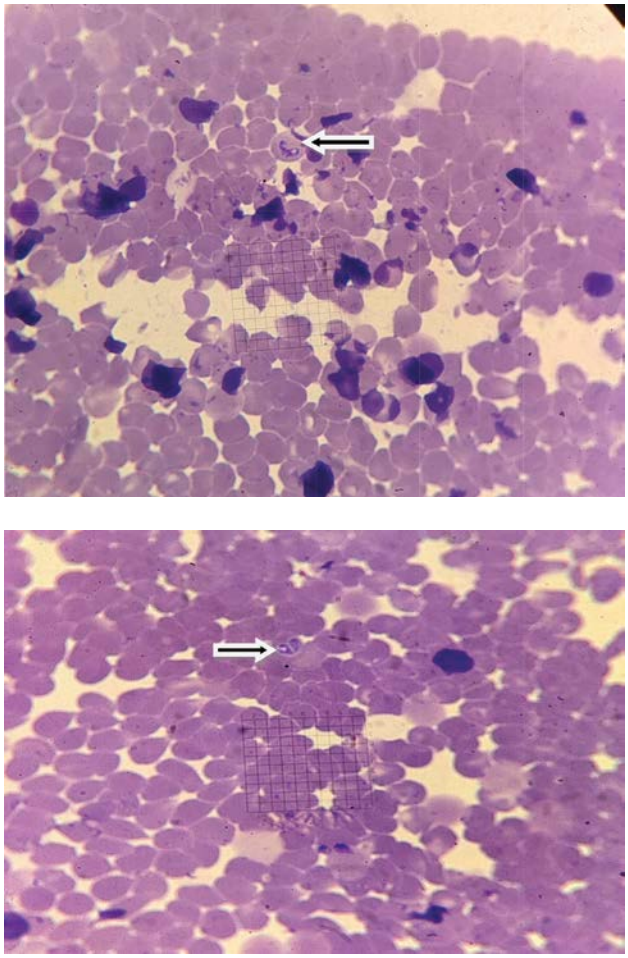

Fig 1. Microscopic finding (40x) *Babesia* spp. with typical basophilic ring shape *(arrow)*

UK) was administered intramuscularly at a dose of 5 mg/kg, with a repeated dose given two weeks later. Rehydration was initiated through intravenous fluid therapy using isotonic crystalloids (Ringer's lactate; e.g., B. Braun, Germany), administered as part of a 24-hour fluid replacement plan, adjusted to ambulatory conditions. To reduce inflammation and fever, meloxicam was used as a non-steroidal anti-inflammatory drug (NSAID). A single subcutaneous dose of 0.2 mg/kg body weight was administered on the first day (Meloxidolor; Le Vet Beheer B.V., Netherlands), followed by oral administration of meloxicam (Meloxoral; Cymedica, Czech Republic) at a dose of 0.1 mg/kg once daily for five consecutive days. Supportive therapy included Catosal (Bayer, Germany), administered at a dose of 0.5 ml twice a week to stimulate metabolism and recovery. Despite the constrained budget, the chosen protocol led to clinical improvement and hematological stabilization, as confirmed by follow-up laboratory testing (Table 2).

For comparative purposes, a retrospective group consisting of 10 dogs with confirmed babesiosis was included. The data was obtained from our student's diploma thesis carried out at the University Veterinary Hospital, where dogs of different breeds, sexes and ages (9 months to 2 years) were carefully documented. The owners of the patients were informed about the use of the results for research purposes. Hematological parameters of this group are summarized in Table 3.

DISCUSSION

The most common hematological abnormalities associated with *Babesia canis* infections are anemia and thrombocytopenia. This was confirmed in our case, where the patient exhibited significant thrombocytopenia in the hematological profile. Although thrombocytopenia is a characteristic feature of the disease, petechiae or epistaxis are rarely observed, except in cases with concurrent *Ehrlichia* infections [7]. Similar findings were observed in a clinical study conducted on 248 dogs positive for *Babesia canis*, where thrombocytopenia was detected in 247 dogs (99.5 %) . We hypothesize that the decrease in platelet count was caused by immune-mediated destruction of platelets and subsequent sequestration in the spleen [8].

