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Evaluation of Hematological and Serum Biochemical Alterations in Dogs Affected with Congestive Heart Failure

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ABSTRACT

Background: Congestive heart failure (CHF) is common disorder of dogs that occur most frequently as a result of Dilated Cardiomyopathy (DCM), Degenerative Mitral Valve Disease and pericardial diseases. An early diagnosis can be carried out through the use of specific diagnostic techniques such as x-rays, echocardiography *etc*. The goal of this study was to see if dogs with CHF go through any substantial alterations in their hematology or serum biochemistry.

Methods: The current investigation was conducted during the period April, 2020 to April 2021 at Veterinary Clinical Complex, Khanapara, Assam. Thirty four (n=34) dogs with CHF confirmed by echocardiography and eight (n=8) healthy dogs were considered for the study. Blood samples from all selected dogs were subjected to routine hematological and serum biochemical examination.

Result: The hematological assessment revealed no significant alterations. During the course of the study, there were significant alterations in the serum biochemical parameters *viz.* LDH, BUN, creatinine, AST, ALT, total serum protein, albumin and albumin: globulin ratio. Findings of the study revealed that hematology and biochemistry were more useful in ruling out CHF or in identifying concurrent diseases than diagnosing CHF itself.

Key words: Azotemia, Canine cardiac diseases, Congestive heart failure, DCM, LDH.

INTRODUCTION

Canine cardiac diseases are common, complicated and devastating for owners. Recent research has indicated a growing mortality rate and a sneaky nature in them. These diseases are now recognized as major health issues for dogs. Heart failure is estimated to be the second largest cause of mortality in dogs after cancer (Teresa, 2002). However, in India, diagnosis of canine heart disorders has been delayed or overlooked due to either owner's lack of awareness and expertise or an insufficient diagnostic facility available to field veterinarians. Congestive heart failure, the final stage of all cardiovascular diseases, is now recognized as a major health problem with potentially life-threatening consequences. The most common causes of this condition are myxomatous valvular degeneration (MVD), dilated cardiomyopathy (DCM) and pericardial disorders. The liver, kidneys, lungs and other organs are also affected by CHF resulting in a multi-organ dysfunction. Ascites, dyspnoea, exercise intolerance, coughing, syncope and tachypnoea are common clinical symptoms in animals with congestive heart failure. Electrocardiographic, radiographic and echocardiographic examinations are commonly used to diagnose congestive heart failure in animals with similar clinical symptoms (Reynolds and Oyama, 2008).

In mild cases, hematology and biochemistry panels are unremarkable, but in severe cases, enzymes and electrolytes may be abnormal and prerenal azotemia may ensue Olsen *et al.* (2010). Hence, the current study was designed to determine whether there is any substantial changes in hematological or biochemical parameters in dogs with CHF.

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MATERIALS AND METHODS

The study was carried out during the period April, 2020 to April, 2021 at Veterinary Clinical Complex, College of Veterinary Sciences, Assam Agricultural University, Khanapara, Assam, India. All the samples were collected in accordance with relevant rules approved by the Institutional Animal Ethics Committee (IAEC) and Institutional Bio-safety Committee (IBC) of College of Veterinary Science, AAU, Khanapara that follows the International guiding principles for biomedical research involving animals. Dogs presented

