Correlation of heart rate and body weight with various electrocardiographic and echocardiographic parameters in indigenous breeds of dogs

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ABSTRACT

The current study was aimed to study the correlation of heart rate and body weight with various electrocardiographic and echocardiographic parameters in indigenous breeds of dogs of Tamil Nadu such as Rajapalayam and Chippiparai. The dogs are known for their skill, companionship and their adaptation to the country's tropical climate. Study population consisted of 24 overtly healthy Rajapalayam (n=12) and Chippiparai (n=12) dogs, sight-hound breeds of Tamil Nadu. After recording the relevant parameters, the values were correlated statistically and results obtained.

Key words: Electrocardiography, Echocardiography, Indigenous dog breeds

INTRODUCTION

The goal in the diagnosis of diseases was to make a complete diagnosis with the fewest diagnostic procedures that are non-invasive or minimally invasive. Numerous modalities had been developed for diagnosis of cardiac disorders, which included angiography, cardiac catheterization, endomyocardial biopsy, nuclear cardiology, pneumoperi cardiography, electrocardiography, thoracic radiography, echocardiography and haemato-biochemical parameters (Gugjoo, 2011).

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India has a rich canine genetic resource, besides the vast wealth of livestock germplasm. Indigenous canine breeds like Rajapalayam, Chippiparai, Mudhol hound, Rampur hound, Caravan hound, Banjara hound and Jonangi are well known. Of these, Rajapalayam and Chippiparai are the indigenous breeds of Tamil Nadu. But due to inflow of exotic canine breeds, the indigenous dogs had not received any attention from scientists (Karthickeyan *et al.,* 2015).

Electrocardiography (ECG), a non-invasive and relatively inexpensive technique was found to be the useful tool in diagnosing cardiac arrhythmias and provided information about the status of myocardium (Tilley, 1992). Echocardiography has evolved as the most promising tool in the study of anatomy, physiology and diagnosis

of disease related to heart. It is considered as a gold standard in diagnosis of cardiac diseases (Dudas-Gyorki *et al.,* 2011).

Although variation in heart rate and body weight could explain differences in dog breeds, the effect of heart rate on various electrocardiographic parameters and body weight on echocardiographic parameters was observed in few exotic breeds of dogs by Bayon *et al.* (1994), Hanton *et al.* (1998) and Lonsdale *et al.* (1998).

Hence this study was aimed to study the correlation of heart rate and body weight with various electrocardiographic and echocardiographic parameters in indigenous breeds of dogs.

MATERIALS AND METHODS

The study was carried out on 24 overtly healthy Rajapalayam and Chippiparai breeds of dogs brought to Madras Veterinary College teaching hospital with the consent of the owner. Those dogs with vital parameters within the established reference range were considered to be clinically healthy and subjected for further evaluation.

Electrocardiography was carried out using RMS VESTA 301i Electrocardiograph using Lead II of standard bipolar limb lead system and subjective assessment of the Electrocardiogram (ECG) reading was done to ensure that the parameters were within the normal reference range for dogs (Tilley, 1992).

Esoate MyLab 20 ultrasound machine with a cardiac probe of 6MHz was used for recording the echocardiographic studies. Two dimensional echocardiographic images were recorded and stored for further evaluation. 2D echocardiography was done at right and left parasternal long axis view at fourth / fifth intercostal space ventrally between the sternum and costochondral junction (Thomas *et al,* 1993).

SPSS® 20.0 for Windows was used for statistical analysis of data. Pearson's correlation coefficient was used to obtain correlation of heart rate and body weight with various electrocardiographic and echocardiographic parameters and regression equation derived.

RESULTS

Correlation of Heart Rate with Electrocardiographic Parameters

Negative correlation was observed between heart rate and heart weight in case of Rajapalayam dogs ($P<0.01$) and Chippiparai dogs ($P<0.05$). All the other parameters showed no correlation with regard to heart rate (Table 1).

