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Haemato-biochemical changes in naturally occurring canine babesiosis in Cauvery delta region of Tamil Nadu

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Abstract

Canine babesiosis is a tick-borne disease caused by protozoan parasites belonging to the genus *Babesia*, with *Babesia canis* and *Babesia gibsoni* being the most common species. The disease is characterized by hemolytic anemia, thrombocytopenia, and multiple organ dysfunction due to the destruction of red blood cells. A detailed study was conducted on 50 naturally occurring cases of canine babesiosis at the Small Animal Clinics, Teaching Veterinary Hospital, Orathanadu, focusing on clinical observations, including clinical history, physical examination, and hematobiochemical alterations. Blood samples were taken from the cephalic vein of the infected dogs. The diagnosis was based on clinical symptoms and the detection of *Babesia* organisms in Giemsa-stained thin blood smears, which was further confirmed by PCR. The affected dogs showed a significant reduction in Hb, TEC, and PCV levels, along with a notable increase in serum bilirubin, ALT, ALP, BUN, and creatinine levels. These hematobiochemical findings highlighted the severity of babesiosis in the dogs studied. This research delves into the pathophysiology of the disease and underscores the importance of various blood parameters in diagnosis and prognosis.

Keywords: *Babesia*, biochemistry, clinical observations, dogs, haematology

1. Introduction

Canine babesiosis is a tick-borne illness caused by protozoan parasites of the genus *Babesia*, with *Babesia canis* and *Babesia gibsoni* being the most frequently encountered species. The condition leads to hemolytic anemia, thrombocytopenia, and multi-organ complications as a result of red blood cell destruction. A clinical investigation was carried out on 50 naturally infected dogs presented to the Small Animal Clinics, Teaching Veterinary Hospital, Orathanadu. The study emphasized clinical history, physical examination, and hematobiochemical changes, with blood samples collected from the cephalic vein of the affected animals. Babesiosis is a significant tick-borne disease caused by protozoan parasites of the genus *Babesia*, which affect a wide range of vertebrate hosts, leading to severe illness in both wild and domesticated animals (Irwin, 2009) ^[1]. This life-threatening disease is caused by different species of intraerythrocytic protozoan parasites, with the prevalence of *Babesia canis* and *Babesia gibsoni* in India ranging from 0.66% to 21.7%. In the Cauvery delta region, *B. gibsoni* (the small form) has been recorded at a higher prevalence rate of 15.04%, compared to *B. vogeli* (the large form) at 0.26% (Singla *et al.*, 2016) ^[2]. The pathogenesis of canine babesiosis varies by region, likely due to differences in *Babesia* species and local ecological conditions (Saud and Hazarika, 2000; Purnell, 1981) ^[3, 4]. The clinical signs of babesiosis can range from subclinical to severe, often resulting in death due to multiple organ dysfunction. In the early stages of the illness, dogs may become lethargic, lose their appetite, and show reluctance to move, with body temperatures rising to 40-41 °C for 2-3 days. Peripheral muscle tremors may develop, and mucous membranes and skin may become pale or yellowish. Urine may darken to a brown or red color due to hemolysis. Splenomegaly can occur, and in severe cases, the spleen may rupture, leading to excessive bleeding into the abdominal cavity, which can be fatal. Other common signs include tachycardia and increased respiratory rate, often due to pulmonary edema. Secondary gastrointestinal symptoms, such as vomiting and diarrhea or, conversely, constipation, may

develop as a result of kidney and liver insufficiency. Irreversible central nervous system changes, including coordination impairment, paresis, or paralysis, are also possible due to systemic intoxication (Ettinger and Feldman, 2005; Vial and Gorenflot, 2006; Lobetti *et al.*, 2006) [5, 6, 7]. Clinico-pathological abnormalities observed in babesiosis include hemoglobinuria, hypoglycemia, acid-base imbalances, azotemia, and elevated liver enzyme levels. *B. canis* and *B. gibsoni* are the primary species causing canine babesiosis worldwide, with *B. canis* typically appearing as single or paired pear-shaped piroplasms, and *B. gibsoni* as small ring forms or pyriform bodies. Both species are transmitted by ixodid ticks and are found across Asia, Africa, Europe, the Middle East, and North America. *B. gibsoni* has been diagnosed in puppies as young as 10 days old, possibly due to transplacental transmission, a shorter period than that following tick transmission (Birkenheuer *et al.*, 1999; Fukumoto *et al.*, 2005) [8, 9]. The most reliable and commonly used diagnostic method is the examination of Giemsa-stained thin blood smears; however, its low sensitivity makes it unsuitable for detecting subclinical and chronic cases. Hematological changes such as hemolytic anemia, thrombocytopenia, anisocytosis, and neutrophilia have been documented by various researchers (Conrad *et al.*, 1991; Suh and Chung, 2000; Suarez *et al.*, 2001) [10, 11, 12].

