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Studies on clinical abnormalities and haemato-biochemical profiling of ehrlichiosis in dogs

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Abstract
The present study was aimed to study the different clinical abnormalities and haemato-biochemical profile against ehrlichiosis in dog population in and around Jabalpur, (M.P.) A total of 4875 dogs (2925 male and 1950 female) were screened which were presented at Veterinary Clinical Complex (V.C.C.), College of Veterinary Science and Animal Husbandry, N.D.V.S.U., Jabalpur, Madhya Pradesh from July, 2021 to December, 2021. Among dog population 207 dogs (110 male and 97 female) exhibited clinical signs suspected of ehrlichiosis. Intermittent fever (85.15) was the most prevalent clinical sign observed in all the dogs, followed by bleeding tendencies (epistaxis) (66.66%), pale mucous membrane (62.96%), labored breathing (48.14%), arthritis (swelling of legs) (37.03%), etc. The mean values of rectal temperature significantly decreased in due course of treatment. However, the values of pulse and respiration rates in all treatments groups varied within normal physiological range. Haemato-biochemical profile revealed significant increase in the values of TEC, lymphocyte count, total platelet count, while a decline in AST, ALT parameters were observed. However, non-significant difference were observed in the values of haemoglobin, TLC, neutrophil, monocyte, eosinophil count, BUN and serum creatinine level.

Keywords: Dog, ehrlichiosis, haemato-biochemical profile

Introduction
Ehrlichiosis is a globally distributed rickettsial disease of dogs caused by *Ehrlichia* spp. It is an obligate intracellular, pleomorphic or coccal, gram- negative bacterium that is transmitted by tick vectors. There are two forms of Ehrlichiosis that occur in dogs: Monocytic form and Granulocytic form. The monocytic form is caused by *Ehrlichia canis* and its tick vector is *Rhipicephalus sanguineus* (Fuente *et al*., 2008) [20]. Canine Monocytic Ehrlichiosis (CME) has three clinical forms: acute, sub-clinical and chronic. The acute form is characterized by thrombocytopenia, non-regenerative anaemia and haemorrhagic tendencies. This form is manifested clinically by high fever, depression, lethargy and anorexia. The sub-clinical form is characterized by persistent bacteremia with no overt clinical signs and normal haematological parameters. The chronic form is characterized by pancytopenia due to suppression or destruction of bone marrow and lymphadenomegaly. The acute phase of canine monocytic ehrlichiosis is more severe than canine granulocytic ehrlichiosis (Anderson *et al*., 1992) [5]. Clinically the dogs are lethargic, weak and anorexic (Waner and Harrus, 2013) [49]. The granulocytic form (CGE) is caused by *Ehrlichia ewingii* and its tick vector is *Amblyomma americanum* (Fuente *et al*., 2008) [20] and *Dermacentor variabilis*.
The tick *Rhipicephalus sanguineus* is often associated with dogs in tropical and sub-tropical urban areas. This explains the greater prevalence of Ehrlichiosis in urban settings such as Mumbai (27.2%) and Delhi (39.5%), which have a tropical and sub-tropical climate respectively as compared to the rural Sikkim (0%) and Ladakh (0%) which have a temperate and dry-arid climate respectively (Abd Rani *et al*., 2011) [1].
Diagnosis of Ehrlichiosis can be done on the basis of blood smear examination, cell culture, serology and molecular detection by PCR. In serology, the Indirect Fluorescent Antibody Test (IFAT) is recommended to confirm a diagnosis of ehrlichiosis. Dot-ELISA kits for the detection of *E. canis*-IgG antibodies are commercially available.

Western immunoblot is a more specific test, which can distinguish between infections with the different organisms causing ehrlichiosis, anaplasmosis, or neorickettsiosis as well as between *Ehrlichia* spp., for example *E. canis* and *E. ewingii* (Straube, 2010) [44].