Correlation of 2D Echocardiographic parameters with Body weight

In the present study, the above 2D Echocardiographic parameters were correlated with body weight of Rajapalayam and Chippiparai dogs. Linear regression analysis was done and regression equation was obtained for these parameters with body weight.

In Rajapalayam dogs, Left ventricular diameter at diastole and systole (LVDd and LVDs) showed high positive correlation with body weight. Left atrial posterior wall thickness in systole (LAPWs) and Right

ventricular diameter (RVD) values showed positive correlation with body weight, whereas, Heart rate (HR) and Aortic root diameter (AO) were found to be having high negative correlation in relation with body weight. Statistical analysis revealed no significant correlation between Left ventricular posterior wall thickness at diastole and systole (LVPWd, LVPWs), Interventricualr septal thickness at diastole and systole (IVSd, IVSs), Aortic area (AOA), Left atrial diameter in diastole and systole (LADd, LADs), Left atrial posterior wall thickness in diastole (LAPWd) and Right ventricular posterior wall thickness (RVPW) with body weight (Table 2).

In Chippiparai dogs, HR and IVSs values showed positive correlation with body weight, whereas, RVDd was found to be having high negative correlation in relation with body weight. Statistical analysis revealed no significant correlation between LVDd, LVDs, LVPWd, LVPWs, IVSd, AO, AOA, LADd, LADs, LAPWd, LAPWs and RVPW with body weight (Table 3).

DISCUSSION

Correlation of Heart Rate with Electrocardiographic Parameters

Though, the values of heart rate were within the normal range (upto 220 bpm for puppies and 70-160 bpm for adult dogs) given by Tilley (1992), there was high significant difference observed between young and adult age groups which might be due to increase in body weight.

The difference in body weight could also affect the heart rate (Vailati *et al.,* 2009) as there is large basal metabolic rate in animals of higher surface area (small body weight compared to the animals with small surface area (large body weight). Regarding body weight and heart rate similar findings were reported by Ferasin *et al.* (2010) and Gugjoo *et al.* (2014).

Another possible reason for difference in heart rate could be the effect of adrenergic system on heart rate (Bavegems *et al.* 2009).

Negative correlation was observed between heart rate and heart weight in case of Rajapalayam dogs ($P<0.01$) and Chippiparai dogs ($P<0.05$). All the other parameters (P wave amplitude, P wave duration, R wave amplitude, QRS interval, and PR interval) showed no correlation with regard to heart rate. This is in contrast to the findings of Hanton and Rabemampianina (2006) where positive correlation observed in P wave amplitude and negative correlation in PR interval.

Correlation of 2D Echocardiographic parameters with Body weight

LVDs is determined by the degree of myofibre shortening which, inturn is affected by the ionotropic state of the myocardium and by afterload. LVDd and LVDs were found to be positively correlated with body weight in Rajapalayam dogs as reported in previous studies of O'Leary *et al.* (2003) and Muzzi *et al.* (2006). This might be due to increase in cardiac size in relation with increased body weight of animals. As cardiac size increases, the left ventricular internal diameter may also increase.

In the present study, no significant correlation was observed between body

weight and IVS in both Rajapalayam and Chippiparai dogs, whereas, positive correlation was reported by Gooding *et al.* (1986), Lombard (1984), Sisson and Schaeffer (1991), Bayon *et al.* (1994) and Kayar *et al.* (2006). Page *et al.* (1993) found a weak relationship between body weight and IVS.

Larger AO diameter in younger animals might be due to increased physical activity as reported by Snoeckx *et al.* (1982) and Vanoverschelde *et al.* (1993). Pearson's correlation revealed high negative relation with body weight in case of Rajapalayam dogs and no correlation in Chippiparai dogs. This is in contrast to the findings of Boon *et al.* (1983), Kayar and Uysal (2004) and Kayar *et al.* (2006) who had reported a positive correlation between aortic diameter and body weight.

Correlation of LAD/AO ratio with body weight revealed there was significant relation in Rajapalayam breed. A similar finding was recorded by Vollmar (1999) who reported that a significant increase in Left atrial dimension resulted in increased LAD/AO ratio with advance in age due to reduction in Aortic root dimension. However, the present finding was in contrast with the findings of Kayar *et al.* (2006) and Saxena (2008).

