RESEARCH ARTICLE Indian Journal of Animal Research, Volume 60 Issue 11: 2048-2054 (November 2026)

Incidence of Various Types of Bleeding Disorders Associated with Canine Vector Borne Diseases in Chennai, Tamil Nadu, India

P. Pothiappan[1], B. Nagarajan[1], P. Selvaraj[1], S. Kavitha[1]

10.18805/IJAR.B-5219

ABSTRACT

Background: Animals with various stages of bleeding tendencies are often presented with obvious blood loss and life threatening complications, although some animals are relatively stable, showing only minimal clinical signs. Canine vector-borne diseases and associated bleeding disorders are commonly encountered in routine practice with high morbidity and mortality. Diagnosis, therapeutic outcome and management of bleeding disorders have always been challenging. The objective is to study the incidence of various types of bleeding disorders with their clinical features in CVBD in the city of Chennai, Tamil Nadu.

Methods: During the study period (2018-2020) a total of 76, 051 dogs were presented to the Madras Veterinary College Teaching Hospital, Chennai. Sixteen thousand five hundred and twenty nine (16529) dogs were presented with signs of bleeding disorders. Dogs affected with vector borne diseases had various stages of bleeding tendencies (1593 dogs) were subjected to detailed clinical, haematological, biochemical and coagulation profile assessments. Under each etiological group, the dogs were further divided into three groups based on various stages bleeding disorders in order to evaluate the clinicopathological changes in dogs.

Result: The observed incidence of bleeding disorders due to canine vector borne diseases in this study were Babesiosis 41.87 per cent, Ehrlichiosis 52.7 per cent and hepatozoonosis 5.5 per cent. The incidence of Ehrlichiosis, Babesiosis and *H. canis* in the study population was found to be 5.2 per cent, 4.04 per cent and 0.53 per cent. Dogs due to *E. canis,* 51 per cent had anaemia and thrombocytopenia, 26.1 per cent had pancytopenia and 22.9 per cent had pancytopenia and DIC. Dogs due to *B. gibsoni,* 47.7 per cent had anaemia and thrombocytopenia, 28.5 per cent had pancytopenia and 23.8 per cent had pancytopenia and DIC.

Key words: Babesiosis, Bleeding disorders, Canine vector borne disease, Dog, Ehrlichiosis.

INTRODUCTION

Vector borne diseases of pet animals are major concerns in subtropical countries like India, where there is an abundance of vector population. Among the vector borne diseases of dogs, Babesiosis, Ehrlichiosis and Trypanosomosis are the three major haemoparasitic diseases which have gained more importance in Indian conditions (Shaw *et al*., 2001).

Animals with various stages of bleeding tendencies are often presented with obvious blood loss and life threatening complications, although some animals are relatively stable, showing only minimal clinical signs. All suspected coagulopathies should always be considered as potential life-threatening conditions due to the possibility of haemorrhage, leading to acute worsening of conditions. Rapid diagnosis of the exact cause of bleeding as either a primary, secondary or tertiary disorder will allow appropriate treatment and improve the case management. Canine vector-borne diseases (CVBD) and associated bleeding disorders are commonly encountered in routine practice with high morbidity and mortality. Diagnosis, therapeutic outcome and management of bleeding disorders have always been challenging. The objective is to study the incidence of various types of bleeding disorders with their clinical features in CVBD in the city of Chennai, Tamil Nadu.

[1]Department of Veterinary Clinical Medicine, Madras Veterinary College, Tamil Nadu Veterinary and Animal Sciences University, Chennai-600 007, Tamil Nadu, India.

Corresponding Author: P. Pothiappan, Department of Veterinary Clinical Medicine, Madras Veterinary College, Tamil Nadu Veterinary and Animal Sciences University, Chennai-600 007, Tamil Nadu, India. Email: vetpothi@yahoo.co.in

How to cite this article: Pothiappan, P., Nagarajan, B., Selvaraj, P. and Kavitha, S. (2026). Incidence of Various Types of Bleeding Disorders Associated with Canine Vector Borne Diseases in Chennai, Tamil Nadu, India. *Indian Journal of Animal Research*. **60(11):** 2048-2054. doi: 10.18805/IJAR.B-5219.

Submitted: 12-08-2023 **Accepted:** 20-04-2024 **Online:** 10-05-2024

MATERIALS AND METHODS

Dogs with bleeding disorders presented to Madras Veterinary College Teaching Hospital were screened and selected for this study over the period of two years from 2018-2020. The presented dogs were screened for blood parasitic diseases and those that positive for canine vector borne diseases by peripheral blood smear examinations were performed by using Wright's stain and Singular and multiplex polymerase chain reaction (PCR) were performed for the detection of blood parasites (Kledmane *et al*., 2009).