Dogs with Ehrlichiosis have been conventionally treated with Tetracycline @ 22mg/kg body weight given every 8 hours or doxycycline @ 5 mg/kg body weight every 12 hours administered daily for 4 weeks. Following therapeutic elimination of *Ehrlichia* spp. dogs do not develop protective immunity and can be reinfected when re-introduced to a vector-competent tick (Breitschwerdt, 1998) [11]. Even after clearance of infection, bone marrow regeneration may require up to 120 days following treatment. In general, the prognosis of acute infection is good but chronic infection is guarded. Keeping in view of the above facts, the present study was proposed to evaluate the clinical abnormalitites and haemato-biochemical profile of different drugs against ehrlichiosis in dogs.

Materials and Methods

The proposed work was conducted in the Department of Veterinary Medicine, College of Veterinary Science and Animal Husbandry, Nanaji Deshmukh Veterinary Science University, Jabalpur, Madhya Pradesh. A total of 4875 dogs which were brought to Veterinary Clinical Complex (V.C.C.), College of Veterinary Science & A.H., Jabalpur (M.P.) were screened for ehrlichiosis for a period of six months i.e. from July 2021 to December 2021. Complete history of the dogs regarding age, breed, sex, mucous membrane and various symptoms like bleeding tendencies (epistaxis), intermittent fever, arthritis (swelling of legs) and laboured breathing was recorded. All the dogs were thoroughly examined and different clinical parameters i.e. rectal temperature, pule rate and respiration rate were recorded. The dogs were screened for the presence of clinical symptoms *viz.* bleeding tendencies/epistaxis, intermittent fever, arthritis (swelling of legs) and labored breathing, lethargy for at least 1-2 weeks or longer. A total of 207 dogs were suspected for ehrlichiosis on the basis of clinical signs, out of which 27 dogs were diagnosed positive for ehrlichiosis by blood smear examination. For epidemiological study, blood samples were collected from marginal ear vein and smears were prepared on clean grease free glass slides and stained with Giemsa stain as per standard procedure (Kelly, 1979) [26].

A total of 18 positive cases of ehrlichiosis in dogs were placed into three groups i.e. G2, G3 and G4. Six apparently healthy dogs were kept as healthy control group (G_1). Each treatment group comprised of six dogs. Animals were treated by the following drugs (Table 1).

Table 1: Drugs and dosage in different groups

Groups	Drugs	Dose, route and duration
G1	Apparently healthy control group	-
G2	Doxycycline	10 mg/kg, PO, BID for 21 days
G3	Rifampin	15 mg/kg, PO, BID for 21 days
G4	*Crotalus horridus* (200C)	4 Pills PO, OD for 21 days

The haematological parameters i.e. haemoglobin (g/dL), total erythrocyte count ($10^6/\mu L$), total leukocyte count ($10^3/\mu L$), total platelets count and differential total leukocyte count (%) were estimated using Abacus automatic haematology analyser. The biochemical parameters i.e. Serum alanine aminotransferase (IU/L)**,** Aspartate aminotransferase (IU/L)**,** Serum creatinine (mg/dl) and Blood urea nitrogen (mg/dl) were estimated with CHEM-5 plus semi-autoanalyzer using readymade kits manufactured by Erba Manheim Transasia biochemical (India) Pvt. Ltd. Symptomatic and supportive therapy including administration of fluids, electrolytes, antacids, antiemetics, diuretics, haematinics and ectoparasiticidal were given according to clinical condition in all the treatment groups. Statistical analysis was done by using methods as described by Snedecor and Cochran (1994) [42]. Means were compared using Fisher's pair wise comparison, based on the least significant difference at 5% level of significance. The data pertaining to the quantitative haemato-biochemical parameters were analyzed by one-way analysis of variance (ANOVA) using Minitab statistical software version 20.4.