to VCC, College of Veterinary Science, AAU, Khanapara having symptoms of coughing, exercise intolerance, tachypnoea, syncope, dyspnoea and ascites were suspected for CHF. A thorough physical examination, routine blood tests, electrocardiography, radiography and echocardiography were performed on such suspect animals. Evidences of cardiomegaly and pulmonary edoema on radiography; mitral regurgitation, reduced systolic function, valve thickening as well as left atrial enlargement on echocardiography were the criteria's to diagnose congestive heart failures in those patients. Eight apparently healthy dogs of various ages, breeds and sexes were kept as control, while thirty-four instances of congestive heart failure, irrespective of age, breed and sex were used in the present study. For hemato-biochemical tests, approximately 5 ml of blood was taken from the cephalic or recurrent tarsal veins as per standard protocols. For the entire set of hematological tests, two ml of blood was drawn and placed in a dry vial containing 10% EDTA. Three ml of blood was transferred into serum vials taking all precautions to avoid hemolysis and serum was collected for biochemical tests (Meinkoth and Clinkenbeard, 2000). Total leucoctic count (TLC), total erythrocytic count (TEC), hemoglobin (Hb), packed cell volume (PCV) and platelet count were determined using a fully automated hematological analyzer. Blood urea nitrogen (BUN), lactate dehydrogenase (LDH), serum creatinine, alanine aminotrasferase (ALT), aspartate aminotransferase (AST), albumin, total serum proteins (TSP), albumin: globulin ratio (A:G) and serum electrolytes (sodium, potassium, chloride) concentrations were determined using specific diagnostic kits in accordance with the manufacturer's recommendations. The biochemical parameters were analysed by using a Visible Spectro-105 spectro photometer. The statistical analysis was done using SPSS software version 20 and T-test was employed to determine the significant differences if any (Snedecor and Cochran, 1994).

RESULTS AND DISCUSSION

The mean±SE values of hematological examinations (Hb, PCV, TEC, TLC and Platelets) revealed no significant alterations in CHF-affected dogs in the current investigation (Table 1). In the present investigation, the result of the hematological values in CHF affected dogs that were found within normal limits are in corroboration with the findings of earlier workers. (Tidholm and Johnsson, 1997; Sisson and Kittleson, 1999; Sisson *et al.,* 2000; Martin *et al.,* 2009 and Deepa *et al.,* 2012).

Significant changes in LDH, BUN, Creatinine, AST, ALT, total protein, albumin and albumin:globulin ratio were observed in serum biochemistry. There was a substantial increase in values of LDH, blood urea nitrogen, creatinine, ALT and AST in CHF affected dogs associated with DCM (Table 2). A similar finding was also reported by earlier workers (Tidholm and Johnson, 1996; Dhanya pai *et al.*, 2012; Deepa *et al.,* 2012 and Indhu *et al.,* 2019). Elevated blood urea nitrogen and creatinine levels in dogs with DCM are related to renal ischemia and organ congestion caused by poor cardiac output Sisson *et al.* (1999a). A rise in ALT may be caused by liver parenchymal injury. The liver parenchyma is damaged as a result of increased venous pressure in the liver caused by right sided heart failure. The mean values of LDH, AST and ALT were found significantly ($P<0.01$) higher in CHF coupled with cardiomyopathy. This finding is almost identical to that of Freeman *et al.* (1996), who observed azotemic abnormalities in five Dalmatians suffering from CHF linked with DCM at the time of diagnosis. Additionally, Benjamin, (2001) found elevated levels of AST and LDH in patients with myocardial infarction and congestive heart failure, suggesting the need of specificity in diagnosing cardiac illnesses. According to Hamm, (1994) a considerable rise in the activities of AST, Creatinine and LDH may be attributed to the hyperactivity of cardiac muscles during arrhythmias. The serum electrolytes (Na, K and Cl) values in clinical cases were within the normal range in comparison to apparently healthy dogs and, this is also in consistent with the findings of following workers (Dunn *et al.* 1999; Sisson *et al.* 2000).

Total protein and albumin levels were found to be low in dogs with CHF. These findings were in agreement with that of De Morais, (2000) and Ristic, (2004) who were of the opinion that in CHF patients routine biochemical parameters may remain within the normal range except for a decrease in the levels of TSP and albumin. Hypoprotenemia and hypoalbuminemia in the affected dogs could be attributed to liver dysfunction and increased protein loss from the intestines due to intestinal edema and poor absorption due to deceased splanchnic perfusion that occur in dogs with cardiac insufficiency (Moser, 1989; Ettinger, 2000).

