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Research Article

ELECTROCARDIOGRAPHIC AND RADIOGRAPHIC CHANGES VIS-A-VIS AGEING IN HEALTHY LABRADOR RETRIEVER DOGS

K. KAVITHA*, U. DIMRI, K. MAHENDRAN, M.R. VERMA[1], AMARPAL[2], A.C. SAXENA[2], M. HOQUE[2], E. MADHESH, A.K. CHAUDHARY, E. KALAISELVAN[2] and S. ANGMO

Division of Medicine, [1]Livestock Economics and Statistics, [2]Division of Surgery,
ICAR-Indian Veterinary Research Institute, Izatnagar-243122, India

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ABSTRACT

The present study has been conducted to evaluate the changes in electrocardiogram (ECG) parameters among various age groups of apparently healthy Labrador retriever dogs. A total of 24 Labrador retriever dogs were included and were divided into four groups of six dogs in each group. Animals below one year-age were kept in group I, between one to eight year-age in group II, between eight to ten year-age in group III and above ten year-age in group IV. Significant ($P<0.05$) changes in P, R and T wave amplitude, QRS duration and PR interval were noticed with ageing. No significant difference was observed in Right lateral Vertebral heart Score (RLVHS) and Left lateral Vertebral heart Score (LLVHS) between various age groups of Labrador retriever dogs. Abnormal rhythm like arrhythmic patterns, sinus tachycardia and abnormal ECG morphology like P mitrale, low QRS voltage complexes and ST segment depression were also predominant in aged dogs. Amplitudes and duration of different ECG waves were affected by age.

Keywords: Ageing, Electrocardiographic parameters, Labrador retriever dogs, Vertebral heart Score

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Prevalence of cardiovascular disorders increases with ageing in dogs (Hamlin, 2005; Shah *et al.*, 2020). During middle to last one-third of life (i.e. transition period), the cardiac output drops by 30 percent and total oxygen intake decreases with age with increased peripheral resistance leading to cardiac arrhythmias (Bright and Mears, 1997). Fat deposition and fibrous tissue accumulation may occur in some of the structures of pacemaker system and degenerative changes occur in heart muscle and its conduction system as age advances (O' Connar *et al.*, 2008). Chronic valve disorders are more frequently encountered in aged dogs, which can lead to inadequate pumping and myocardial hypoxia. Arrhythmias, conduction abnormalities and the function of the myocardium can all be evaluated with electrocardiography. In diagnosing cardiac disorders especially dilated cardiomyopathy, thoracic X-rays are very much useful. Radiography is useful to evaluate change in size, shape, contour, density and/or location of the silhouette and great vessels of heart, as well as extra cardiac signs (Woolley *et al.*, 2007). Regular monitoring of cardiac activity is very crucial for early detection of cardiac problems. Only limited scientific data are available on changes in ECG pattern with ageing (Kumar *et al.*, 2003; Spasojevic *et al.*, 2017). Purpose of the present study is to compare the variation in electrocardiogram (ECG) parameters in apparently healthy Labrador retriever dogs among various age groups, so that it helps the clinician in early diagnosis and intervention.

*Corresponding author: geturkavitha@gmail.com

MATERIAL AND METHODS

Apparently healthy dogs presented for vaccination, deworming and general health check up etc. during year (2019-20) at the Referral Veterinary Polyclinic, ICAR-Indian Veterinary Research Institute, Izatnagar were considered. A thorough clinical examination was carried out in dogs *viz.*, rectal temperature, heart rate, pulse rate, respiratory rate, blood pressure, haematobiochemical estimation, urine analysis, radiography and electrocardiographic examination. As per literature, there is no generally accepted definition for a "geriatric" dog (Davies, 2012). Classifications of different stages of life are somewhat vague and differ as per the source. It is difficult to establish cut off age to senior and geriatric dogs mainly due to different life expectancy of small and large breeds. Adding our clinical experience,the dogs were categorized into 4 groups (groups I to IV), each group having 6 animals (n=6). Group I consisted of below one year-age, II consisted of one to eight years, III consisted of eight to ten years and IV consisted of above ten years age (Geriatric).