These findings are consistent with the study by Kettner et al. (2003), which reports that up to 99 % of dogs with babesiosis exhibit thrombocytopenia, with 62 % having platelet counts below 25 × 10^9/L. This finding is considered characteristic of the disease and holds high diagnostic value [9]. Compared to a retrospective group of 10 dogs with confirmed babesiosis (Table 3), the described patient exhibited a significantly lower platelet count (14 × 10^9/L vs. an average of 15.6 ± 20.03 × 10^9/L), placing him at the lowest end of the observed range. This data supports the hypothesis of pronounced immune-mediated thrombocytopenia. Thrombocytopenia is a consistent finding in canine babesiosis and is usually severe in the acute phase of infection. Platelet counts typically rise within a week after initiating treatment, suggesting that immune-mediated mechanisms are involved in its pathogenesis [10].

In addition to thrombocytopenia, another common hematological abnormality in babesiosis is anemia, which can significantly affect the clinical picture of the patient [11]. Anemia is a frequent finding in canine babesiosis, with its prevalence ranging from 20 % to over 90 % of infected dogs, depending on various studies. The mechanisms leading to the development of anemia are multifactorial, including intravascular hemolysis caused by the rupture of parasitized erythrocytes, extravascular hemolysis mediated by phagocytosis in the spleen and liver, immune-mediated damage to erythrocytes, and in some cases, inhibition of erythropoiesis [12]. In our patient's case, however, anemia was not present, which aligns with normal hematocrit and hemoglobin values upon admission. The average hematocrit value in the retrospective group of dogs was 33.8 ± 3.97 %, while our patient's value was 38 %, corresponding to the reference range. This deviation may be due to early diagnosis and treatment, which prevented the development of the hemolytic phase of the infection.

The leukocyte response in canine babesiosis is variable, with leukopenia, neutropenia, and lymphocytosis being the most commonly observed changes [13]. These alterations reflect the dynamic response of the immune system to parasitic infection, as well as the disease phase. In the acute phase, a decrease in white blood cell count may occur due to their migration into tissues or increased destruction resulting from the inflammatory response [14]. In the retrospective group of 10 dogs, the average WBC count was 3.03 ± 3.22 × 10^9/L, indicating mild to moderate leukopenia (Table 3). In our patient's case, leukopenia with a value of 4,22 × 10^9/L was recorded, confirming the presence of an inflammatory response and aligning with findings described in the literature.

The patient in this case exhibited a normal neutrophil count and mild lymphocytosis. These findings align with the typical progression of *Babesia canis* infection, where neutropenia—commonly reported in other cases—may result from the redistribution of neutrophils into tissues or their increased consumption during the acute inflammatory response. Conversely, lymphocytosis may reflect activation of the adaptive immune system and is more frequently observed in the later stages or in less severe forms of the disease [15]. In contrast, analysis of a retrospective group of ten dogs with confirmed babesiosis revealed a trend toward lower neutrophil counts and normal lymphocyte levels, highlighting the variability in leukocyte responses associated with canine babesiosis.

Among the retrospective group of 10 dogs, an increased average MPV value (16.9 ± 2.45 fL) was observed, which may indicate compensatory production of young platelets in response to thrombocytopenia. This finding is consistent with the study by Goddard et al. (2015), which states that elevated MPV values may reflect platelet activation in canine babesiosis [16]. The concordance between the retrospective group's results and data from the literature confirms that increased MPV is a common finding in babesiosis.

Biochemical analysis revealed elevated AST, ALP, and total bilirubin levels in our patient. These changes are common in *Babesia canis* infection and are primarily as-

sociated with hemolytic damage and secondary liver involvement. Elevated AST activity may result from hepatocellular or muscle damage [17]. ALP elevation is typical in cholestasis or inflammatory processes in the hepatobiliary system. Hyperbilirubinemia in our patient corresponded with the clinical finding of jaundice and indicates the breakdown of infected erythrocytes during the hemolytic phase of babesiosis [18]. Azotemia occurs in many cases of dehydration, which was also demonstrated in our case [19].

