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Research Article

Electrocardiographic and Echocardiographic Parameters in Indigenous Dog Breed (Rajapalayam) of Tamil Nadu

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Abstract

The study was aimed to record electrocardiographic parameters using standard bipolar limb II system and measurements of various chambers of heart by 2D echocardiography. Study population consisted of 36 overtly healthy young (n = 18) and adult (n = 18) Rajapalayam dogs, an indigenous, sight-hound breed of Tamil Nadu. After recording the relevant parameters, the values were compared between young and adult dogs and statistically analyzed. Mean ± SE of heart rate was 177.70 ± 6.61 and 248.32 ± 12.49 beats/min in young and adult dogs respectively. There was significant difference in R wave amplitude (mV), QRS interval (sec), Heart rate (beats/min) and Heart weight (g) between young and adult age groups. 2D echocardiographic parameters such as diastolic and systolic left ventricular diameter (cm), aortic root diameter (cm) and right ventricular diameter showed significant variation between young and adult age groups in Rajapalayam dogs.

Keywords: *Electrocardiography; Echocardiography; Cardiac Measurements; Indigenous Dog; Rajapalayam*

Abbreviations

2DE: Two Dimensional Echocardiography; AO: Aortic Root Diameter; LVDs: Left Diameter at Diastole; AOA: Aortic Area; bpm: Beats Per Minute; cm: Centimeter; ECG: Electrocardiograph; IVSd: Interventricular Septal Thickness at Diastole; IVSs: Interventricular Septal Thickness at Systole; LADd: Left Atrial Diameter in Diastole; LADs: Left Atrial Diameter in Systole; LAPWd: Left Atrial Posterior Wall Thickness in Diastole; LAPWs: Left Atrial Posterior Wall Thickness in Systole; LVDd: Left Ventricular Diameter at Systole; LVPWd: Left Ventricular Posterior Wall Thickness at Diastole; LVPWs: Left Ventricular Posterior Wall Thickness at Systole; MHz: Mega Hertz; mm: Millimeter; mV: Milli Volt; °C: Degree Celsius; RVD: Right Ventricular Diameter; RVPW: Right Ventricular Posterior Wall Thickness; SE: Standard Error

Introduction

Normal cardiovascular function is essential for life and health. Hence, evaluation of heart is considered to be an important clinical variable and variations in cardiac size may be used to diagnose various cardiac diseases. However, a normal cardiac size does not rule out the presence of cardiovascular abnormality [1].

The electrocardiograph (ECG) is a graphic record of the heart's electrical activity plotted over time. It is a very useful test, easy to perform and readily available. ECG helps to rule out arrhythmias during clinical examination. ECG electrodes attached at multiple sites of the body records electrical activity of the heart from multiple angles. The standard bipolar lead II system measures the P-QRS-T waveform [2].

Echocardiographic techniques is used to image two-dimensional slices of the heart (B-mode). It is considered as gold standard in diagnosis of cardiac diseases. Being non-invasive diagnostic modality, is the main advantage to assess structure and function [3]. Though, it is reported that gender did not have an important effect on echocardiographic measurements in most of the breeds, variations due to breed, age and body weight occur. Hence, care should be taken before interpreting the echocardiographic findings [4].

India has a rich canine genetic resource, besides the vast wealth of livestock germ plasm. Indigenous canine breeds like Rajapalayam, Chippiparai, Mudhol hound, Rampur hound, Caravan hound, Banjara hound and Jonangi are well known. Of which, Rajapalayam and Chippiparai are indigenous breeds of Tamil Nadu. But due to inflow of exotic canine breeds, the indigenous dogs had not received any attention from scientists [5].

Rajapalayam is a medium sized, sight-hound breed of South India. It is described as the companion of royalty and aristocracy in southern India, particularly in the town of Rajapalayam in Virudhunagar district and also known as Paleiyakaran and Poligar hound. The characteristic features of Rajapalayam were pristine white coat, pink nostrils, golden brown eyes, semidrooping or pendant ears, broad chest and tucked up abdomen (Figure 1) giving the appearance of hound type of dog [6].

Figure 1: *Photograph of adult Rajapalayam dog.*

Reference values for Electrocardiographic and Echocardiographic measurements have been determined for various dog breed in the world. But there is little or no work on cardiac anatomy in Indigenous breeds of Tamil Nadu such as Rajapalayam. Hence, the present study was aimed with the objective to assess the cardiac structural changes including major blood vessels using electrocardiography and 2D echocardiography in Rajapalayam breed of dog.