Blood pressure measurement: Blood pressure was measured using BPL multi-parameter monitor ULTIMA PRIME D machine on left forearm region by indirect oscillometric method.

Electrocardiographic examination: In all the dogs, ECG was done by using single channel cardiart ® 6108 T BPL

ECG machine at paper speed 50 mm/s and sensitivity of 10 mm/mV. For recording of ECG, dogs were positioned in right lateral recumbency. Dogs were placed on an insulated table with forelimbs straight and parallel to each other, and hind limbs flexed normally and to avoid direct contact, finger is placed in between the two limbs. The ECG machine was placed at body level. Dogs were given sufficient time to acclimatize before recording of the ECG. Positive and negative ECG electrodes were placed on the skin at palmer aspect of left and right forelimbs or just distal to olecranon and at the cranial aspect of right and left hind limb over patellar ligament. Before applying alligator clips, areas were properly cleaned and shaved and ECG gel was applied to increase the body contact. During ECG recording, precautions were taken to avoid contact of two clips. The amplitude and duration of various complexes were calculated. Leads I, II and III and augmented unipolar limb leads, Lead aVR, aVL and aVF were recorded. All the measurements of P, Q, R, S, T complexes were studied in lead II electrocardiogram.

Thoracic Radiography for measuring Vertebral Heart Score: Computerized radiographic machine (DRGM 32KW HF, Medion Healthcare Pvt ltd, Mumbai, India) was used for radiographic examination and observations were made on computer with software provided calipers. Radiograph was done with manual restrain in dogs. In right lateral and left lateral recumbency, a plain chest X-ray was taken after standard exposure factors. Animals were properly restrained and positioned in such a way, there is no overlapping of ribs over cardiac silhouette and specific precautions were taken to view entire thoracic vertebrae. Exposure to X-ray was made during complete inspiration and to prevent any image magnification caused by increased film subject distance. Radiographs were studied for any abnormalities of heart and thoracic region. Vertebral Heart Score (VHS) was measured as per Buchanan and Bucheler (1995). The short and long axes of heart were calculated using inbuilt caliper of digital radiography machine. Long axis of heart was measured from ventral border of the left main stem bronchus to apex of the heart and expressed in centimeters. The long axis measurement will be transferred to the vertebrae, starting at the cranial edge of T4, and count the number of vertebrae that fall within the caliper points. The maximal width of cardiac silhouette perpendicular to the long axis was calculated in the mid third area. After repositioning the caliper, a parallel to the measurement of long axis over the thoracic vertebrae was taken in a similar way, starting from T4. VHS was calculated after measuring short and long axis in terms of vertebral number covered and sum of these two numbers gave the VHS value.

Statistical analysis: To study the effect of groups for various parameters, one way ANOVA (analysis of variance) was used. The multiple comparisons between the groups for

Table 1

Electrocardiographic parameters in different age groups of Labrador retriever dog. (Mean ± S.E.)