Results and Discussion

Significant variation was observed in body temperature between G_2 and G_3 group on day 0 (pre-treatment), but higher than the healthy control group. Significant difference was recorded in G_3 from day 7 to day 21 and in G_4 from day 0 to day 7. Similar findings of increase in rectal temperature due to lysis of blood cell & release of pyrogen resulting pyrexia in dogs with ehrlichiosis was also recorded by Anuchai *et al.* (2006) [6], Chipde *et al.* (2007) [14], Schaefer *et al.* (2007) [40], Akhtardanesh *et al.* (2011) [4], Procajlo *et al.* (2011) [36], Shukla *et al.* (2011) [41], Bhadesiya and Raval (2015) [8], Roopali *et al.* (2018) [37] and Venkatesakumar *et al.* (2018) [46]. Mean pulse rate was comparatively higher on day 0 in all groups as compared to the healthy control group, however the values remain within the normal physiological range. It was within normal reference range (70-120 per minute) as documented by (Chakraborty, 2014) [13]. The increase in pulse rate in ehrlichiosis was also recorded by Islam *et al.* (2017) [24] and Kottadamane *et al.* (2017) [27]. Ehrlichiosis is a multisystemic disease with the potential to cause cardiomyocyte injury in naturally infected dogs resulting in an increased pulse rate (Diniz *et al.*, 2008) [15]. Analysis of data revealed non-significant difference in the respiration rate of all treatment groups on day 0 (pre-treatment). The mean respiratory rate of dog infected with ehrlichiosis was slightly higher before initiation of treatment. Similar clinical findings of an increase in the respiratory rate in dogs with ehrlichiosis were also recorded by Kottadamane *et al.* (2017) [27] and Islam *et al.* (2017) [24]. Anaemia in dogs with an increased ventilator requirement causes an additional increase in breathing, resulting in an increased respiration rate in dogs affected with erhlichiosis.

Table 2: Mean values of temperature (°F), pulse rate (beats/minute) and respiration rate (breaths/minute) in dogs in different groups at different intervals

Groups	Body temperature (Mean ± SE)			Pulse rate (Mean ± SE)			Respiration rate (Mean ± SE)		
	Day 0	Day 7	Day 21	Day 0	Day 7	Day 21	Day 0	Day 7	Day 21
G_1	101.78^{cA}±0.11	102.62^{aA}±1.01	102.05^{aA}±0.20	98.00±2.13	99.50±1.52	99.83±0.65	25.50^{bA}±1.34	23.00^{bA}±1.67	23.17^{cA}±1.66
G_2	102.55^{bA}±0.18	102.57^{aA}±0.16	102.32^{aA}±0.19	108.50±4.48	104.50±2.93	101.17±2.71	31.00^{abA}±2.68	29.83^{aA}±1.66	26.17^{bcA}±1.64
G_3	103.37^{aA}±0.26	103.38^{aA}±0.19	101.82^{aB}±0.20	105.27±3.86	101.67±4.14	100.83±3.15	32.67^{aA}±1.87	34.17^{aA}±2.09	31.83^{aA}±1.85
G_4	104.02^{aA}±0.33	102.42^{aB}±0.31	102.23^{aB}±0.31	108.33±3.36	107.00±2.58	100.83±1.40	37.33^{aA}±3.27	33.00^{aA}±2.92	28.83^{abA}±1.17

Mean values with different superscripts between groups (lowercase) and between days (uppercase) differ significantly (p<0.05)

Table 3: Clinical abnormalities of ehrlichiosis in dogs

Clinical abnormalities	Affected (27)	Distribution (%)
Intermittent fever	23	85.15
Bleeding tendencies (epistaxis)	18	66.66
Pale mucous membrane	17	62.96
Labored breathing	13	48.14
Arthritis (swelling of legs)	10	37.03

Intermittent fever was observed in mostly infected dogs which might be caused by increased production of interleukin-1 (IL-1) by antigen presenting cells and B cells or exogenous pyrogen products of the parasite (Gershwin *et al*., 1995). The clinical indications of epistaxis were observed in 18 dogs in this investigation. Bhadesiya and Raval (2015) [8], Kottadamane *et al*. (2017) [27], Petrov *et al*. (2018) [33], and Roopali *et al*. (2018) [37] observed clinical symptoms of bleeding tendency in dogs with ehrlichiosis. In dogs with ehrlichiosis, epistaxis is linked to thrombocytopenia, moderate vasculitis, and thrombocytopathy (Castro *et al*., 2004, Mylonakis *et al*., 2004 and Waner and Harrus, 2013) [12, 30, 49]. Lameness was detected in 37.03% of cases, which could be due to oedema and arthritis in the rear limb. These findings are similar to those of Akhtardanesh *et al*. (2011) [4], Shukla *et al*. (2011) [41], Bhadesiya and Raval (2015) [8], Kottadamane *et al*. (2017) [27], and Roopali *et al*. (2018) [37], who also found lameness in dogs infected with ehrlichiosis. Sneezing, nasal discharge, and respiratory discomfort were found in 48.14% of the cases in this study. In canine ehrlichiosis, Procajlo *et al*. (2011) [36], Salib and Farghali (2015) [39] reported similar results. The data is summarized in table 2.

