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Studies on the pathophysiology of *Babesia gibsoni* infection in Pakistani Bully, Shih TZU, German shepherd and Labrador dogs

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Abstract

Studies on the pathophysiology of 4 breeds of dogs with varying age groups were admitted in a pet clinic in Jaipur with varying clinical manifestations. Examination of all the 4 dogs was confirmed for the infestation of *Rhipicephalus sanguineus* ticks. The clinical signs exhibited by the individual infected dogs of all the 4 breeds were recorded. Based on the clinical signs microscopic examination of the blood smears were carried out. All the 4 infected animals revealed small form of *Babesia gibsoni* within erythrocytes and the hemato-biochemical parameters revealed changes in their values from the normal values. The Pakistan bully and Shih Tzu indicated the complicated version and the other two dogs' i.e the German shepherd and Labrador indicated the uncomplicated version by their clinical and hematological parameters analysis. In this study the 4 dogs of different breeds with varying age groups suffered with varying clinical signs in complicated cases and in uncomplicated cases the hematological parameters were got altered only in neutrophil /lymphocytes ratio, which may be considered as a diagnostic feature for dogs suffering due to sub clinical status of *Babesia gibsoni* infection. The attributed pathophysiological factors for changes in their hemato-biochemical parameters in *B. gibsoni* infected dogs discussed in this study.

Keywords: Pathophysiology, canine breeds and *Babesia gibsoni*

Introduction

Canine babesiosis is a clinically significant and geographically wide spread hemo- protozoan disease of domesticated dogs and wild canids. Jain K J *et al.* (2017) ^[13] reported *B. gibsoni* infection in dogs in South Kerala. Clinical cases associated with infection by *B. gibsoni* have also been described in Germany (Hodiz A, *et al.* (2015) ^[9]). It is reported that the *Babesia gibsoni* infection is common in fighting dogs. The course of infection related to disease manifestation may be acute and chronic. The large *Babesia canis* and the small *Babesia gibsoni* are two organisms known to infect the dogs. (Uilenberg: 2006) ^[22]. Typical intra erythrocytic piroplasms often occur in *Babesia gibsoni*. The organisms in the RBCs are small signet ring forms both in single and in multiple Wang J *et al.* 2019 ^[25]; Solano-Gallego L *et al.* 2016 ^[20]; Soulsby. 1982) ^[21]. The clinical signs and laboratory abnormalities differ among *Babesia* species. In *B. gibsoni* infection moderate to severe infection with lymphnode enlargement, splenomegaly, small bowel diarrhea, weight loss, protein -losing nephropathy and abdominal effusion are reported (Solano-Gallego L *et al.* 2016) ^[20]. Deprived appetite, pyrexia, pallor of mucus membrane, lethargy, diarrhea, melena, lymphadenopathy, jaundice, vomiting, hemoglobinuria and seizures were the major clinical signs in dogs infected with *B.gibsoni*. (Anju *et al.* 2022) ^[11]. Wang J *et al.* (2019) ^[25] reported that the clinical signs depend on the species of *Babesia* causing infection and other co-factors such as immune status and the host age.

Materials and Methods

Case reports

Pakistani bully, Shih Tzu, German shepherd and Labrador dogs with varying age groups were admitted in a private pet clinic in Jaipur city for their chronic ailments. Accordingly disease investigation was carried out. Clinical examinations, blood smear examinations followed by hematological studies were carried out in these dogs.

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Table 1: Breed age and sex of the infected dogs

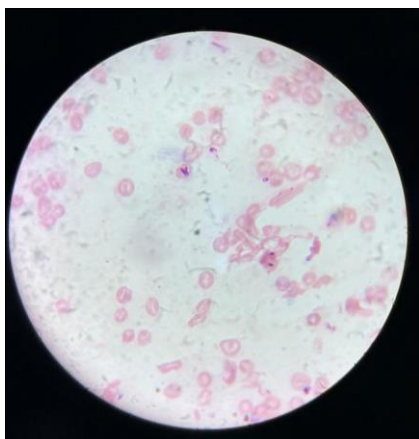
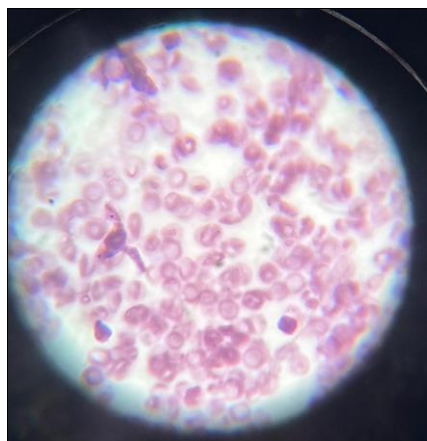
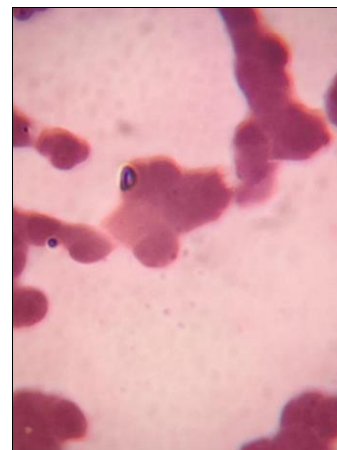
Breed	Age	Sex
Pakistani bully	8 years	Female
Shih Tzu	4 years	Male
German shepherd	2 years	Male
Labrador	3 years	Female