Parameters	Group I (n=6)	Group II (n=6)	Group III (n=6)	Group IV (n=6)
Body weight (Kg)	23.67±3.73^{b}	26.50±3.69^{ab}	34.67±2.12^{ab}	38.00±1.93^{a}
HR (bpm)	126.67±4.84^{a}	115.33±4.75^{ab}	104.67±0.84^{bc}	99.00±3.48^{c}
RR (breaths/min)	56.17±2.81^{a}	46.17±2.69^{b}	45.00±2.42^{b}	44.00±1.44^{b}
SBP (mm Hg)	132.67±4.94^{a}	130.67±4.18^{a}	133.67±3.84^{a}	132.50±4.15^{a}
DBP (mm Hg)	82.17±1.45^{a}	80.50±1.18^{a}	78.33±1.23^{a}	72.33±2.03^{b}
MAP (mm Hg)	101.17±3.40^{a}	99.33±3.89^{a}	96.67±3.13^{a}	93.33±2.91^{a}
P ampl (mV)	0.22±0.017^{b}	0.24±0.020^{ab}	0.25±0.032^{ab}	0.32±0.017^{a}
Q ampl (mV)	0.33±0.021^{a}	0.35±0.067^{a}	0.33±0.036^{a}	0.36±0.021^{a}
R ampl (mV)	1.90±0.113^{a}	1.75±0.119^{a}	1.63±0.117^{a}	0.91±0.056^{b}
S ampl (mV)	0.14±0.020^{a}	0.17±0.021^{a}	0.17±0.016^{a}	0.18±0.009^{a}
T ampl (mV)	0.29±0.015^{bc}	0.26±0.013^{c}	0.33±0.013^{ab}	0.35±0.017^{a}
P dur (s)	0.04±0.000^{a}	0.04±0.000^{a}	0.05±0.007^{a}	0.04±0.002^{a}
QRS dur (s)	0.05±0.004^{ab}	0.06±0.004^{a}	0.05±0.003^{ab}	0.04±0.003^{b}
T dur (s)	0.04±0.000^{a}	0.04±0.002^{a}	0.04±0.002^{a}	0.04±0.003^{a}
PR Int (s)	0.09±0.006^{c}	0.11±0.009^{bc}	0.13±0.10^{ab}	0.15±0.10^{a}
QT Int (s)	0.18±0.015^{a}	0.18±0.010^{a}	0.20±0.012^{a}	0.21±0.011^{a}
ST Int (s)	0.06±0.016^{a}	0.07±0.015^{a}	0.08±0.010^{a}	0.08±0.008^{a}

Values within a row, having different superscripts, differ significantly ($P<0.05$) with each other.

various parameters were done by using Tukey's test at 5% level of significance. The analysis was done by JMP 9.0 software. Results of the various parameters are expressed as Mean ± S.E.

RESULTS AND DISCUSSION

Mean ± S.E. of body weight, heart rate, respiratory rate, systolic blood pressure, diastolic blood pressure (DBP) and mean arterial pressure in various age groups of Labrador retriever dog are depicted in Table1. Significant (P<0.05) decrease in heart rate was noticed in group IV compared to group I dogs, significant (P<0.05) decrease in respiratory rate was noticed in groups II, III and IV compared to group I dogs. No significant difference was noticed in systolic blood pressure and mean arterial pressure with ageing in Labrador retriever dogs. Significant (P<0.05) decrease in diastolic blood pressure was noticed in group IV dogs compared to other groups of Labrador retriever. With ageing, stiffening and loss of elasticity will occurs in blood vessels; thereby reducing the effect of vascular recoil in maintaining DBP, therefore causes fall in DBP in geriatric dogs (Meurs *et al.*, 2000).

Significant (P<0.05) increase in P wave amplitude was noticed in group IV dogs compared to group I dogs, significant (P<0.05) decrease was noticed in R wave amplitude in group IV as compared to group I, II and III dogs of various age groups (Table 1). Significant (P<0.05) increase was observed in T wave amplitude in group IV as compared to group I and II dogs of various age groups of Labrador retriever dogs. No significant difference was observed in Q wave amplitude and S wave amplitude between various age groups.

Significant (P<0.05) decrease in QRS duration was noticed in group IV compared to group II in Labrador retriever. Significant (P<0.05) increase in PR interval was noticed in group III and IV compared to group-I. No significant difference was observed in P wave duration, T wave duration, QT interval and ST segment between various age groups (Table 1).

In the present study, in group IV dogs, abnormal rhythm noticed are arrhythmia (Fig. 1) and sinus tachycardia, abnormal ECG morphology noticed are P mitrale and low QRS voltage complexes (Fig. 2). In group III dog's abnormal rhythm noticed is sinus tachycardia (Fig. 3) and abnormal ECG morphology is ST segment depression (Fig. 4), in group II, one animal exhibited deep S wave as abnormal ECG morphology. Changes in cardiac

Table 2

VHS of different age groups of Labrador dog (Mean ± SE)

Parameters	Group I (n=6)	Group II (n=6)	Group III (n=6)	Group IV (n=6)
RLVHS	10.35 ± 0.11[a]	10.47 ±0.10[a]	10.22 ±0.10[a]	10.32 ±0.13[a]
LLVHS	10.12± 0.18[a]	10.08± 0.19[a]	9.80± 0.13[a]	9.97±0.13[a]

Values within a row, having different superscripts, differ significantly (P<0.05) with each other.