Haematological profiling of dogs affected with Ehrlichiosis

Hb concentration (g/dl) revealed significant decline in the mean values in all the treatment groups as compared to the healthy control group G_1. As the organisms are progressively dividing and spreading throughout the body via mononuclear cells, thrombocytopenia and eventually irreversible bone marrow destruction was observed in later stages. In comparison to the usual reference range (10-16 gm/dl), dogs affected with ehrlichiosis have a low Hb content. These findings are consistent with those of Saniz *et al*. (2000) [38], Anuchai *et al*. (2006) [6], Chipde *et al*. (2007) [14], Akhtardanesh *et al*. (2011) [4], Shukla *et al*. (2011) [41], Barman *et al*. (2014) [7], Dubie *et al*. (2014) [17] and Petrov *et al*. (2018) [33]. G_2, G_3 and G_4 revealed significant difference in the mean values of TEC ($\times 10^6$/µl) on day 0 (pre-treatment), as compared to the healthy control G_1. The mean values of Total erythrocyte counts were significantly increased in group G2 and G4 at different intervals. As observed by Brar *et al*. (2014) [10], certain studies showed a decrease in TEC in dogs with ehrlichiosis when compared to the normal reference range (5 to 8 $x10^6$/ul). After therapy with imidocarb dipropionate, oxytetracycline, and doxycycline in dogs with *Ehrlichia* infection, Akhtardanesh *et al*. (2011) [4], Barman *et al*. (2014) [7], Islam *et al*. (2017) [24], and Petrov *et al*. (2018) [33] reported similar improvements in TEC. The loss of blood due to epistaxis, petechial, ecchymotic haemorrhages, and haematemesis, reported in dogs with ehrlichiosis, could be due to thrombocytopenia and haematopoietic system disturbances, as well as bone marrow hypoplasia caused by progressive replication of canine ehrlichiosis in the bone marrow which results in suppression of erythroid, myeloid and megakaryocytic cells, resulting in decreased RBC production (Abeygunawardena *et al*., 1990, Petrov *et al*., 2018 and Roopali *et al*., 2018) [2, 33, 37]. Dixit *et al*. (2012) [16] and Kottadamane *et al*. (2017) [27] reported leucocytosis in ehrlichiosis-infected dogs.

Groups G_2, G_3 and G_4 revealed significant increase in the mean values of neutrophil count (%) in circulation on day 0 (pre-treatment) as compared to the healthy control group. Castro *et al*. (2004) [12], Mulla (2007) [29] and Bhadesiya and Raval (2015) [8], who reported a 1% increase in neutrophils in ehrlichiosis. This may be due to initial enhanced immunological response of the invaded rickettsial pathogen (Mulla, 2007) [29]. There was a significant decrease (P≤0.05) in the monocyte values on the day of presentation which is in agreement with Podhade *et al*. (2009) [35], Tsachev *et al*. (2013) [45] and Kottadamane *et al*. (2016) [54]. Ettinger and Feldman (2000) [18] postulated that some monocytes infected with *Ehrlichia canis* would adhere to the vascular endothelium leading to reduction in their peripheral blood numeration. The mean values of lymphocyte count (%) was decreased significantly in group G_3 at day 0 (pre-treatment), whereas there was no significant change in groups G_1, G_2 and G_4. Oliveira *et al*. (2000) [32], Castro *et al*. (2004) [12], Bhadesiya and Raval (2015) [8], and Kottadamane *et al*. (2017) [27] reported that dogs with ehrlichiosis exhibited a significant decrease in lymphocytes percent at day 0 (pre-treatment).

