TRANSTHORACIC ECHOCARDIOGRAPHIC ASSESSMENTOF CARDIAC DYSFUNCTION IN DOGS WITH BABESIOSIS

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The current study aimed to evaluate the cardiac functional parameters in canine Babesiosis patients. In this study, dogs presented to Critical Care Unit of the Department of Veterinary Clinical Medicine, Madras Veterinary College, Chennai during April 2021 to December 2021 with suspicion on canine Babesiosis were assessed with detailed clinical, hemato-biochemical, echocardiographic and electrocardiographic examination. Among 92 canine Babesiosis patients, echocardiographic examination revealed cardiac dysfunction in 31 dogs. Outof thirty one dogs, twohad systolic dysfunction, twenty four had diastolic dysfunction and 5had both systolic and diastolic dysfunction. Predominant ECG findings in cardiac dysfunction associated with canine Babesiosis patients were sinus tachycardia, ST coving and atrial fibrillation. Survival rate was lower in canine Babesiosis patient with cardiac dysfunction (26%, 8/31). Therefore, cardiac dysfunction in canine Babesiosis patients was considered as good prognostic indicator.
Keywords: CanineBabesiosis, Cardiacdysfunction, Echocardiography, Electrocardiography.

Canine Babesiosis is a most common vector borne hemoprotozoal disease throughout India, caused by variety of Babesia spp., predominantly *Babesia canis* and *Babesia gibsoni*.Based on the clinical signs canine babesiosis is classified as uncomplicated form and complicated form. The complicated form of Babesiosis was associated with hemolytic anemia, icterus, acute renal injury (AKI), acute respiratory distress syndrome (ARDS), hepatopathy, immune mediated hemolytic anemia, disseminated intravascular coagulopathy (DIC) and myocarditis (Karasova *et al.* 2022). Myocarditis in canine babesiosis is mainly due to sepsis induced myocardial depression (SiMD) which cause reversible systolic and diastolic dysfunction (Dantas and Costa, 2015). Cardia troponin I is a highly sensitive marker for myocardial cell death in dogs. But it doesnot indicates type of cardiac dysfunction and more expensive. M mode, Pulsed wave Doppler and tissue Doppler

imaging of transthoracic echocardiography were used for evaluation of systolic and diastolic cardiac function in dogs. This technique was used for hemodynamic management of myocardial dysfunction in human sepsis patients. The incidence rate of sepsis induced myocardial dysfunction in human sepsis patients varies from 20 to 60%. Survival rate was significantly lower in patient with cardiac dysfunction (30%) compared to sepsis patient without cardiac dysfunction. In humans, most of the study has been evaluate the left ventricular systolic and diastolic dysfunction in sepsis.Studies related to sepsis induced cardiac dysfunction in sepsis dogs were limited. Ince *et al.,* 2019 reported that among 20 dogs with severe sepsis and septic shock, 3 dogs had systolic dysfunction, and 14 dogs had diastolic dysfunction.Dogs with diastolic dysfunction had poor survival rate.Thus, the objective of the study was to evaluate the left ventricular systolic and diastolic functional parameters in dogs infected with Babesiosis and its prognostic importance.

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Materials and Methods

The study was carried out at the Critical Care Unit of the department of Veterinary Clinical Medicine, Madras Veterinary College, Chennai-7, during the period of 'April 2021 to December 2021'. Apparently healthy dogs (n=10) aged between 1 to 6 years presented to MVCTH for regular health checkup and routine vaccination were taken up as control group. The study dogs had a history of tick infestation, clinical signs (pyrexia, splenomegaly and lymphadenopathy) and hematology findings (thrombocytopenia and anemia) suggestive of blood parasitic infection. All of them had intraerythrocytic parasites in peripheral blood smear examination. Inclusion criteria in those dogs were presence of systemic inflammatory response syndrome, severe sepsis and septic shock. The dogs had preexisting cardiac disease, co morbid conditions like diabetes, acute respiratory distress syndrome and severely elevated creatinine (above 7 mg/dL) or ultrasonography suggestive of chronic renal disease were excluded from the study.The presence of SIRS, severe sepsis and septic shock in the study group of dogs were determined. If the dogs fulfill 2 or more criteria with known source of microorganism considered as sepsis. Sepsis associated with one or more organ dysfunction and hypotension was defined as severe sepsis. If hypotension does not respond with initial bolus dose of fluid therapy was considered as septic shock. All the dogs were treated. Dogs with systolic dysfunction, positive inotropes such as dopamine (10 ug/kg/min, CRI, IV) was given. In case of diastolic dysfunction, a colloidal solution (Hydroxyethyl starch 6%, 5 ml/kg/hr, IV) was given.All the clinical, hemato-bichemical, echocardiography and electrocardiography examination of the study group dogs were performed within 2 hrs of presentation. Bedside echocardiographic examination was performed in all the selected cases using Esaote, Italy ultrasound machine. Systolic functional parameters were measured from M-mode imaging on right side parasternal long axis and short axis view and diastolic functional parameters were measured from Pulse wave Doppler and Tissue Doppler imaging of left apical view. Transthoracic echocardiographic values in dogs were assessed based on body weight.Electrocardiogram was recorded in all the selected cases by standard limb lead system using Welch Allyn ECG monitor.The dogs were split into two groups as survivors and non survivors based on the treatment response. The data obtained in this study was subjected to statistical analysis using one was analysis of variance (ANOVA) by the statistical package, using software IBM SPSS 23.0 for windows.