Fig. 1. Electrocardiogram (Lead II) of a 10 year old Labrador retriever dog showing arrhythmic pattern (Paper speed: 50 mm /sec, Sensitivity: 1 mV=1 cm)

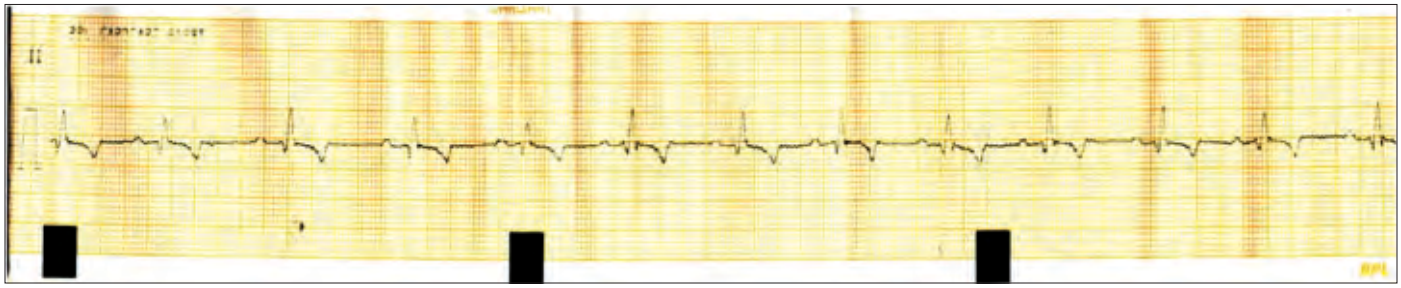

Fig. 2. Electrocardiogram (Lead II) of a 11 year old Labrador retriever dog showing low QRS voltage complexes (Paper speed : 50 mm /sec, Sensitivity: 1 mV = 1 cm)

Fig. 3. Electrocardiogram (Lead II) of a 9 year old Labrador retriever dog showing sinus tachycardia (Paper speed: 50 mm /sec, Sensitivity: 1 mV = 1 cm)

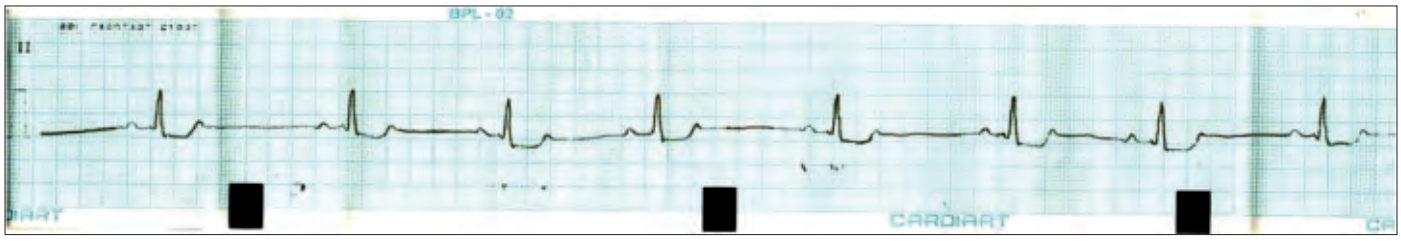

Fig. 4. Electrocardiogram (Lead II) of a 9 year old Labrador retriever dog showing ST segment depression (Paper speed: 50 mm /sec, Sensitivity: 1 mV = 1 cm)

rhythm and morphology are predominant in more than 10 year age and 8-10 year aged animals.