In the present study, in G_3 and G_4 groups, there was increase in eosinophil (%) which might be due to alteration in haemostasis and involvement of parasite responsible for elucidating immune response in the dogs affected with ehrlichiosis. Similar findings were reported by Oliveira *et al*. (2000) [32], Castro *et al*. (2004) [12] and Srikala *et al*. (2012) [43].

The mean values of total platelets count were significantly increased in all treatment groups. Platelet-associated IgG and antibodies that recognize platelet proteins in animals with *E. canis* infection may play a role in the thrombocytopenia. In addition, platelet migration-inhibition factor (PMIF) has been found to exist in animals with Ehrlichiosis and its level is related inversely to the platelet count. These findings are consistent with those of Saniz *et al*. (2000) [38], Anuchai *et al*. (2006) [6], Chipde *et al*. (2007) [14], Barman *et al*. (2014) [7], Kottadamane *et al*. (2017) [27], Petrov *et al*. (2018) [33], and Roopali *et al*. (2018) [37]. Increased splenic sequestration of platelets, decreased half-life of circulatory platelets, suppressed production, platelet dysfunction, and increased platelet destruction by anti-platelet antibodies may all contribute to thrombocytopenia in ehrlichiosis Pierce *et al*. (1977) [34], Kuehn and Gaunt (1985) [28], Hibler and Greene

(1986) [23], Abeygunawardena *et al*. (1990) [2] Weiser *et al*. (1991) [51], Waner *et al*. (1995) [50] and Kelly (2000) [25]. Similarly, Akhtardanesh *et al*. (2011) [4], Petrov *et al*. (2018) [33], Roopali *et al*. (2018) [37] and Xaxa and Kumar (2018) [52] reported that treatment with oxytetracycline, doxycycline, and imidocarb dipropionate improved platelet count in dogs affected with ehrlichiosis.

Table 4: Different means of haemoglobin concentration, total erythrocyte count, total leukocyte count, neutrophil, monocyte, lymphocyte, eosinophil, total platelet count in dogs in different groups at different intervals

Different parameters	Groups	Mean ± SE		
		Day 0	Day 7	Day 21
Haemoglobin conc. (g/dl)	G_1	12.95^{aA}±0.19	12.86^{aA}±0.17	13.05^{aA}±0.11
	G_2	8.50^{bA}±0.60	9.25^{bA}±0.52	10.01^{bA}±0.56
	G_3	7.00^{bA}±01.21	8.63^{bA}±0.91	10.45^{bA}±0.65
	G_4	10.26^{aA}±0.27	10.88^{aA}±0.26	11.58^{aA}±0.32
TEC ($\times10^6$/µl)	G_1	5.33^{aA}±0.21	5.50^{aA}±0.18	5.45^{aA}±0.19
	G_2	3.78^{bC}±0.13	4.61^{bB}±0.15	5.83^{aA}±0.22
	G_3	3.81^{bA}±0.40	4.38^{bA}±0.39	4.91^{aA}±0.50
	G_4	4.23^{bB}±0.19	4.76^{abAB}±0.29	5.43^{aA}±0.24
TLC ($\times10^3$/µl)	G_1	12.31±0.56	12.20±0.59	12.26±0.54
	G_2	15.23±1.07	14.70±0.98	14.31±0.94
	G_3	18.78±3.47	14.68±2.26	12.38±1.65
	G_4	15.47±1.12	14.33±1.15	13.40±1.21
Neutrophil (%)	G_1	65.92^{bA}±1.27	66.23^{bA}±0.87	66.56^{bA}±0.70
	G_2	80.16^{aA}±0.98	75.66^{aB}±0.99	72.16^{aC}±0.69
	G_3	80.17^{aA}±2.39	74.58^{aAB}± 2.16	69.57^{abB}±2.01
	G_4	79.33^{aA}±1.58	74.68^{aB}±1.08	72.03^{aB}±1.04
Monocyte (%)	G_1	5.25^{aA}±0.22	5.73^{aA}±0.29	5.18^{aA}±0.09
	G_2	4.36^{abA}±0.77	5.00^{abA}±0.95	4.91^{aA}±0.75
	G_3	3.16^{bcA}±0.70	3.55^{bcA}±0.60	3.88^{aA}±0.52
	G_4	2.50^{cA}±0.15	2.71^{cA}±0.27	3.25^{aA}±0.47
Lymphocyte (%)	G_1	26.28^{aA}±1.19	25.85^{aA}±0.92	26.21^{aA}±0.64
	G_2	12.33^{bA}±1.31	14.95^{bA}±1.15	16.33^{bA}±1.10
	G_3	12.33^{bB}±2.46	17.00^{bAB}± 2.26	22.93^{aA}±1.84
	G_4	15.75^{bA}±0.82	17.23^{bA}±0.68	19.07^{bA}±1.11
Eosinophil (%)	G_1	5.03±0.51	3.15±0.26	4.91±0.23
	G_2	1.50±0.42	1.16±0.30	1.25±0.28
	G_3	1.05±0.26	1.08±0.37	1.66±0.40
	G_4	1.00±0.25	0.83±0.27	1.58±0.37
Total platelets count (10^3/ul)	G_1	200.50^{aB}±5.70	198.3^{aB}±2.18	203^{aB}±22.3
	G_2	171.17^{bC}±9.15	193.6^{bB}±14.5	222^{bA}±14.3
	G_3	146.83^{bA}±8.47	185.2^{bA}±16.8	199.33^{bA}± 9.07
	G_4	161.03^{bA}±4.14	216.72^{bA}± 7.02	234.02^{bA}± 3.46