Table 2: Clinical manifestations in various dog breeds.

Condition	Complicated		Uncomplicated	
	Pakistani bully	Shih-Tzu	German shepherd	Labrador
Hematological parameters				
Temperature	103.6F	103.8F	103.1F	102.9F
Pulse/Heart rate	130bpm	125bpm	95bpm	90bpm
Respiration/ bronchitis /pneumonia	Tachypnea,	Tachypnea,	Normal.	Normal,
Appetite	Anorexic	Anorexic	Anorexic	Anorexic
Conjunctivitis	Present	Present	Absent	Absent
Epistaxis	Not found	Not found	Not found	Not found
Lymphadenopathy	Present	Present	Absent	Present
Lusture of skin	Dull	Dull	Normal	Normal
Mucus membrane of the eyes	Pale	Pale	Pink	Pink
Dehydration	Present	Present	No	No
Weight loss	Present	Present	Not present	Not present
Splenomegaly	Not found	Not found	Not found	Not found
Hemoglobinuria	Not found	Not found	Not found	Not found
Seizures	Not found	Not found	Not found	Not found

Microscopic examination of the infected dogs' blood smear by Giemsa staining

Microscopic examination of the dog's infected blood smear was carried out as per the procedure of T Wang *et al.* 2019 [25]; Solano-Gallego L *et al.* (2016) [20] as stated here. In which the blood smear revealed small signet ring form organisms inside the infected RBCs (Fig 1) *B. gibsoni* was demonstrated either as single or multiple and signet-ring shaped in the infected blood smear as stated by Souls by (1982) [21].

**Fig 1:** Pleomorphic *B. gibsoni* organisms in Shih Tzu**Fig 2:** Pleomorphic *B. gibsoni*: Pakistani bully**Fig 3:** Signet shaped *B. gibsoni* in German shepherd

Results and Discussion

Clinical examination of the affected dogs

Clinical examination of the infected dogs exhibited their clinical signs as detailed in table no.2.

Varying clinical manifestations were reported by concerned authors in the *B. gibsoni* infected dogs. In this study also the clinical signs expressed by the dogs in complicated conditions were anorexia, pyrexia (103.4 F), tachypnea, conjunctivitis, pale mucus membrane, dull skin coat, weight loss and dehydration. In uncomplicated dogs, lymphadenopathy was observed in one dog and pyrexia & anorexia were reported in both dogs. (Table 2). Solano-Gallego L *et al.*, (2016) [20] reported moderate to severe infection with lymph node enlargement, splenomegaly, small bowel diarrhea, weight loss, protein –losing nephropathy and abdominal effusion in *B. gibsoni* infections. Wang J *et al.* (2019) [25] reported that the clinical signs depend on the species of Babesia causing infection and other co-factors such as immune status and the host age, which is in concurrence with the present case also.

Hematological studies

Pakistani Bully & ShihTzu: The Hb level, hematocrit value, RBC count, platelet count & MCH level were declined. The level of MCV was elevated. In German Shepherd & Labrador

dogs all the hematological parameters were in normal status even though blood smears were positive for *B. gibsoni* in both

breeds.

Table 3: Hematology of the *B. gibsoni* infected dogs of various breeds.

Parameter	HGB	HCT	RBC	MCV	MCH	MCHC	PLT	WBC	Neu	Lym
Unit	g/dl	%	10 ¹² /L	fL	pg	g/dl	10 ⁹ /L	10 ⁹ /L	%	%
Normal Range	11.0-19.0	33.0-56.0	5.10-8.50	60.0-76.0	20.0-27.0	30.0-38.0	200.0-900.0	6.00-17.00	52.0-81.0	12.0-33.0
Complicated cases										
Pakistani Bully	8.7	24.4	2.97	82.8	29.2	35.5	22	9.18	6.0	86.8
Shih-Tzu	3.4	9.6	1.26	76.6	26.6	34.7	57	12.18	53.1	26.0
Uncomplicated cases										
German Shepherd	13.6	40.7	6.05	67.2	22.4	33.3	140	13.11	7.2	83.5
Labrador	15.6	47	6.09	77.1	25.7	33.3	155	16.43	5.6	88.4

However altered neutrophil/ lymphocyte ratio was observed in all the above breeds except Shih-Tzu with mild elevation values. Omobowale *et al.* 2017^[15]; Booser and McIntire (2003)^[5] reported altered neutrophil/ lymphocyte ratio as a diagnostic feature in babesia infected dog's to detect complicated cases. Welzl *et al.* (2001)^[26] observed leukocytosis in babesia infected cases due to systemic inflammatory reactions which are in concurrence with the observations of these studies.