PCR cycling conditions for singular and multiplex PCR.

Babesia spp - 94°C/10 min (94°C/30s, 60°C/30s, 72°C/30s) 40 cycles, 72°C/5 min.

E. canis - 94°C/4 min (94°C/30s, 63°C/30s, 72°C/30s) 35 cycles, 72°C/2 min.

Multiplex PCR- 95°C/3 min (94°C/45s, 60°C/45s, 72°C/90s) 30 cycles, 72°C/10 min.

Dogs positive for vector-borne diseases with various stages of bleeding tendencies alone (1593 dogs) were subjected to detailed haematological, biochemical and coagulation profile study. Further *Babesia gibsoni* and *Ehrlichia canis* affected cases dogs were divided in to three groups such as anaemia and thrombocytopenia (Group I), pancytopenia (Group II) and pancytopenia with disseminated intravascular coagulation (Group III). Since the majority of *B. canis* and *H. canis* cases were not fulfilled the selection criteria for grouping various stages of bleeding disorder. Those cases were not included in this study. Ten apparently healthy dogs brought for routine general health check up were assigned as healthy control group for comparison of data.

RESULTS AND DISCUSSION

Incidence

During the study period a total of 76, 051 dogs were presented to the Small Animal Medicine Outpatient Unit and Critical Care Unit of Madras Veterinary College Teaching Hospital, Vepery, Chennai. Sixteen thousand five hundred and twenty nine (16529) dogs out of total cases showed signs of bleeding disorders. These dogs were subjected for peripheral blood smear examinations. Selected cases were subjected for Singular and multiplex polymerase chain reaction (PCR).

One thousand five hundred ninety three (1593) dogs were diagnosed to have canine vector borne diseases with bleeding disorders. It includes Babesiosis 41.87 per cent (667 cases), Ehrlichiosis 52.7 per cent (839 cases) and hepatozoonosis 5.5 percent (87 cases). Out of the six hundred sixty seven babesia cases *Babesia gibsoni* was observed 81.11 per cent (541 cases) and *Babesia canis* 18.89 per cent (126 cases). The incidence of Ehrlichiosis, Babesiosis and H.canis in the study population was found to be 5.2 per cent, 4.04 per cent and 0.53 per cent. In babesiosis, *Babesia gibsoni* was found to be 3.3 per cent and *Babesia canis* was found to be 0.76 per cent.

Incidence of various stages of bleeding disorders in dogs

Out of eight hundred thirty nine dogs due to *Ehrlichia canis* four hundred twenty eight dogs (51 per cent) had anaemia and thrombocytopenia, two hundred nineteen dogs (26.1 per cent) had pancytopenia and one hundred ninety two dogs (22.9 per cent) had pancytopenia with disseminated intravascular coagulation.

Out of five hundred forty one dogs due to *Babesia gibsoni,* two hundred fifty eight dogs (47.7 per cent) had anaemia and thrombocytopenia, one hundred fifty four dogs (28.5 per cent) had pancytopenia and one hundred twenty nine dogs (23.8 per cent) had pancytopenia with disseminated intravascular coagulation.

Breed wise incidence

The breed wise incidence in dogs with *Ehrlichia canis* was higher in Labrador 32.89 per cent (276 cases), eighty eight German shepherd (10.49 per cent), eighty four non-descript (10.01 per cent), eighty one Spitz (9.65 per cent), sixty one Rottweiler (7.27 per cent), fifty eight Doberman (6.91 per cent), fifty two Golden retriever (6.2 per cent), forty nine Great dane (5.8 per cent), thirty four Pug (4.05 per cent), twenty six Beagle (3.09 per cent), twelve dalmation (1.4 per cent), eight Bull mastiff (0.95 per cent), six Pit bull (0.72 per cent) and four Cocker spaniel (0.48 per cent).

The breed wise incidence in dogs with *Babesia gibsoni* was high in Labrador 36.6 per cent (198) which was followed by sixty five non-descript (12 per cent), sixty two Spitz (11.5 per cent), Fifty six German shepherd (10.4 per cent), forty three Rottweiler (7.9 per cent), thirty one Great Dane (5.7 per cent), twenty eight Pug (5.2 per cent), eighteen Golden retriever (3.3 per cent), fourteen Doberman (2.6 per cent), eleven Dachshund (2 per cent), five each of Dalmatian and Siberian husky (0.9 per cent), three Shih tzu (0.6 per cent) and one Terrier cross (0.37 per cent).