Results and Discussion

The most common clinical signs were anorexia, vomiting, pale or congested or icteric mucous membrane, hyperthermia or hypothermia, tachycardia, tachypnea, lymphadenopathy, petechia or ecchymosis, splenomegaly, melena, prolonged capillary refilling time and severe dehydration as reported by Bartnicki *et al.*, 2017. Approximately 50% of human sepsis develops sepsis induced cardiac dysfunction. Pericardial effusion and pericardial, epicardial and endocardia hemorrhages were most commonly noticed lesion in canine babesiosis. Pericardial effusion in canine babesiosis was associated with myocardial necrosis, Hypoalbuminemia and/ or increased capillary permeability as also mentioned by Koster *et al.,* 2015. Increased heart rate was the common clinical manifestation of canine babesiosis. It may be associated with anemia, fever or metabolic acidosis. Persistent tachycardia results in decreased cardiac output and myocardial perfusion which ends up in myocardial hypoxia and myocardial ischemia. There is a significant decrease in WBC count, platelet count and albumin level and increases in activated partial thromboplastin time (aPTT) and prothrombin time (PT) in non survivors compare to survivors (Table.1).Metabolic acidosis is the predominant acid base disturbance observed in canine babesiosis groups compared to control group. In the study group, 31 dogs

(34%) had at least one type of cardiac dysfunction. In which, 2 dogs (6.5%) had left ventricular systolic dysfunction, 24 dogs (77.4%) had LV diastolic dysfunction and 5 dogs (16.1%) had both systolic diastolic dysfunction. Both dogs with LV systolic dysfunction had reduction in fractional shortening (FS) and cardiac output. Within the LV diastolic dysfunction group, 17 dogs had impaired relaxation and 7 dogs had pseudonormalisation. One dog with babesiosis had pericardial effusion and showed both systolic and diastolic dysfunction (Table. 2). Left ventricular ejection fraction (LVEF) is most often used parameter to assess the left ventricular systolic function.. There is a significant increase in EPSS in non survivors compared to survivors. E-point septal separation (EPSS) is also one of the indices for left ventricular systolic function. It may be considered more relevant parameter of reduced vascular tone

than the left ventricular contractility in sepsis dogs (Ince *et al.* 2019). Left ventricular diastolic dysfunction was described based on the guideline of American Society of Echocardiography (ASE) 2009, and described as: if $E' \geq 8$ cm/s : normal, if $E' < 8$ cm/s, $E/A = 0.8$: impaired relaxation; if $E' < 8$ cm/s, $E/A = 0.8$ to 1.5 and $E/E' = 9$ to 12 : pseudonormal; if $E' < 8$ cm/s, $E/A > 2$, $E/E' \geq 13$: restrictive. In humans, E' is considered as important prognostic parameter in cardiac disease. In our study, highly significant decreases in E' and increases in E/E' in non survivors compare to survivors. Mortality rate was higher in canine babesiosis with cardiac dysfunction (74%, 23/31)when compared to canine babesiosis without cardiac dysfunction (31.1%, 19/61).Cardiac dysfunction in canine babesiosis was associated with multi organ dysfunction syndrome (MODS) and severity of the infection

Table 1: Hematobiochemical values of dogs under different groups(Mean ± S.E)