Mean values with different superscripts between groups (lowercase) and between days (uppercase) differ significantly (p<0.05)

Biochemical profiling of dogs affected with Ehrlichiosis

The mean values of AST were significantly decreased in groups G_3 and G_4 at different intervals. Many authors observed a rise in AST levels. Similar findings were reported by Waner and Harrus (2000) [48], Anuchai *et al*. (2006) [6], Agnihotri *et al*. (2012) [3], Bhardwaj (2013) [9], Barman *et al*. (2014) [7], Kottadamane *et al*. (2017) [27], Petrov *et al*. (2018) [33] and Roopali *et al*. (2018) [37]. Increased AST activity may be due to inflammation and destruction of the intestinal mucosa as well as substantial blood loss by parasite forming toxic metabolites that are absorbed and detoxified in the liver resulting in increased AST activity (Walker *et al*., 1970) [47]. It is rare in pancytopenic dogs with advanced *Ehrlichia canis*-induced bone marrow aplasia, which could be due to anaemic hypoxia, intrahepatic haemorrhage, or a combination of both these factors.

The mean values of ALT were significantly decreased in group G_3 at different intervals. Similar findings were reported by (Frank and Breitschwerdt, 1999; Mylonakis *et al*., 2010, Agnihotri *et al*., 2012, Barman *et al*., 2014, Kottadamane *et al*., 2017 and Roopali *et al*., 2018) [19, 7, 3, 30, 27, 37]. It has been reported that the increase in ALT level in ehrlichiosis affected dogs could be attributed to the underlying hepatic injury, followed by hepatic necrosis, reversible damage in which hepatocytes become leaky as reported by Reardon and Pierce (1981) [53] and Anuchai *et al*. (2006) [6]. Others authors stated that in ehrlichiosis the alteration of ALT level might be because of primary liver disease or secondary to hypoxia, intrahepatic haemorrhage or septicaemia in myelosuppressive CME (Harrus *et al*., 1998; Castro *et al*., 2004 and Mylonakis *et al*., 2010) [22, 12, 31].