Age wise incidence

The age wise incidence in dogs with *E. canis* below four years 53.9 per cent (453 cases). Two hundred and ninety seven of the affected dogs were aged between four to eight years (35.4 per cent) and ranked second in age wise incidence. Eighteen of the affected dogs were aged above eight years (10.6 per cent).

The age wise incidence in dogs with *B. gibsoni* below four years 52.1 per cent (282 cases). Two hundred and sixteen of the affected dogs were aged between four to eight years (39.9 per cent) and ranked second in age wise incidence. Forty three of the affected dogs were aged above eight years (7.9 per cent).

Sex wise incidence

In the present study the incidence was higher in males dogs affected with *E. canis*. Four hundred and ninety six male dogs (59.1 per cent) were affected when compared to three hundred and forty three female dogs (40.9 per cent). The sex wise incidence of dogs with *B. gibsoni* three hundred and four male dogs (56.2 per cent) were affected when compared to two hundred and thirty seven female dogs (43.8 per cent).

Clinical findings in dogs affected with *E. canis*

The clinical findings of dogs affected with *E. canis* were given in Plate 1 and Table 1.

Dogs with anaemia and thrombocytopenia

Clinical signs in *E. canis* affected dogs which had anaemia and thrombocytopenia included Pyrexia (86 per cent), lethargy (71 per cent), anorexia (66 per cent), weakness

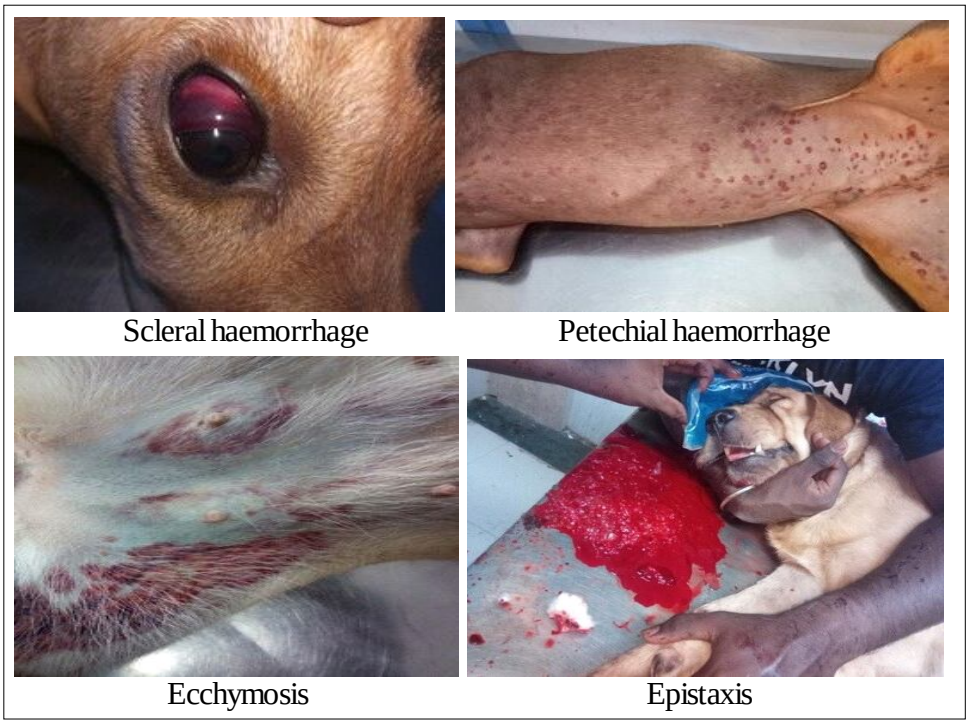


Plate 1: Clinical findings in dogs affected with CVBD.

Table 1: Clinical finding in dogs suffering from *B. gibsoni* and *E. canis* (in per cent).