Hematological study revealed low level of hemoglobin, RBC count and platelet count in *B. gibsoni* infected dogs. (Jain *et al.* 2017)^[13]. Anemia was one of the clinical sign in canine babesiosis. A moderate to severe thrombocytopenia in *B. gibsoni* infection was observed by Anju, S *et al.* (2022)^[1]. The reasons for low levels of the above hematological changes are attributed to immune mediated destruction of erythrocytes (Meinkoth *et al.* 2002)^[14] reported low levels of MCV and MCH in the cases of *B. gibsoni* infections indicating normocytic normochromic anemia due to the acute infection of the bone marrow, and iron deficiency was suggested by Dawn Ruben (2018)^[6] reported anemia, thrombocytopenia, normocytic normochromic anemia, both re-regenerative and non-re-regenerative anemia in the *Babesia gibsoni* infected dogs. The alkaline phosphatase in this study was in elevated status. Bilawal A *et al.* (2018)^[2] attributed the reason for the elevation of alkaline phosphatase in *babesia canis* infection for hepatic dysfunction. This observation is in concurrence with the findings of the present study.

Solano-Gallego *et al.* 2011^[19] reported the clinical signs and clinic-pathological abnormalities that are common across all *Babesia* species infected dogs. The frequent clinical signs are apathy, weakness, anorexia, pale mucus membrane. All *Babesia* species can cause fever, lymphadenopathy, splenomegaly, anemia, thrombocytopenia, jaundice and pigmenturia. Thrombocytopenia frequently detected in all infected dogs frequently and it varies from mild to moderate as does anemia. Solano-Gallego *et al.* (2008)^[18] reported that anemia can be regenerative or non-regenerative which depends on the infective species and the course of infection, and it is non-regenerative in *B. canis* infection. Solano-Gallego *et al.* (2016)^[20] reported that in all species anemia is caused by a combination of intravascular and extravascular hemolysis resulting from parasite caused injury and ruptures of red blood cells, increased osmotic fragility and due to the activity of secondary immune-mediated processes. Jacobson *et al.* (2006)^[10] reported differed clinic-pathological abnormalities *i.e* weight loss, chronic nephropathy, glomerulonephritis, coagulation disorders, jaundice from liver disease, thrombocytopenia, hemo-concentration, shock, respiratory acidosis/alkalosis, pancreatitis, vomiting, diarrhea, ocular lesions & myalgia in dogs infected especially with *B.*

rossi. In this study also the variations in clinical signs were observed in all the 4 breeds and the hematological values were altered to high levels in two complicated cases *i.e* Pakistani bully and Shih Tzu and alterations occurred only in neutrophil /lymphocytes ratio in other two uncomplicated cases *i.e* German sphered & Labrador. Some clinical signs and clinic-pathological abnormalities differ among *Babesia* species infecting dogs. Solano-Gallego L *et al.* 2011 & Irvin PJ (2009)^[19, 11] reported that the varying clinical signs and hematological /biochemical parameter changes could be due to the inability of the immune system to eliminate the infection or when the immune system is in abatement. In this study the 4 dogs of different breeds with varying age groups suffered with varying clinical signs in complicated cases and in uncomplicated cases the hematological parameters were got altered only in neutrophil /lymphocytes ratio, which may be considered as a diagnostic feature for dogs suffering due to sub clinical status of *Babesia gibsoni* infection.

Conclusions

Studies on the prevalence of *Babesia gibsoni* in the breeds of Pakistani bully, ShihTzu, German shepherd and Labrador dogs with varying age groups were studied for their varying clinical manifestations. The studies revealed the differed clinical manifestations in these breeds. The hematological parameters altered to a larger extent in Pakistan bully & ShihTzu breeds, wherein the German shepherd and Labrador dog's profiles got altered with neutrophil and lymphocytes ratio which can be taken as diagnostic criteria in *Babesia gibsoni* infection in dogs or dogs in sub clinical status for *B. gibsoni* infection. The attributed risk factors associated for the development of varying clinical manifestations could be due to poor management of the dogs, exposure of the dogs for the ticks thereby rendering the dogs for abatement of the immune system to safeguard the life of the dogs.

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