Table 1: Hemogram (Mean±S.E) of dogs with CHF in comparison to healthy control animals.

Parameter	Group I (Healthy control, n=8)	Group 2 (CHF dogs, n=34)	Significance (T-Test; p<0.05)
Hb (g/dl)	14.70±1.60	13.92±0.78	NS
PCV (%)	42.50±4.41	41.40±2.95	NS
TEC (10^6/mm^3)	6.56±0.95	6.34±0.39	NS
TLC (10^3/mm^3)	13.10±0.38	13.65±0.10	NS
Platelets (10^5/mm^3)	2.25±0.47	2.03±0.35	NS

Note: Hb: Hemoglobin; PCV: Packed cell volume; TEC: Total erythrocytic count, TLC: Total leucocytic count; NS: Non-significant difference ($p>0.05$); S: Significant difference ($p<0.05$).

Table 2: Serum biochemical values (Mean±S.E) of dogs with CHF in comparison to healthy control animals.

Parameters	Group I (Healthy control, n=8)	Group 2 (CHF dogs, n=34)	Significance (T-Test; p<0.05)
LDH (U/L)	145.49±1.14	322.05±14.24	S
BUN (mg/dL)	23.21±0.89	60.45±1.64	S
Creatinine (mg/dL)	1.19±0.03	2.32±0.22	S
AST (U/L)	18.99±0.34	72.15±5.07	S
ALT (U/L)	26.88±0.71	66.88±6.71	S
Total protein (gm/dL)	7.09±0.03	5.75±0.32	S
Albumin (gm/dL)	3.64±0.01	2.19±0.13	S
Albumin : globulin	1.03±0.00	0.70±0.06	S
Sodium (mmol/L)	135.14±0.75	138.76±3.29	NS
Potassium (mmol/L)	4.21±0.01	4.16±0.16	NS
Calcium (mg/dL)	9.82±0.02	9.88±0.29	NS
Chloride (mmol/L)	109.33±0.34	106.36±2.93	NS

Note: LDH: Lactate dehydrogenase, BUN: Blood urea nitrogen, AST: Aspartate aminotransferase, ALT: Alanine aminotrasferase, S: Significant at P<0.05; NS- Non Significant at P>0.05.

CONCLUSION

Hematological analysis although revealed no significant alterations in the current investigation. A significant variation in the mean values of LDH, BUN, creatinine, ALT, AST, total protein and albumin could be seen in serum biochemical analysis. In conclusion, the enzyme LDH may be employed as a cardiac biomarker to help differentiate CHF situations. Hemato-biochemical indicators are critical for excluding concomitant disease processes and determining a patient's prognosis. A bigger sample size is needed to further establish the clinical significance of these measures as diagnostic and/or prognostic biomarkers. Nonetheless, this is one of the few studies in the available literature that examines the significance of LDH and other biochemical indicators in the pathogenesis and diagnosis of heart disorders in dogs.

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Conflict of interest: None.

REFERENCES

Benjamin, M.M. (2001). Cardiovascular Disease Tests. Outline of Veterinary Clinical Pathology, 3rd edn., Kalyani Publishers, New Delhi, pp: 265-269.

De Morais, H.A. (2000). Heart Failure and Cardiac Function. In: Textbook of Veterinary Internal Medicine, [Ettinger, S.E. and Feldman, F.C. (eds)], 5th edn. W.B. Saunders Co. Philadelphia. pp: 693-713.

Deepa, C., Anju, A., Ajithkumar, S., Alex, P.C. (2012). Cardiomyopathy in a Doberman Pinscher. The Indian Veterinary Journal. 89: 83-84.

Dhanya Pai, V., Usha, N.P., Alex, P.C. (2012). Haemato-biochemical and therapeutic studies on Dilated Cardiomyopathy in dogs. Indian Journal of Veterinary Medicine. 32(2): 71-74.