History and clinical signs	*Babesia gibsoni*			*E.canis*		
	Anaemia + T. Penia (n=258)	Pancytopenia (n=154)	Pancytopenia + DIC (n=129)	Anaemia + T. Penia (n=428)	Pancytopenia (n=219)	Pancytopenia + DIC (n=192)
Anorexia	67	79	100	66	82	100
Lethargy	68	86	100	71	86	100
Pyrexia	75	70	68	86	74	72
Weakness	57	68	100	60	64	100
Tachypnoea	56	65	94	48	72	90
Dehydration	40	68	94	53	60	85
Pale mucosa	29	51	80	30	74	90
Haematuria	13.5	18.2	24.3	11.9	12	21
Ecchymosis	5.4	18.2	68.6	9.5	14.3	54
Petechiation	17.5	15.9	8.1	16.7	7.1	5.3
Melena	4	11.4	21.6	5.9	19	31.5
Epistaxis	5.4	4.4	6	28.6	23.8	21
Jaundice	2.7	9	16.2	-	7.1	15.7
Hyphema	-	4.4	-	-	5.4	13.1
Haematochezia	4	11.4	5.4	-	-	14
Haematemesis	-	9	16.2	-	7.1	12
Vaginal bleeding	-	4.4	10.8	-	-	11.8
Tremor	2.7	-	-	-	-	-
Retinal detachment	-	-	11	-	-	13.1
Corneal opacity	-	-	-	13.5	7.1	5.2
Scleral haemorrhage	-	9	5.4	-	-	18
Testicular swelling	-	6.6	5.4	7.1	4.8	5
Cutaneous vasculitis	-	9	15.6	-	-	18.4
Gum bleeding	-	2.2	5.4	-	2.3	-
Ecchymosis with abscess	-	-	0.78	-	-	-

(60 per cent), Tachypnoea (48 per cent), Dehydration (53 per cent), Pale mucosa (30 per cent), Epistaxis (28.6 per cent), Petechiae (16.7 per cent), corneal opacity (13.5 per cent), Haematuria (11.9 per cent), testicular swelling (7.1 per cent), ecchymosis (9.5 per cent) and Melena (5.9 per cent).

Dogs with pancytopenia

Clinical signs in *E. canis* affected dogs which had pancytopenia included lethargy (86 per cent), anorexia (82 per cent), Pyrexia (74 per cent), weakness (64 per cent), Dehydration (60 per cent), Tachypnoea (72 per cent), pale mucosa (74 per cent), Epistaxis (23.8 per cent), Haematuria (12 per cent), Ecchymosis (14.3 per cent), Petechiae (7.1 per cent), Melena (19 per cent), jaundice (7.1 per cent), hyphema (5.4 per cent), haematemesis (7.1 per cent), corneal opacity (7.1 per cent), Testicular swelling (4.8 per cent) and gum bleeding (2.3 per cent).

Dogs with pancytopenia and DIC

Clinical signs in *E.canis* affected dogs which had pancytopenia with DIC included lethargy, anorexia and weakness (100 per cent), Dehydration 85 per cent), Tachypnoea (90 per cent), Pyrexia (72 per cent), pale mucosa (90 per cent), Haematuria (21 per cent), Ecchymosis (44 per cent), Petechiation (5.3 per cent), Melena (31.5 per cent), Epistaxis (21 per cent), jaundice (15.7 per cent), hyphema (13.1 per cent), haematochezia (14 per cent), haematemesis (12 per cent), Vaginal bleeding (11.8 per cent), retinal detachment (13.1 per cent), corneal opacity (5.2 per cent), Scleral haemorrhage (18 per cent), Testicular swelling (5 per cent) and Cutaneous Vasculitis (15.6 per cent).

Clinical findings in dogs affected with *Babesia gibsoni*

The clinical findings in dogs affected with *Babesia gibsoni* were given Table 1.

Dogs with anaemia and thrombocytopenia

Clinical signs in *Babesia gibsoni* affected dogs which had anaemia and thrombocytopenia included Pyrexia (75 per cent), lethargy (68 per cent), anorexia (67 per cent), weakness (57 per cent), Tachypnoea (56 percent), Dehydration (40 per cent), Pale mucosa (29 per cent), Petechiation (17.5 per cent), Haematuria (13.5 per cent), Ecchymosis (5.4 per cent), Epistaxis (5.4 per cent), Melena (4 per cent), haematochezia (4 per cent), tremor (2.7 per cent) and jaundice (2.7 per cent).

Dogs with pancytopenia

Clinical signs in *Babesia gibsoni* affected dogs which had pancytopenia included lethargy (86 per cent), anorexia (79 per cent), Pyrexia (70 per cent),weakness (68 per cent), Dehydration (68 per cent), Tachypnoea (65 percent), pale mucosa (51 per cent), Haematuria (18.2 per cent), Ecchymosis (18.2 per cent), Petechiation (15.9 per cent), Melena (11.4 per cent), haematochezia (11.4 per cent), haematemesis (9 per cent), Scleral haemorrhage (9 per cent), Cutaneous Vasculitis (9 per cent), jaundice (9 per cent), Testicular swelling (6.6 per cent), Epistaxis (4.4 per cent), hyphema (4.4 per cent), Vaginal bleeding (4.4 per cent) and Gum bleeding (2.2 per cent).