Brar *et al*. (2014) [10] found an increase in BUN level in dogs with ehrlichiosis when compared to the normal reference range (8 - 25 mg/dl). Similar findings were found by Anuchai *et al*. (2006) [6], Chipde *et al*. (2007) [14], Procajlo *et al*. (2011) [36], Barman *et al*. (2014) [7], Kottadamane *et al*. (2017) [27], and Roopali *et al*. (2018) [37]. In canine ehrlichiosis, an increase in BUN may be related to immune complex-mediated glomerulonephritis (Harrus *et al*., 1998) [22]. Roopali *et al*. (2018) [37] also found that *Ehrlichia*-infected dogs treated with imidocarb dipropionate and oxytetracycline, followed by doxycycline had a lower BUN level. Most of the studies have found that dogs with ehrlichiosis had higher serum creatinine levels. According to Frank and Breitschwerdt (1999) [19], Mylonakis *et al*. (2004) [30], Anuchai *et al*. (2006) [6], Chipde *et al*. (2007) [14], Procajlo *et al*. (2011) [36], Agnihothri *et al*. (2012) [3], Barman *et al*. (2014) [7], Bhadesiya and Raval (2015) [8], Kottadamane *et al*. (2017) [27]

and Roopali *et al*. (2018) [37], the rise in creatinine levels associated with ehrlichiosis could be attributable to glomerular proteinuria which is caused by glomerulonephritis with or without immune complex deposition in chronic and acute ehrlichiosis, (Bhadesiya and Raval 2015, Kottadamane *et al*., 2017 and Roopali *et al*., 2018) [8, 27, 37] respectively.

Table 5: Mean values of serum aspartate aminotransferase concentration, serum alanine aminotransferase, blood urea nitrogen concentration, serum creatinine in dogs in different groups at different intervals

Different parameters	Groups	Mean ± SE		
		Day 0	Day 7	Day 21
AST concentration (U/L)	G_1	32.88^{bA}±2.29	41.27^{aA}±2.11	41.37^{aA}±3.47
	G_2	66.2^{aA}±11.5	45.82^{aA}±7.04	38.73^{aA}±2.54
	G_3	55.37^{aA}±3.25	44.08^{aB}±2.00	36.32^{aC}±1.44
	G_4	57.72^{aA}±4.21	40.73^{aB}±2.49	36.28^{aB}±1.77
ALT concentration (U/L)	G_1	30.12^{aA}±2.58	30.75^{aA}±2.35	32.23^{aA}±2.88
	G_2	59.03^{aA}±7.93	39.27^{aA}±2.58	33.94^{aA}±2.04
	G_3	53.85^{aA}±7.05	43.12^{aAB}±4.35	34.08^{aB}±2.03
	G_4	54.22^{aA}±3.35	45.17^{aA}±3.54	45.05^{aA}±5.82
BUN concentration (mg/dl)	G_1	12.21±0.45	13.76±0.61	14.92±1.88
	G_2	20.58±3.38	19.17±3.20	17.70±2.82
	G_3	23.30±7.27	19.47±4.91	16.30±2.80
	G_4	24.53±7.17	18.90±5.33	15.78±3.38
Serum creatinine (mg/dl)	G_1	1.40±0.25	1.68±0.07	1.46±0.18
	G_2	1.51±0.24	1.15±0.15	1.05±0.15
	G_3	1.63±0.30	1.41±0.26	1.21±0.15
	G_4	1.78±0.30	1.28±0.20	1.15±0.20

Mean values with different superscripts between groups (lowercase) and between days (uppercase) differ significantly (p<0.05)

Conclusion

Intermittent fever (85.15) was the most prevalent clinical sign observed in all the dogs, followed by bleeding tendencies (epistaxis) (66.66%), pale mucous membrane (62.96%), labored breathing (48.14%), arthritis (swelling of legs) (37.03%), etc. The mean values of rectal temperature significantly decreased in due course of treatment. However, the values of pulse and respiration rates in all treatments groups varied within normal physiological range. Haemato-biochemical profile revealed significant increase in the values of TEC, lymphocyte count, total platelet count, while a decline in AST, ALT parameters were observed. However, non-significant difference were observed in the values of haemoglobin, TLC, neutrophil, monocyte, eosinophil count, BUN and serum creatinine level.

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