ELECTROCARDIOGRAPHIC STUDIES IN CONGESTIVE HEART FAILURE IN DOGS

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ABSTRACT

Electrocardiographic abnormalities in dogs with congestive heart failure presented to Veterinary College, Bangalore were studied. Abnormalities included rhythm and morphological changes. The abnormalities of rhythm were seen in 49 cases and they were sinus and ventricular tachycardia, atrial flutter and fibrillation, atrial and ventricular premature complexes and right bundle branch block. The abnormalities of morphology pattern in 17 dogs were tall R and T waves, deep Q and S waves, small R waves and ST segment sagging.

KEYWORDS: Dog, congestive heart failure, electrocardiography

INTRODUCTION

Electrocardiography is useful in the clinical evaluation of arrhythmias, conduction disturbances and the status of the myocardium (Cohen, 1983; Tilley, 1992). Boswood (2001) has reported that cardiac arrhythmias are commonly discovered in veterinary patients. These animals may be suffering from cardiac disease, non-cardiac disease or may be apparently normal. The finding of supraventricular or ventricular premature complexes or tachycardia is compatible with heart failure, but is not exclusive to a diagnosis of heart failure. The main indication for performing electrocardiography is to categorise arrhythmias noted during clinical examination (Ristic, 2004).

MATERIALS AND METHODS

This study was taken up during the year 2014 at the Veterinary College Hospital, Bangalore on dogs that were presented as primary cases or were referred by other veterinarians. Dogs were suspected to be suffering from congestive heart failure (CHF) based on history and clinical signs like cough, ascites, exercise intolerance, dyspnea, syncope and cyanosis. These cases were subjected to a thorough physical examination (including auscultation of heart and lung), routine hematology and blood biochemical analysis, electrocardiography, radiography and echocardiography to confirm the presence of CHF as well as other diseases.

Electrocardiograms (ECG) were recorded from bipolar and unipolar limb leads with the animal in right lateral recumbency. In animals with orthopnea or dyspnea, ECG was recorded in the standing or sitting position.MAC 400 (Wipro GE Healthcare Pvt. Ltd., Bangalore), 3 channel, 12 lead electrocardiograph was used to record the electrocardiograms. The electrocardiograph recording paper (Marquette Hellige Medical systems), a thermosensitive paper of a recording width of 75 mm was used. An electrically conductive gel (Medietech , Kardia Cares, Chennai) was used as a conducting medium for application of electrodes. Commercially available crocodile clips used for connecting electrical circuits were modified and used to connect the electrodes of the electrocardiograph to the skin. Recording was done at the speed of 25 mm/s and amplitude of 1 mV = 1 cm unless stated otherwise.

RESULTS AND DISCUSSION

A total of 78 dogs were diagnosed with congestive heart failure during the study period. Arrhythmia was seen in 49 cases and abnormal morphology of the complexes in 17 cases. Table 1 and 2

interprets the electrocardiographic findings. Two dogs which had sinus tachycardia at the first visit developed atrial fibrillation by the second visit. Twelve dogs did not have any ECG changes.

Standing or sternal recumbency position was used in dyspnoeic and orthopnoeic dogs even though the standard position for recording ECG is right lateral recumbency. Changing the position can lead to some alteration in the morphology of the complexes recorded. However this was not clinically important and the rhythm, which is the most important aspect of the recording, will remain unaffected (Johnson, 2008).

Table 1: Arrhythmias in CHF dogs (n=49)

Abnormal rhythm	No. of dogs	% of abnormal rhythm
Sinus tachycardia	29	59.18
Atrial fibrillation	14	28.57
Ventricular premature complexes	2	4.09
Atrial flutter	1	2.04
Ventricular tachycardia	1	2.04
Right bundle branch block	1	2.04
Premature atrial contraction	1	2.04
Total	49	100

Table 2: ECG abnormal morphology in CHF dogs (n=17)

Abnormal morphology	No. of dogs	% of abnormal morphology
Tall R waves	7	41.2
Tall T waves	5	29.1
Short R waves	2	11.7
Deep Q	1	6
Deep S	1	6
ST segment sagging	1	6
Total	17	100

Sinus tachycardia was the most common abnormality in the present study which occurs at an elevated rate caused by sympathetic predominance over parasympathetic inputs (Cote, 2010). Sinus tachycardia may be physiological or pathological and its mere presence, even though should raise suspicion, will not confirm cardiac problems.

Atrial fibrillation was the second most common abnormality as reported in earlier studies as a commonly observed arrhythmia (Moise, 1999; Tidholm et al., 2001; Sleeper et al., 2002). Saunders et al., 2009 have reported that the hemodynamic consequences of atrial fibrillation include decreased cardiac output and the development of clinical signs of heart failure.