Dogs with pancytopenia and DIC

Clinical signs in *Babesia gibsoni* affected dogs which had pancytopenia with DIC included lethargy, anorexia and weakness (100 per cent), Dehydration (94 per cent), Tachypnoea (94 percent), Pyrexia (68 per cent), pale mucosa (80 per cent), Haematuria (24.3 per cent), Ecchymosis (48.6 per cent), Petechiation (8.1 per cent), Melena (21.6 per cent), haematochezia (5.4 per cent), haematemesis (16.2 per cent), Scleral haemorrhage (5.4 per cent), Cutaneous Vasculitis (15.6 per cent), retinal detachment (11 per cent), jaundice (16.2 per cent), Testicular swelling (5.4 per cent), Epistaxis (6 per cent), Vaginal bleeding (10.8 per cent), Gum bleeding (5.4 per cent) and Ecchymosis with abscess (0.78 per cent).

Canine Vector-borne diseases and their associated complications often represent a diagnostic challenge, as they usually cause non-specific signs and their clinical presentations vary according to the pathogen involved, level of parasitemia or bacteraemia, immune status and the age of the dog. Early diagnosis and management of canine vector borne disease is very important to avoid various episodes of complicated bleeding tendencies and other life threatening complications.

Animals with bleeding disorders vary widely in their presentations depending on the severity of the disease and any inciting trauma to the blood vessels. In this study, Ehrlichiosis was found to be the most prevalent among the canine vector borne diseases. Laxmi Bai *et al*. (2019) reported that the prevalence of haemoparasitic diseases in Hisar, Haryana included *Ehrlichia canis* (4.76 per cent), followed by *H. canis* (2.85 per cent), *Babesia canis* (0.95 per cent) and *Trypanosome* spp. (0.95 per cent). Weerathunga *et al*. (2019) reported of a prevalence of Ehrlichiosis (20.06 per cent), Babesiosis (16.29 per cent) and *H. canis* (1.56 per cent) in Srilanka. In all these studies, Ehrlichiosis was observed in higher incidence and the same was observed in the study undertaken with different breeds of dog attending the small animal wards.

In the present study among Babesiosis, *Babesia gibsoni* was observed in 81.11 per cent and *Babesia canis* 18.89 per cent of the cases. These findings concurred with Senthilkumar *et al*. (2009) who revealed that the prevalence of *Babesia gibsoni* was 84.9 per cent followed by *Babesia canis* (3.9 per cent). Similar findings were also observed by Selvaraj *et al*. (2010) who reported among Babesiosis, *Babesia gibsoni* was 69 per cent and *Babesia canis* was 31 per cent. Higher prevalence of these parasites in this study could be due to the high prevalence of *Rhipichephalus sanguinus* tick infestation which is the most commonly seen in dogs in Chennai and this was in agreement with the reports furnished by Soundararajan *et al*. (2016).

Labrador was found to be the most commonly affected breeds in both Babesiosis and Ehrlichiosis. Latha Bhaskaran *et al*. (2015) observed that Spitz, Labrador, Non-descript and German shepherd were the most affected breeds with both the species of Babesia. German shepherd dogs were observed to be more susceptible to the vector borne diseases with a higher mortality rate, as reported by Harrus *et al*. (1997). Vairamuthu *et al.* (2014) reported that the incidence was evenly distributed among exotic breeds and non-descript dogs, though a much lower level of incidence was noticed among the non hairy breeds of dogs.

In present study, it was found that Labrador was the most predominant breed affected with Babesiosis and Ehrlichiosis. Possibly most of the pet owners of the study location own Labrador and also Madras Veterinary College Hospital record showed the Labrador was high in overall attendance that could be the reason for the higher incidence observed. These findings correlated with the earlier studies of Soundararajan *et al*. (2016).

Any age can be affected with canine vector borne diseases the incidence of *E.canis* and *B.gibsoni* in this study was more in the dogs aged below four years. This was in accordance with the previous report of Rodriguez-vivas *et al*. (2005) who recorded a higher incidence of *E.canis* infection in dogs aged between 2 and 4 years.

Seropositivity for Babesia infection was observed to first increase and then decline with age and it reached a maximum in case of 3.1-to 5-year-old dogs (Sandor *et al*., 2006). Senthilkumar *et al*. (2009) recorded in his study that the dogs aged above three years of age were involved to a greater extent. However, the bleeding disorders due to canine vector borne diseases were observed to be more in younger dogs aged less than four years in this study and this could be due to the increased susceptibility to infectious diseases, as stated by Bashir *et al*. (2009) who observed that Babesiosis can infect dogs of all ages and that most of the infected dogs were less than three years old.