It is important to note that the hematological and biochemical analyses of the individual patient were performed by an external diagnostic laboratory (UNILABS, Slovakia) using their standard reference intervals, while the retrospective group data were obtained using the IDEXX ProCyte Dx analyzer (IDEXX Laboratories, Kobe, Japan). Therefore, minor discrepancies in reference ranges were anticipated. Nevertheless, the comparative interpretation was based on relative deviations from each laboratory's standards, allowing for an accurate evaluation of the results.

For the treatment of canine babesiosis, Imizol containing the active substance imidocarb dipropionate was used. It is an aromatic diamidine for which several mechanisms of action against *Babesia canis* have been proposed. The most likely include damage to nucleic acids, inhibition of cellular repair and replication, or direct action on the parasite by targeting its nucleus and cytoplasmic structures. Additionally, hypoglycemia in the parasite and inhibition of the division of its unicellular structure are also suggested mechanisms [20].

During treatment, some dogs may develop parasympathetic symptoms such as excessive salivation, vomiting, general weakness, tremors, and muscle contractions. These symptoms can be mitigated by administering atropine as premedication at a dose of 0.05 mg/kg. Other, less frequent adverse effects include dyspnea, restlessness, diarrhea, renal tubular or hepatic necrosis, and local inflammation at the injection site. Ulceration occurs rarely and usually heals within a few days to weeks. Fatal anaphylactic reactions have also been reported [21]. None of these adverse effects were clinically observed in our case.

Prevention of babesiosis is essential for safeguarding canine health, as the disease can have severe and potentially life-threatening consequences. Basic preventive measures include the regular use of antiparasitic agents, thorough inspection of the coat after outdoor activity, and prompt removal of any detected ticks. These measures are especially important in regions with a high incidence of ticks. Many pet owners mistakenly believe that ticks pose a threat only during the summer months, as was the case with the presented patient. However, ticks can remain active in the autumn and during mild winters, which significantly increases the risk of *Babesia* infection [22].

Our case was successfully managed through early diagnosis and appropriate treatment. In this context, it is important to note that babesiosis is often fatal in cases of delayed diagnosis or inadequate therapy. This highlights the importance of timely veterinary care and the responsibility of pet owners to respond promptly to clinical signs such as fever, lethargy, reduced appetite, and pale mucous membranes. Effective protection against parasites can significantly help prevent serious health complications associated with babesiosis.

CONCLUSION

This study described a clinical case of babesiosis in a four-year-old Yorkshire Terrier with no history of prophylactic antiparasitic treatment and retrospectively compared hematological findings with a group of ten dogs infected with *Babesia* spp., also without preventive antiparasitic care. Characteristic hematological alterations, such as anemia, neutropenia, and thrombocytopenia, were observed in the affected animals. The presence of Babesia spp. was confirmed by cytological examination. Based on our findings, we strongly recommend the regular administration of antiparasitic supplements to prevent *Babesia* spp. infections, thereby reducing animal suffering and treatment costs. Furthermore, long-term monitoring of the seasonal occurrence of babesiosis in relation to climatic conditions may contribute to a better understanding of the disease's epidemiology and support more effective implementation of preventive and therapeutic measures in veterinary practice.

Data Availability Statement

The data presented in this study are available on request from the corresponding author.

Ethical Statement

All owners of dogs used in this study consented to data collection, and all dogs underwent routine clinical examinations.

Conflict of Interest

The authors have no pertinent financial or non-financial conflicts of interest to declare.

Generative AI Statement

No generative artificial intelligence or artificial intelligence-enabled technologies were used in writing the manuscript.

Authors' Contributions

All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by [Veronika Vinclérová], [Csilla Tóthová] and [Viera Karaffová]. The first draft of the manuscript was written by [Veronika Vinclérová] and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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