Ventricular premature complexes (VPCs) were observed in 2 cases. VPCs are the most common of all pathologic rhythm disturbances in dogs. Causes of VPCs include any cardiac or systemic

disorder, with the most common being primary cardiac diseases as cardiomyopathy and valvular heart disease (Cote, 2010). The VPCs found in the present study were isolated complexes. Since such isolated complexes do not cause hemodynamic abnormalities, no specific treatment is attempted for controlling this arrhythmia.

Atrial flutter seen in one dog was recognised as a rapid and regular series of atrial depolarizations and this occurs due to a micro-re-entry pathway (Cote, 2010).Ventricular tachycardia was seen in one Labrador Retriever even though they are very common in Dobermans as stated by Moise (1999) and Tidholm et al., (2001). Right bundle branch block (RBBB) was seen in one dog. RBBB was differentiated from ventricular tachycardia by the presence of a P wave preceding every QRS as described by Cote (2010). Premature atrial contraction was seen in one dog and was characterised by P on T phenomenon as described by Tilley (1992).

Increased height of R waves was seen in 7 dogs. This change may indicate left ventricular enlargement and cardiomegaly (Tilley, 1992; Cote, 2010). In this study, ECG was not a very sensitive indicator of myocardial mass as 51 cases had cardiomegaly by thoracic radiography and only7 cases had tall R waves in ECG recording.

Tall T waves, i.e. amplitude of T being more than one fourth the R wave were seen in 5 dogs. Myocardial disease or electrolyte abnormalities may cause T wave changes as described by Tilley (1992). In those 5 cases, serum sodium and potassium levels were within normal range, indicating T wave changes to be due to myocardial involvement. Deep Q (> 0.5 mV in Lead II) and deep S (in Leads I, II, III and aVF) observed in the ECG of two dogs were suggestive of right ventricular enlargement or hypertrophy.These findings correlated clinically by the presence of ascites in such dogs. Short R waves, i.e. less than 0.5 mV was observed in two dogs. Consistently low-amplitude R waves suggest pericardial or pleural effusion or obesity. In the present study, one dog with pleural effusion had small R waves and in the other, obesity was the cause of the change in the dog's ECG. ST segment sagging was seen in one dog. ST segment depression may be associated with myocardial hypoxia, nonspecific electrolyte changes, or cardiac hypertrophy (Cote, 2010). But in this dog, non-specific electrolyte changes were ruled out as serum sodium and potassium remained within normal levels (sodium 145 mg/dL and potassium 4 mg/dL).

Even though the ECG is an invaluable tool in the diagnosis of cardiac problems (when arrhythmias are present), it has many limitations. The ECG is not usually an accurate guide to heart size. If cardiomegaly is suspected, other tests particularly radiology should be considered (Schober et al., 2010). A CHF dog may have a normal ECG, as seen in this study (12 dogs had normal ECG) and a perfectly normal animal may show nonspecific ECG abnormalities. Therefore one should avoid reading too much into borderline changes. Serial tracings over a period of time are of greater value in evaluating the functional status of heart as suggested by Tilley (1992); Johnson (2008) and Cote (2010).

REFERENCES :

Boswood, A. (2001). *In. Pract.,***23**: 63-73.

Cohen, R. B. (1983). *et. Clin. North. Am.: Small. Anim. Pract.,***13**: 217-240.

Cote, E. (2010). Electrocardiography and cardiac arrhythmias. In Ettinger, S. E. and Feldman, F. C., (eds): *Textbook of Veterinary Internal Medicine*, 7th edn, W. B. Saunders Co., Philadelphia, pp 1159-1187.

Johnson, M. (2008). *Vet. Focus*, **18** (3): 47-48

Moise, N.S. (1999). *Cardiovascular Res*., **44**(1): 37-46.

Ristic, J. (2004). *In. Pract.,* **26**: 192-199.

Saunders, A., Gordon, S. and Miller, M. (2009). Canine atrial fibrillation. *Compend. Contin. Educ.Vet*., 31(11): E1-9

Schober, K.E., Hart, T.M., Stern, J.A., Li, X., Samii, V.F., Zekas, L.J., Scansen, B.A. and Bonagura, J.D. (2010). Detection of congestive heart failure in dogs by Doppler Echocardiography. *J. Vet. Intern. Med.* 24: 1358–1368

Sleeper, M. M., Henthorn, P. S., Vijayasarathy, C., Dambach, D. M., Bowers, T., Tijskens, P., Armstrong, C. F. and Lankford, E. B. (2002). *J. Vet. Intern. Med*., **16**: 52–62

Tidholm, A., Häggström, J., Borgarelli, M. and Tarducci, A. (2001). *The. Vet. J.*,**162**: 92-107.

Tilley, L. P. (1992). In Tilley, L. P., (ed): *Essentials of canine and feline electrocardiography*, 3rd edn, Lea and Fabinger, Philadelphia.

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