Materials and Methods

The study was carried out on 36 overtly healthy Rajapalayam breeds of dogs brought to Madras Veterinary College teaching hospital with the consent of the owner. The dogs were grouped into two as young/puppy (from 1 to 6 months) and adult (6 months and above). Each group consisted of eighteen animals.

All the animals were subjected to screening initially to ascertain that they were clinically healthy by physical examination and clinical examination. The history and signalments were noted. A thorough physical examination was carried out and vital parameters like respiration rate (per minute), heart rate (beats per minute), rectal temperature (°C) were recorded. 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 [7].

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 [8].

SPSS® 20.0 for Windows was used for statistical analysis of data. The data obtained from various electrocardiographic parameters were subjected to Mean ± SE and independent sample test or t-test for equality of means.

Results

Electrocardiography

Mean ± SE of various ECG parameters such as P wave amplitude (mV), R wave amplitude (mV), P wave duration (sec), PR interval (sec), QRS interval (sec) and Heart rate (beats/min) were recorded using Lead II of standard bipolar limb lead system. Heart weight (g) was calculated with QRS interval (Hs) and body weight (Bw) by using Steel's formula (Hw = (3.2 x Hs) + (6.1 x Bw) – K) (Table 1). Statistical analysis was performed for comparison of two age groups was recorded (Table 1).

Parameters	Mean ± SE		t value
	Young	Adult	
P amplitude (mV)	0.17 ± 0.03	0.16 ±0.03	0.19 ^{NS}
R amplitude (mV)	0.55 ± 0.06	0.88 ±0.10	2.88*
P duration (sec)	0.02 ± 0.00	0.03 ±0.00	1.84 ^{NS}
PR interval (sec)	0.10 ± 0.01	0.10 ±0.01	0.15 ^{NS}
RS interval (sec)	0.03 ± 0.00	0.04 ± 0.00	2.21*
HR (beats/min)	177.0 ± 6.15	147.0 ± 6.67	3.31**
Heart Weight (g)	177.70 ± 6.61	248.32 ± 12.49	9.24**

Table 1: *Mean ± SE of various ECG parameters in Rajapalayam dogs.*

^{NS}*: No significant difference between young and adult age groups (P > 0.05).*

**: Significant difference between young and adult age groups (P < 0.05).*

***: Significant difference between young and adult age groups (P < 0.01).*

2D Echocardiography

Mean ± SE of all the 2D echocardiographic parameters such as left ventricular diameter during diastole and systole (LVD) (cm), left ventricular posterior wall thickness (Figure 2) during systole and diastole) (LVPW) (mm), interventricular septal thickness during systole and diastole (IVS) (mm), left atrial diameter (LAD) (cm), aortic root diameter (AO) (cm), aortic area (AOA) (cm^2), left atrial posterior wall

thickness (LAPW) (mm), LAD/AO ratio, right ventricular diameter (RVD) (cm), right ventricular posterior wall thickness (RVPW) (mm) were given in table 2.