High negative correlation was observed for RVD in relation with body weight in Chippiparai dogs whereas positive correlation reported n Rajapalayam breed.

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Table 1 Correlation of heart rate with various electrocardiographic parameters in Rajapalayam and Chippiparai

Parameters	Rajapalayam (n=12)	Chippiparai (n=12)
P amplitude (mV)	-0.33 NS	0.25 NS
R amplitude (mV)	0.46 NS	-0.52 NS
P duration (sec)	-0.17 NS	0.16 NS
PR interval (sec)	0.21 NS	0.06 NS
QRS interval	-0.20 NS	0.21 NS
Heart Weight (g)	-0.75**	-0.63*

NS - No significant correlation between HR and ECG parameters (P>0.05)

* - Significant correlation between HR and ECG parameters (P<0.05)

** - Significant correlation between HR and ECG parameters (P<0.01)

Table 2 Correlation of body weight with various 2D echocardiographic parameters in Rajapalayam dogs

Parameters	Rajapalayam (n=12)	Regression Equation	R^2
LVDd (cm)	0.94**	37.09 (x) - 83.50	0.89
LVDs (cm)	0.88**	81.91 (x) -180.82	0.80
LVPWd (mm)	0.31 NS	1.82 (x) +11.49	0.09
LVPWs(mm)	0.14 NS	0.87 (x) + 19.86	0.01
IVSd (mm)	0.54 NS	4.63 (x) - 9.14	0.29

IVSs (mm)	0.19 NS	2.64 (x) + 8.20	0.05
LADd (cm)	-0.29 NS	-8.52 (x) +47.17	0.06
LADs(cm)	-0.14 NS	-4.02 (x) + 34.86	0.01
AO (cm)	-0.73**	-27.24 (x) + 89.51	0.51
AOA (cm^2)	-0.36 NS	-5.42 (x) + 47.71	0.12
LAPWd (mm)	0.45 NS	9.28 (x) -16.06	0.19
LAPWs (mm)	0.65*	12.66 (x) -24.37	0.41
RVD (cm)	0.69*	19.47 (x) - 17.48	0.48
RVPW (mm)	0.31 NS	2.58 (x) + 9.33	0.09

NS - No significant correlation between body weight and parameters (P>0.05)

* - Significant correlation between body weight and parameters (P<0.05)

** - Significant correlation between body weight and parameters (P<0.01)

Table 3 Correlation of body weight with various 2D echocardio graphic parameters in Chippiparai dogs

Parameters	Chippiparai (n=12)	Regression Equation	R^2
LVDd (cm)	0.03 NS	0.28 (x) + 13.97	0.41
LVDs (cm)	0.02 NS	0.16 (x) + 14.23	0.01
LVPWd (mm)	-0.26 NS	-2.25 (x) +30.99	0.07
LVPWs (mm)	-0.31 NS	-2.95 (x) +35.52	0.10
IVSd (mm)	0.00 NS	-0.12 (x) + 15.34	0.00
IVSs (mm)	0.69*	2.90 (x) - 2.39	0.48
LADd (cm)	0.39 NS	2.94 (x) + 9.71	0.15
LADs (cm)	0.51 NS	4.72 (x) + 8.76	0.27
AO (cm)	0.53 NS	7.68 (x) + 1.21	0.28
AOA (cm^2)	0.51 NS	2.60 (x) +8.12	0.26
LAPWd (mm)	-0.37 NS	-10.23 (x) + 29.23	0.14
LAPWs (mm)	-0.40 NS	-9.76 (x) + 25.46	0.16
RVD (cm)	-0.86**	-7.47 (x) + 29.23	0.73
RVPW (mm)	0.34 NS	2.12 (x) + 3.15	0.11

NS - No significant correlation between body weight and parameters (P>0.05)

* - Significant correlation between body weight and parameters (P<0.05)

** - Significant correlation between body weight and parameters (P<0.01)