In the present study, male dogs were found to be most affected with *E. canis, B. gibsoni*. This was in agreement with the report of Mojgan *et al*. (2013) who encountered of similar findings in Malaysia. Previously, Costa *et al.* (2007) also reported similar findings in Pakistan. Bashir *et al*. (2009) reported a higher incidence of Babesiosis in males and attributed it to the bite wounds or blood transmission during fighting contact in male dogs as possible routes of transmission for *B. gibsoni*. Senthilkumar *et al.* (2009) reported higher incidence of haemoprotozoan infection among male dogs in Chennai which concurred with our findings. In this study, the higher incidence of male dogs could possibly be due to over representation of male dogs in the population, choice of pet owners, avoidance of problems related to breeding *etc*.

Clinical findings in dogs affected with *E. canis*

Manifestations of bleeding such as epistaxis was more prevalent in the *E. canis* affected dogs in this study. The clinical signs in this study were similar to those reported by Harrus *et al*. (1997) who observed lethargy, anorexia, pale mucus membrane and it was further reported that the capillary time-prolongation could be due to impairment of circulation, decreased tissue perfusion and lack of RBC in capillaries at peripheral tissues.

Pale mucous membranes were the result of anaemia and were more prevalent in affected dogs and is caused by loss of blood due to thrombocytopenia, suppression of bone marrow and probably due to immune-mediated red cell destruction and all these ultimately resulted in pallor mucosa, as reported by Buhles *et al*. (1974). Bleeding disorders such as epistaxis, haematuria and haemorrhagic diarrhoea were reported in dogs with vector-borne diseases. These disorders were considered as possible causes of death in dogs, especially with ehrlichiosis (Ciaramella *et al*., 2005 and Bhadesiya and Raval, 2015).

In this study the encountered bleeding tendencies included ecchymosis (44 per cent), epistaxis (21 per cent), haematuria (24.3 per cent), hyphema (13.1 per cent), haematochezia, haematemesis, retinal detachment, corneal opacity and scleral haemorrhage which was more prevalent in *E. canis* affected dogs which had pancytopenia and DIC. Dhankar *et al.* (2011) opined that bleeding tendencies like epistaxis, Melena, haematemesis, petechial and ecchymotic haemorrhages on oral gums and ventral abdomen were mainly due to thrombocytopenia and damage to vascular endothelium caused by deposition of immune complexes on the vascular wall. Canine monocytic ehrlichiosis was observed to be the leading cause of pancytopenia, as reported by Frezoulis *et al*. (2017) and similar findings were also encountered in this study.

Clinical findings in dogs affected with babesiosis

Lobetti (2000) reported that Babesiosis affected dogs had the clinical signs of pale mucous membranes, depression, tachycardia, tachypnoea, anorexia, weakness, spleenomegaly and fever. It was observed that the clinical signs were the result of tissue hypoxia, following anaemia and concomitant systemic inflammatory response syndrome which was caused by marked cytokine-release. Based on underlying mechanisms the pathophysiology for acute respiratory distress syndrome (ARDS) might be attributed to the increased alveolar capillary permeability due to SIRS reaction. Pyrexia is attributed to the release of endogenous pyrogens from erythrolysis, parasite destruction and activation of inflammatory mediators as reported by Meinkoth *et al*. (2002).

Jacopson, (2006) observed that clinical signs in babesiosis included coagulation disorders (disseminated intravascular coagulation), gastrointestinal disorders and ocular lesions (uveitis or blindness). The most common clinical signs observed due to Babesiosis were fever (87.3 per cent), pallor (52.3 per cent) and lymphadenopathy (47.4 per cent). Other clinical signs observed included vomiting, spleenomegaly, dehydration, jaundice, epistaxis and

ascites, as quoted by Casapulla *et al*. (1998). The anaemia present in canine babesiosis is due to hemolysis, caused by the intra-erythrocyte parasite and the local disruption of the red blood cells leads to the exposure of intracellular stromal material, especially phospholipids, which are expected to trigger the coagulation system as reported by Schetters *et al*. (1997) and Schetters, (2005).

Bleeding tendencies, ecchymoses (48.6 per cent), haematuria (24.3 per cent) and other bleeding signs were observed to be more prevalent in the Babesia affected dogs which had pancytopenia and DIC. Among this group of dogs, the other typical clinical signs observed included cutaneous vasculitis (15.6 per cent), retinal detachment (11 per cent) and ecchymosis with abscess (0.78 per cent). DIC syndrome was reported to be common in cases of canine babesiosis in South Africa as cited by Moore and Williams (1979). Cutaneous vasculitis secondary to *B. gibsoni* infection in a dog was characterized by generalized alopecia, ear tip papules and erosions and necrosis of the skin of the forelimb. The skin changes were due to immune complex adherence to blood vessel-wall and perivascular pathology as reported by Tasaki *et al*. (2013).