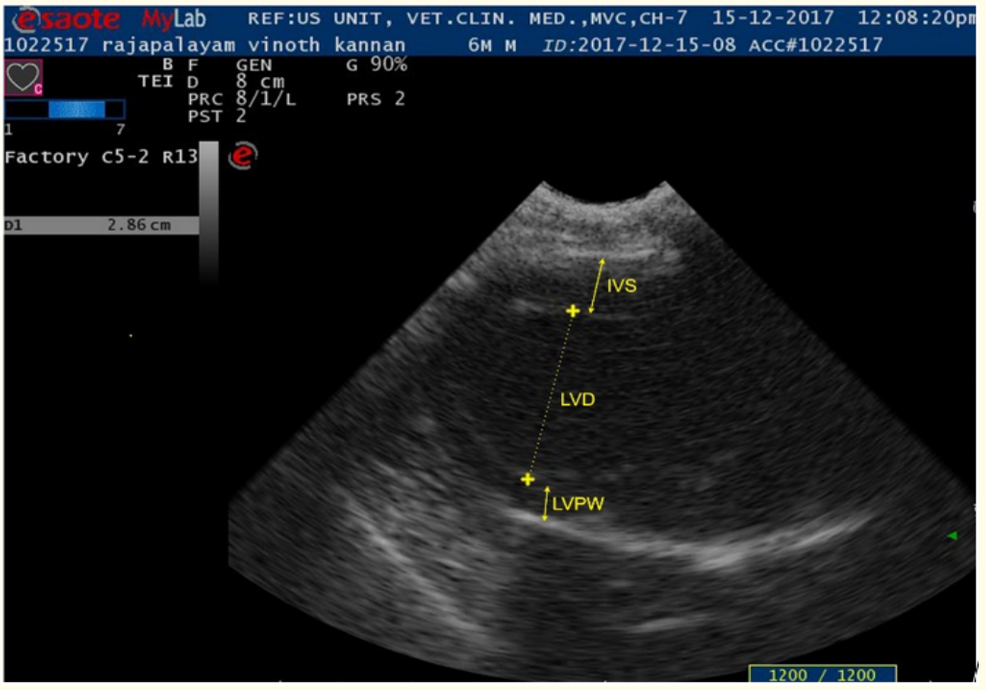

Figure 2: *Two dimensional echocardiographic image-Right long axis view of left ventricle. IVS: Interventricular Septum; LVD: Left Ventricle Diameter; LVPW: Left Ventricular Posterior Wall.*

Parameters	Mean ± SE		t value
	Young	Adult	
LVDd (cm)	2.77 ± 0.02	3.14 ± 0.06	6.17**
LVDs (cm)	2.46 ± 0.02	2.60 ± 0.03	4.55**
LVPWd (mm)	7.26 ± 0.09	7.93 ± 0.65	1.78 NS
LVPWs(mm)	7.26 ± 0.09	7.93 ± 0.65	1.01 NS
IVSd (mm)	7.40 ± 0.05	7.96 ± 0.58	0.97 NS
IVSs (mm)	6.97 ± 0.04	6.88 ± 0.42	0.23 NS
LADd (cm)	2.53 ± 0.03	2.35 ± 0.14	1.30 NS
LADs(cm)	2.15 ± 0.01	2.04 ± 0.14	0.84 NS
AO (cm)	2.48 ± 0.02	2.18 ± 0.10	2.83*
AOA (cm^2)	4.06 ± 0.02	3.81 ± 0.32	0.784 NS
LAPWd (mm)	4.43 ± 0.02	4.72 ± 0.23	1.27 NS
LAPWs (mm)	3.77 ± 0.01	4.22 ± 0.22	1.99 NS
LAD/AO	1.02 ± 0.05	1.10 ± 0.06	0.54 NS
RVD (cm)	2.07 ± 0.02	2.42 ± 0.15	2.35*
RVPW (mm)	6.37 ± 0.01	6.86 ± 0.58	0.85 NS

Table 2: *Mean ± SE of various 2D echocardiographic parameters in Rajapalayam dogs.*

NS: No significant difference between young and adult age groups (P > 0.05).

**: Significant difference between young and adult age groups (P < 0.05).*

***: Significant difference between young and adult age groups (P < 0.01).*

T-test for equality of means was performed to detect the significant difference between the two age groups studied (young and adult). High significant difference ($P < 0.01$) was observed in case of both LVDd and LVDs in Rajapalayam dogs between the age groups. AO and RVD also showed significant difference ($P < 0.05$) between young and adult groups. Whereas, no significant difference was observed between two age groups for rest of the parameters measured.

Discussion

Electrocardiography

P wave amplitude is the first deflection on ECG and represents depolarization of atria which spreads radially from sinoatrial node to the right atrium, then to the left atrium [9,10]. Analysis of P wave amplitude data revealed that there was no change in size of right atrium between the groups [11]. A similar value was observed in German Shepherd, Cocker Spaniel, Labrador and Pug [10,12]. Whereas, significantly higher P wave amplitude value was recorded in Beagle (0.255 ± 0.54 mV) [13]. Increase in P wave amplitude is an indicator of right atrial enlargement. Tall P waves are seen in Right atrial hypertrophy and/or dilatation. Increase in the later portion of the P wave in lead II indicates left atrial enlargement [7].

R wave is the first positive deflection in QRS complex in lead II. The present study revealed lower R wave amplitude in young age group when compared to adult age groups. However, the R wave amplitude was within the reference range of less than 3.0 mV [7]. R wave is the most commonly used clinical measurement of the left ventricular function and considered as a good indicator of ventricular compliance and contractility. A similar report was observed in Doberman, Pomeranian and Rottweiler [14]. Whereas, higher R wave amplitude (1.65 ± 0.552) was recorded in healthy adult German Shepherd dogs [12].