Dunn, J.K., Eilliott, J., Heritage, M.E. (1999). Diseases of Cardiovascular System. In: Text Book of Small Animal Medicine. [Dunn, J.K., (edn)]. Saunders W.B., Philadelphia, pp: 256-288.

Ettinger, S.J. (2000). Dietary Modifications in Cardiac Disease. In: Textbook of Veterinary Internal Medicine, [Ettinger, S.E. and Feldman, F.C., (eds)]: 5th edn, W.B. Saunders Co., Philadelphia, pp: 262-269.

Freeman, L.M., Michel, K.E., Brown, D.J., Kaplan, P.M., Stamoulis, M.E., Rosenthal, S.L., Keene, B.W., Rush, J.E. (1996). Idiopathic dilated cardiomyopathy in Dalmatians: Nine cases (1990-1995). Journal of American Veterinary Medical Association. 209: 1592-1596.

Hamm, C.W. (1994). Cardiac enzymes. New England Journal of Medicine. 331: 607-609.

Indhu, M.S., Sesh, P.S.L., Loganathasamy, K., Jeyaraja, K., Padmanath, K., Pandiyan, V. (2019). Analysis of certain blood biochemical parameters in relation to oxidative stress in chronic mitral valve insufficiency of dogs with heart failure. Indian Journal of Animal Research. 53(9): 1181-1187.

Martin, M.W.S., Stafford Jhonson, M.J., Celona, B. (2009). Canine dilated cardiomyopathy: A retrospective study of signalment, presentation and clinical findings in 369 cases. Journal of Small Animal Practice. 50: 23-29.

Meinkoth, J.M. and Clinkenbeard, K.D. (2000). Normal Hematology of the Dog. Schalm's Veterinary Hematology, 5th edition, [(eds). Fieldman, R.W., Zinkl, J.G. and Jain, N.C.] Wolters Kluwer Company. Philadelphia. pp: 1057-1063.

Moser, E. (1989). Dietary management of congestive heart failure. Veterinary Medicine. 84: 518-524.

Olsen, L.H., Haggstrom, J., Petersen, H.D. (2010). Aquired Valvular Heart Disease. In: Textbook of Veterinary Internal Medicine, [Ettinger, S.E. and Feldman, F.C., (eds)], 7th edn., W.B. Saunders Co., Philadelphia, pp: 1299-1319.

Reynolds, C. and Oyama, M.A. (2008). Biomarkers in the diagnosis of canine heart disease. Veterinary Focus. 18: 2-6.

Ristic, J. (2004). Clinical assessment of the dog with suspected cardiac disease. In. Practice. 26: 192-199.

Sisson, D.M., Grady, R.O., Calvert, C.A. (1999a). Myocardial Diseases of Dogs: Principles and Clinical Practice. W.B. Saunders, Philadelphia. pp: 558-582.

Sisson, D. and Kittleson, M.D. (1999). Management of Heart Failure: Principles of Treatment Therapeutic Strategies and Pharmacology. In: Text Book of Canine and Feline Cardiology. [Fox, P.K. (ed.)], Saunders W.B., Philadelphia. pp: 582-597.

Sisson, D., Thomas, W.P., Keene, B.W. (2000). Primary Myocardial Disease. In: Text Book of Veterinary Internal Medicine, [Ettinger, E.J. and Feldman, S. (ed.)], 5th edn., Saunders WB Philadelphia. pp: 874-891.

Snedecor, G.W. and Cochran, W.G. (1994). Statistical Methods. 8th Edn. IOWA State University Press, USA. pp: 506-523.

Teresa, D.F. (2002). Advanced discussions in the diagnosis of heart failure. Walt Focus. 12: 3-11.

Tidholm, A. and Johnsson, L. (1996). Dilated cardiomyopathy in the Newfound land: A study of 37 cases (1983-1994). Journal of American Hospital Association. 32: 465-470.

Tidholm, A. and Jonsson, L. (1997). A retrospective study of canine Dilated Cardiomyopathy (189 cases). Journal of American Hospital Association. 33: 540-544.