Jacobson, (2006) reported about other clinical signs in babesiosis such as coagulation disorders (disseminated intravascular coagulation), jaundice from liver disease, immune-mediated hemolysis or thrombocytopenia, hemoconcentration, shock, metabolic and/or respiratory alkalosis and/or acidosis, gastrointestinal disorders (vomiting or diarrhea), pancreatitis, ascites, ocular lesions (uveitis or blindness), myalgia, rhabdomyolysis and respiratory problems (edema or acute respiratory distress). Comparable findings were also reported by Macintire *et al*. (2002) and Meinkoth *et al*. (2002).

CONCLUSION

The observed various types of bleeding disorders in Dogs due to *E. canis,* 51 per cent had anaemia and thrombocytopenia, 26.1 per cent had pancytopenia and 22.9 per cent had pancytopenia and DIC. Dogs due to *B. gibsoni,* 47.7 per cent had anaemia and thrombocytopenia, 28.5 per cent had pancytopenia and 23.8 per cent had pancytopenia and DIC. Recent days mortality percentage was increased due to CVBD exhibiting various bleeding related clinical signs which are usually under diagnosed. These study reports have an impact on various types of bleeding disorders with their associated clinical features which will help the clinicians for early diagnosis of canine vector borne diseases. Early intervention correlating with various type of bleeding tendency helps in prompt treatment and hence avoiding potential life threatening coagulopathic complications in dogs.

Conflict of interest

All authors declared that there is no conflict of interest.

REFERENCES

Bashir, I.N., Chaudhry, Z.I., Ahmed, S. and Saeed, M.A. (2009). Epidemiological and vector identification studies on canine b abesiosis. *Pakistan Veterinary Journal*. **29(2):** 51-54.

Bhadesiya, C.M. and Raval, S.K. (2015). Hematobiochemical changes in ehrlichiosis in dogs of Anand region, Gujarat. *Veterinary World.* **8:** 713-717.

Buhles, W.C., Huxsoll, D.L. and Ristic, M. (1974). Tropical canine pancytopaenia: Clinical, hematologic and serologic response of dogs to *Ehrlichia canis* infection, tetracycline therapy and challenge inoculation. *Journal of Infectious Disease.* **130:** 357-367.

Casapulla, R., Baldi, L., Avallone, V., Sannino, R., Pazzanese, L. and Mizzoni, V. (1998). Canine piroplasmosis due to Babesia gibsoni: clinical and morphological aspects. *Veterinary Record*. **142(7):** 168-169.

Ciaramella, P., Pelagalli, A., Cortese, L., Pero, M.E., Corona, M., Lombardi, P., Avallone, L. and Persechino, A. (2005). Altered platelet aggregation and coagulation disorders related to clinical findings in 30 dogs naturally infected by *Leishmania infantum*. *Veterinary Journal.* **169:** 465-467.

Costa, J.R., Rembeck, L.M., Ribeiro, K., Beelitz, M.F., Pfister, P. and Passos, P. (2007). Sero-prevalence and risk indicators for canine ehrlichiosis in three rural areas of Brazil. *Veterinary Journal*. **174(3):** 673-676.

Dhankar, S., Sharma, R.D. and Jindal, N. (2011). Epidemiological observations on canine ehrlichiosis in Haryana and Delhi states. *Haryana Vet.* **50:** 9-14.

Frezoulis, P.S., Angelidou, E., Karnezi, D., Oikonomidis, I.L., Konstantinou, M.K., Kasabalis, D. and Mylonakis, M.E. (2017). *Canine pancytopoenia* in a Mediterranean region: A retrospective study of 119 cases (2005 to 2013). *Journal of Small Animal Practice.* **58:** 395-402. doi: 10.1111/jsap.12647.

Harrus, S., Kass, P.H., Klement, E. and Waner, T. (1997). Canine monocytic ehrlichiosis: A retrospective study of 100 cases and an epidemiological investigation of prognostic indicators for the disease. *Veterinary Record*. **4:** 360-363.

Jacobson, L.S. (2006). The South African form of severe and complicated canine babesiosis: Clinical advances 1994-2004. *Veterinary Parasitology.* **138:** 126-139.

Kledmanee, K., S. Suwanpakdee, S., Krajangwong, S. and Chatsiriwech, J. (2009). Development of multiplex polymerase chain reaction for detection of ehrlichia canis, babesia spp and hepatozoon canis in canine blood. *The Southeast Asian Journal of Tropical Medicine and Public Health*. **40(1):** 35-39.