In the present study, increased R wave amplitude in adult dogs might be due to increased left ventricular depolarization when compared to young age group. An enlarged ventricle with an increased surface area and thickened wall produces greater potential [7]. A similar observation was made by in Beagles [15] and Mastin Espanaol dogs aged between one day to three years [16].

Mean ± SE values for P wave duration did not exceed the normal reference range of 0.04 seconds [7]. A similar observation was recorded in Whippets [17]. Accurate analysis of P-wave duration, amplitude, and morphology is crucial in identification of morphologic and functional changes of the atria [18].

The mean ± SE values of PR interval was similar in both young and adult age groups in dogs [19]. PR interval represents the time frame from the beginning of atrial depolarization to the beginning of ventricular depolarization.

QRS interval represents the duration of ventricular depolarization. Though there was a significant difference observed between young (0.03 ± 0.0) and adult (0.04 ± 0.0) age groups in the present study, the values were within the normal range in dogs (upto 0.06) as specified [7]. This positive relationship between QRS complex and age might be due to the increase in heart size associated with increase in age [20,21].

A high significant difference observed between age groups in the study might be due to increase in body weight. However, the heart rate were within the normal range (upto 220 bpm for puppies and 70 - 160 bpm for adult dogs) [7]. The difference in body weight could also affect the heart rate [22] 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) [4,23]. Another possible reason for difference in heart rate could be the effect of adrenergic system on heart rate [17].

There was a high significant difference observed between young and adult age groups which suggested that the heart weight increased as overall body weight increased. Joseph [24] postulated the ratio between heart weight and body weight in dogs as 7.43 g/Kg body weight in male and 7.61 g/Kg in female dogs. Average per cent of heart weight to body weight calculated was 0.743 in male and 0.761 in female dogs.

Echocardiographic Parameters - 2D

In the present study, in both age groups, LVDd was found to be greater than LVDs which indicates the normal ventricular morphology and contractility. Similar observation was made in dogs with no ventricular abnormalities [25,26].

Similarly, LVDd and LVDs were found to be less in young age groups when compared to adult age groups [27,28]. LVDs is determined by the degree of myofibre shortening which, inturn is affected by the ionotropic state of the myocardium and by afterload.

It was found that LVPWs value was greater than LVPWd in both the age groups studied. This is in contrast to the findings of Crippa., *et al.* [29] and Jacobson., *et al* [30]. No significant difference was observed in diastolic and systolic IVS between young and adult dogs which is in contrast to Gugjoo., *et al*. [4] who recorded an increased IVS as body weight increased.

Mean ± SE for LADd was in correlation with Morrison., et al. [31] in Afghan Hound. Increased values were reported by Stepien., *et al.* [32] and Vollmar [33]. Whereas lesser values were reported in Whippets (1.88) and Italian Greyhounds (1.43) [34,35]. Unlike ventricles, left atrium increases in size in response to both pressure and volume overload. Hence, for making confirmatory diagnosis, primary cause which increased the atrial pressure and volume should be identified.

Mean values of AO was very close to the findings in German Shepherd [36]. The same was reflected in aortic area (cm^2) which was higher in young dogs (4.06) than adult dogs (3.81). Larger AO diameter in younger animals might be due to increased physical activity [37].

In the study, mean diastolic and systolic LAPW was thinner in young dogs and the same was found to be thicker in adult dogs. Thinner LAPW in young dogs indicates that they may be prone for atrial fibrillation [38]. Left atrium to aortic root ratio was within the established range (from 0.8 to 1.2) recorded in dogs [39].

Mean ± SE of RVPW was in accordance with the findings of Matsukubo., *et al* [40]. It was found that this parameter showed no significant variation between age groups studied.

Conclusion

Since the electrocardiographic and echocardiographic studies on healthy Rajapalayam dogs are not available, and the number of native breed dogs being presented in Veterinary hospitals and clinics has increased drastically, there is a need to establish the reference values for various electrocardiographic and echocardiographic parameters in healthy indigenous Rajapalayam dogs. This helps in understanding the structural and functional changes and also to predict the cardiovascular abnormalities, if any.

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Conflict of Interest

The authors declare that there is no conflict of interest.

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