To date, no detailed study has been conducted on the hematobiochemical changes in naturally occurring canine babesiosis in the Cauvery Delta region of Tamil Nadu, India. This study provides a detailed evaluation of clinical history, physical findings, and hematobiochemical alterations in 10 naturally occurring cases of canine babesiosis reported from this region.

2. Materials and Methods

A study was conducted on 50 dogs, aged between 2 months and 10 years, diagnosed with babesiosis at the Small Animal Clinics, Teaching Veterinary Hospital, Orathanadu. The study spanned from January 2024 to June 2024. Comprehensive histories were obtained, and detailed clinical manifestations were recorded for each dog. Blood samples were collected from the cephalic vein of the naturally infected dogs. Diagnosis was based on clinical signs and the identification of the *Babesia* organism in Giemsa-stained thin blood smears, confirmed by PCR. Out of the 50 samples, 10 tested positive for *B. gibsoni*. Blood samples were also collected from 10 healthy dogs to establish control values.

A complete blood count (Hb, PCV, WBC, and RBC) was performed following the method described by Schalm (1965) [13], using Ethylenediamine Tetra-acetic Acid (EDTA) at a concentration of 1.5 mg/ml of blood as an anticoagulant. Blood glucose levels were measured from samples collected in sodium fluoride vials. For the estimation of biochemical parameters, 2 ml of blood was collected without anticoagulant in sterile syringes. Serum concentrations of alanine aminotransferase (ALT), alkaline phosphatase (ALP), blood urea nitrogen (BUN), total protein (TP), blood glucose, albumin, creatinine, and total bilirubin were determined using the SELECTRA automated biochemical analyzer with standard kits (Q-line diagnostic kit). Results were expressed as means $\pm$ standard deviation

2.1 Statistical Analysis

Analysis of variance (ANOVA) was used to evaluate differences among the study groups, while an unpaired t-test

was applied for comparisons between two groups. All statistical analyses were carried out using SPSS software, version 21.0.

Fifty dogs were screened for babesiosis based on clinical symptoms and microscopic examination of Giemsa-stained blood smears, which showed the characteristic intraerythrocytic, double pear-shaped (pyriform) *Babesia* organisms (Fig. 1). Polymerase chain reaction (PCR) further confirmed *Babesia gibsoni* infection in 10 of these cases (Fig. 2).

3. Results and Discussion

The haematological profile in Babesiosis affected dog and Healthy dog in the present study has been represented in Table-1.

Table 1: Haematological parameters of Babesiosis affected dogs

Sl. No	Parameter	Control (n = 10)	Babesiosis affected dogs (n = 10)
1.	Hemoglobin (g/dl)	13 ^a $\pm$ 0.3	5.0 ^b $\pm$ 0.8
2.	PCV (%)	41 ^a $\pm$ 1.1	19 ^b $\pm$ 2.5
3.	WBC X 10 ³ /μl	6 ^a $\pm$ 0.2	14 ^b $\pm$ 3.1
4.	RBC X 10 ⁶ /μl	5.0 ^a $\pm$ 0.17	4.0 ^b $\pm$ 1.2
Means $\pm$ SE bearing different superscripts in a row vary significantly ($p < 0.01$).			

A significant ($p < 0.01$) decrease in hemoglobin, total erythrocyte count (TEC), and packed cell volume (PCV) (Table 1) indicated severe anemia. Blood films showed anisocytosis and nucleated erythrocytes, suggesting regenerative anemia. Previous studies have reported a higher leukocyte count along with anemia in babesiosis affected dogs was reported (Court *et al.*, 2001) [14]. The leukocyte count was significantly increased ($p < 0.01$) in affected dogs, likely due to the destruction of red blood cells by *Babesia* parasites, which can lead to the release of inflammatory cytokines. This inflammation may trigger an increase in white blood cell production. These findings were also in accordance with earlier reports where significant reduction in RBC, Hb and PCV values leading to anemia in animals affected with babesiosis was reported (Goes *et al.*, 2007; Salem *et al.*, 2016; Ramadevi *et al.*, 2017 and Zahid *et al.*, 2005) [15, 16, 17, 18].

3.1 Serum Biochemical parameters

The serum biochemical profile in Babesiosis and healthy dog in the present study has been represented in Table-2.

Table 2: Serum biochemical parameters of Babesiosis affected dogs

Sl. No	Parameter	Control (n = 10)	Babesiosis affected dogs (n = 10)
1.	Total Protein g/dL	6.0 ^a $\pm$ 0.10	5.0 ^b $\pm$ 0.11
2.	Albumin g/dL	2.9 $\pm$ 0.10	2.6 $\pm$ 0.10
3.	ALT U/L	62 ^a $\pm$ 1.9	84 $\pm$ 2.0
4.	ALP U/L	54.0 ^a $\pm$ 2.1	124.0 ^b $\pm$ 2.3
5.	Urea	14 $\pm$ 1.0	32 $\pm$ 1.7
6.	Creatinine	0.6 $\pm$ 0.03	1.9 $\pm$ 0.02
7.	Total Billurubin	0.2 $\pm$ 0.16	1.7 $\pm$ 0.04
* Means $\pm$ SE bearing different superscripts in a row vary significantly ($p < 0.05$).			