Parameters		Control (n=10)	Survivors (n=69)	Non survivors (n=23)	F value
Hb (g/dL)	Mean ± S.E	11.4 ±0.536	10.47 ±0.807	9.125 ±1.054	1.255[NS]
PCV (Per Cent)	Mean ± S.E	34.33 ±1.534	30.03 ±2.317	25.74 ±2.947	2.173[NS]
RBC (million/cmm)	Mean ± S.E	5.71 [a] ±0.258	4.68 [ab] ±0.292	3.96 [b] ±0.473	3.891[*]
WBC count (cells/cmm)	Mean ± S.E	10016.66 [b] ±940.005	39225.0 [a] ±4800.664	25908.33 [ab] ±5736.637	6.383[**]
Platelet count (cells/cmm)	Mean ± S.E	248333.33 [a] ±12789.752	95083 [b] ±13573.848	76816 [b] ±23373.391	17.127[**]
Prothrombin Time (sec)	Mean ± S.E	8.53 [b] ±0.481	8.22 [b] ±0.403	12.66 [a] ±1.483	5.755[**]
activated Partial Thromboplastin Time (sec)	Mean ± S.E	16.71 [b] ±0.733	16.4 [b] ±0.986	28.8 [a] ±4.819	4.578[*]
ALT (IU/dL)	Mean ± S.E	55.16 ±7.573	133 ±37.032	178.25 ±31.358	2.623[NS]
ALP (IU/dL)	Mean ± S.E	111.16 [b] ±6.685	312 [a] ±67.491	484.91 [a] ±95.262	4.316[*]

Total protein (g/dL)	**Mean ± S.E**	6.98 ±0.107	6.74 ±0.315	6.65 ±0.525	0.118[NS]
Albumin (g/dL)	**Mean ± S.E**	3.38[b] ±0.137	2.85[a] ±0.183	2.72[a] ±0.377	3.714[*]
Total bilirubin (mg/dL)	**Mean ± S.E**	0.28 ±0.033	1.29 ±0.382	2.24 ±0.625	0.346[NS]
Direct bilirubin (mg/dL)	**Mean ± S.E**	0.09 ±0.006	0.9 ±0.316	1.65 ±0.50	2.932[NS]
Lactate (mmol/L)	**Mean ± S.E**	1.36[b] ±0.189	2.70[b] ±0.626	7.15[a] ±1.042	12.338**

The values bearing same superscript did not differ significantly.
*$p < 0.005$ –significant, **$p < 0.01$ –highly significant and [NS]$p > 0.05$ –non significant.

Table 2: Transthoracic echocardiographicvalues in dogs under different groups(Mean ± S.E)

Parameters		Control (n=10)	Survivors (n=69)	Non survivors (n=23)	F value
LVIDd (cm)	Mean ± S.E	4.28 ± 0.208	3.72 ± 0.190	3.86 ± 0.368	0.704 [NS]
LVIDs (cm)	Mean ± S.E	2.76 ± 0.14	2.49 ± 0.116	2.16 ± 0.131	4.493 [NS]
FS (Per Cent)	**Mean ± S.E**	**35.27 ± 2.101**	**35.24 ± 0.691**	**40.05 ± 4.572**	**0.756 [NS]**
EDV (ml)	Mean ± S.E	52.9 ± 1.353	43.72 ± 2.601	56.87 ± 8.824	1.286 [NS]
ESV (ml)	Mean ± S.E	18.64 ± 1.244	15.68 ± 1.012	16.97 ± 2.634	0.438 [NS]
SV (ml)	Mean ± S.E	34.26 ± 0.963	28.26 ± 2.004	39.44 ± 7.552	1.252 [NS]
EF (Per Cent)	**Mean ± S.E**	**64.85 ± 1.892**	**63.93 ± 1.797**	**67.52 ± 4.409**	**0.353 [NS]**
CO (L/min)	Mean ± S.E	4.86 ± 0.185	4.57 ± 0.228	4.13 ± 0.552	0.667 [NS]
EPSS (cm)	**Mean ± S.E**	**0.26[b] ± 0.098**	**0.271[b] ± 0.008**	**0.503[a] ± 0.054**	**6.853****
E (cm/s)	Mean ± S.E	81.64 ±3.274	69.54 ±2.881	86.29 ±9.292	1.843 [NS]
A (cm/s)	Mean ± S.E	55.91 ±2.242	53.70 ±1.591	57.46 ±6.617	0.183 [NS]
E/A	Mean ± S.E	1.46 ±0.074	1.33 ±0.067	1.63 ±0.238	0.902 [NS]
E' (cm/s)	Mean ± S.E	-10.49[b] ±0.125	-10.48[b] ±0.660	-7.35[a] ±0.471	10.907**
A' (cm/s)	Mean ± S.E	-12.85 ±0.272	-13.21 ±0.912	-9.44 ±1.936	2.14 [NS]

E/E'	Mean ± S.E	7.76 [b] ±0.296	6.93 [b] ±0.284	12.4 [a] ±1.209	12.850**
IVRT (ms)	**Mean ± S.E**	51.83 ±2.12	54.33 ±1.345	64.0 ±8.013	1.249 [NS]

The values bearing same superscript did not differ significantly.
*p < 0.005 –significant, **p < 0.01 –highly significant and [NS]p>0.05 –non significant.

Conclusion

Echocardiographic examination of left ventricular systolic dysfunction with EPSS and left ventricular diastolic dysfunction with E' and E/E' was associated with increased mortality in canine babesiosis.

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