Latha, B.R., Dhivya, B. and Vairamuthu, S. (2015). Escalations in the incidence of canine babesiosis over a period of 8 years (2006-2013) in Chennai, Tamil Nadu, India. *Journal of Parasitic Diseases*. pp. 1-4.

Laxmi, B., Parveen, G., Jhambh, R. and Preeti, (2019). Prevalence of haemoparasitic diseases in dogs in and around Hisar, Haryana. *Journal of Entomology and Zoology Studies*. **7(1):** 1311-1313.

Lobetti, R.G. (2000). Canine babesiosis. In: BSAVA Manual of Canine and Feline Haematology and Transfusion Medicine, [Day, M.J., Mackin, A. and Littlewood, J.D.], BSAVA, Gloucester. Pp. 85-91.

Macintire, D.K., Boudreaux, M.K., West, G.D., Bourne, C., Wright, J.C. and Conrad, P.A. (2002). *Babesia gibsoni* infection among dogs in the southeastern United States. *Journal of America Veterinary Medical Association.* **220(3):** 325-329.

Meinkoth, J.H., Kocan, A.A., Stephanie D. and Lorenz, M.D. (2002). Clinical and hematologic effects of experimental small animals infection of dogs with recently identified Babesia gibsoni-like isolates from Oklahoma. *Journal of America Veterinary Medical Association*. **220(2):** 185-189.

Mojgan, N., Lim, S.Y., Mahira, W., Reuben, S.K., Sharma, N.A.B.Y. and Malaika, W. (2013). Molecular detection of *Ehrlichia canis* in Dogs in Malaysia. *Tropical Diseases*. **7(1):** 1-4.

Moore, D.J. and Williams, M.C. (1979). Disseminated intravascular coagulation: A complication of Babesia canis infection in the dog. *Journal of South Africa Veterinary Association*. **50(4):** 265-275.

Rodriguez-Vivas, R.I., Albornz, R.E. and Bolio, G.M. (2005). *Ehrlichia canis* in dogs in Yucatan, Mexico: Seroprevalence, prevalence of infection and associated factors. *Veterinary Parasitology.* **127(1):** 75-79.

Sandor, H., Edelhofer, R. and Farkas, R. (2006). Seroprevalence of canine babesiosis in hungary suggesting breed predisposition. *Journal of Parasitology Research*. **99(6):** 638-642.

Schetters, TPM., Kleuskens, J. and Scholtes, N.C. (1997). Vaccination of dogs against *Babesia canis* infection. *Veterinary Parasitology*. **73(1):** 35-41.

Schetters, T. (2005). Vaccination against canine babesiosis. *Trends Parasitology.* **21(4):** 179-184.

Selvaraj, P., Senthilkumar, K.S., Vairamuthu, S., Prathaban, S. and Srinivasan, S.R. (2010). Babesia gibsoni-An emerging challenge in canine paediatric practice in Chennai. *Tamil Nadu Journal of Veterinary and Animal Sciences*. **6(6):** 122-124.

Senthilkumar, K., Vairamuthu, S. and Kathiresan, D. (2009). Prevalence of haemoprotozoans in canines in C hennai city. *Tamil Nadu Journal of Veterinary and Animal Sciences*. **5(3):** 104-108.

Shaw, E.S., Michael, J.D. Birtles, R.J. and Edward, B.B. (2001). Tick-borne infectious diseases of dogs. *Trends Parasitology.* **17(2):** 74-80.

Soundararajan, C., Nagarajan, K., Selvakumar, S., Kanna, K.C., Rajesh, C., Prakash, M., Raja, R.A. and Ananda, (2016). Prevalence of *Rhipicephalus sanguineus* on dogs in Chennai, Tamil Nadu. *Journal of Veterinary Parasitology.* **30(1):** 12-16.

Tasaki, Y., Miura, N. and Iyori, K. (2013). Generalized alopecia with vasculitis like changes in a dog with babesiosis. *Journal of Veterinary Medical Sciences.* **75(10):** 1367-1369.

Vairamuthu, S., Ranju, R.B.R., Latha, R., Dhivya, B. and Balachandran, C. (2014). A six year (2006-2011) retrospective study of hemoprotozoan parasites affecting dogs in Chennai, Tamil Nadu, India. *Journal of Parasitic Diseases*. **38(2):** 193-195.

Weerathunga, D., Amarasinghe, A., Iddawela, D. and Wickramasinghe, S. (2019). Prevalence of canine tick-borne haemoparasites in three divisional secretariat divisions (Rambewa, Tirappane and Galenbidunuwewa) in the Anuradhapura district, Sri Lanka. *Sri Lankan Journal of Infectious Diseases.* **9(2):** 111-119.