The mean values for total protein (g/dL), albumin (g/dL), alanine aminotransferase (ALT) (U/L), alkaline phosphatase (ALP) (U/L), urea (mg/dL), creatinine (mg/dL), and total bilirubin (mg/dL) in the healthy control group were 6.0 ± 0.10 , 2.9 ± 0.10 , 62 ± 1.9 , 54 ± 2.1 , 14 ± 1.0 , 0.6 ± 0.03 , and 0.2 ± 0.16 , respectively (Table 2). In dogs affected by babesiosis, the corresponding values were 5.0 ± 0.11 , 2.6 ± 0.10 , 84.0 ± 2.0 , 124.0 ± 2.3 , 32 ± 1.7 , 1.9 ± 0.02 , and 1.7 ± 0.04 . Statistical analysis indicated a significant ($p < 0.05$) increase in the levels of ALP, ALT, urea, creatinine, and total bilirubin in dogs affected by babesiosis, while total protein and albumin levels were significantly ($p < 0.05$) decreased compared to healthy dogs.

The significant elevation of bilirubin ($p < 0.05$) is indicative of red blood cell destruction leading to hemolysis. This destruction releases hemoglobin, which is then broken down into bilirubin. The increased bilirubin levels result in jaundice, which is often observed in affected dogs (Aysul *et al.*, 2013) [19]. Additionally, the liver may be directly affected by the infection, leading to impaired processing and excretion of bilirubin, further elevating its levels in the blood.

In *Babesia*-infected dogs, there is a significant rise in serum urea and creatinine levels compared to control dogs. This elevation in *Babesia* infected cows may indicate kidney dysfunction. The impaired renal function could result from necrosis and separation of epithelial cells in the proximal convoluted tubules, as well as the presence of hemoglobin casts (Solano-Gallego *et al.*, 2008) [20]. Additionally, the increase in serum creatinine and urea levels could be attributed to systemic hypotension caused by *Babesia* infection, which leads to renal vasoconstriction. This vasoconstriction is likely a primary factor in kidney hypoxia, potentially more detrimental to renal tissue than hemoglobinuria. Hemolytic anemia may also contribute to insufficient oxygenation, leading to degenerative changes in the cytoplasm of the epithelial cells lining the renal tubules. These changes are often accompanied by perivascular mononuclear leucocytic infiltration, primarily involving lymphocytes and macrophages (Hamoda *et al.*, 2014) [21].

The significant elevation of ALT indicates hepatocellular damage. ALT is an enzyme primarily found in the liver, and its elevation suggests liver cell damage, which can occur due to the toxic effects of the parasite and hypoxia resulting from the body's inflammatory response to the infection. In severe cases, liver cells are damaged, releasing ALT into the bloodstream [19].

The significant elevation of ALP suggests liver dysfunction, which can lead to cholestasis and a subsequent increase in ALP levels. Acute renal failure, a known complication of canine babesiosis (Schoeman, 2009) [22], may lead to significant ($p < 0.05$) increases in blood urea nitrogen (BUN) and creatinine in dogs infected with *B. gibsoni*.

3.2 Molecular confirmation of *Babesia gibsoni*

In this study, DNA extracted from suspected cases of canine babesiosis using a commercial DNA isolation kit (Qiagen, Germany) was subjected to polymerase chain reaction (PCR). The assay amplified a 671 bp fragment of the *Babesia gibsoni* 18S rRNA gene, consistent with the findings reported by Latchumikanthan *et al.*, (2024) [23].

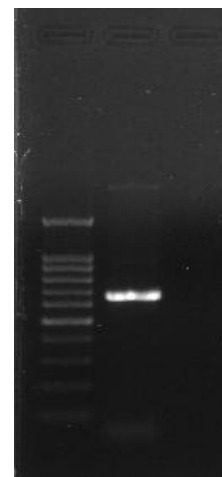


Fig 1: *Babesia gibsoni*-671 bp amplicon by PCR in 1.5% agarose gel electrophoresis (Lane 1-100 bp DNA ladder, Lane 2-671 bp amplicon)

4. Conclusion

This study highlights the significance of detailed hemobiochemical profiling in the management of canine babesiosis. Alterations in hematological and biochemical parameters serve as important tools for diagnosis, disease monitoring, and understanding its pathophysiology and prognosis. Further investigations are warranted to evaluate the therapeutic relevance of these findings and to formulate targeted treatment strategies to reduce the systemic impact of babesiosis.

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