ECG parameters in different age groups of dog were within the normal reference range as reported by authors (Tilley, 1992; Gugjoo *et al.*, 2014). However, significant changes in P, R and T wave amplitude, QRS duration, PR interval were noticed with ageing. In the present study, significant ($P<0.05$) decrease was noticed in R wave amplitude and QRS duration in group IV dogs with ageing, one dog in group IV exhibited low QRS voltage complexes. Similar observations were noticed by Spasojevic *et al.* (2017). Ventricular depolarization parameters like QRS duration and amplitude of R wave differed significantly with ageing. Aged dog may exhibit low voltage QRS complexes; this may cause significant decrease in amplitude of R wave with ageing.

In the present study, significant ($P<0.05$) increase in P and T wave amplitude, PR interval were noticed with ageing. Kumar *et al.* (2003) also made similar observations with ageing *viz.*, P and T wave amplitudes increased, R wave amplitude decreased, where as duration of PQ interval, ST segment and QT interval increased with age. Rezakhani *et al.* (1990) reported prolonged PR and QT interval in German shepherd dogs which may be attributed to slower heart rate in these breeds. Variance to this, non significant ($P>0.05$) changes in P wave amplitude and PR interval was reported in older dogs but comparatively higher values for P wave amplitude and PR interval in old dogs was observed than young (Spasojevic *et al.*, 2017). Elongation of PR interval in this study can be attributed to

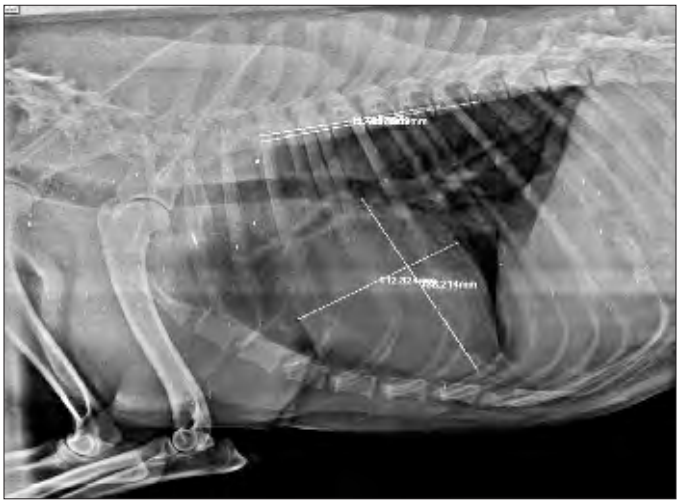

Fig. 5. Long axis and short axis measurement of VHS in a Labrador retriever dog.

first degree AV block noticed in geriatric dogs. Ageing leads to changes in cardiac electrical characteristics, impulse conduction disturbance increases as age advances.

Arrhythmia and sinus tachycardia were predominantly recorded in groups III and IV along with high incidence of P mitrale, low QRS voltage and ST segment depression noticed in the same. In group II, deep S wave was noticed in one 4 year aged dog. Spasojevic *et al.* (2017) reported similar findings of Sinus arrhythmia, Wandering pacemaker, Sinus bradycardia, Sinus block, Sinus pause, Sinus arrest and AV block 1° in both young and aged healthy German Shepherd dogs. Shah *et al.* (2021) reported significant ($P<0.05$) reduction in calcium, sodium

and chloride levels in congestive heart failure dogs. Generally pericardial or pleural effusion causes low R wave amplitudes, as none of the dogs exhibited these changes in our study, low R wave amplitudes can be attributed to obesity (Deepti *et al.*, 2015) and also ST segment depression in this study can be attributed to nonspecific electrolyte changes (Cote, 2010).

In veterinary patients, cardiac arrhythmias are often detected. These animals may have cardiac disease, non-cardiac disease, or may be apparently healthy (Boswood, 2001). Sinus tachycardia may be physiological or pathological. Sinus tachycardia occurs at an elevated rate caused by sympathetic predominance over parasympathetic inputs (Cote, 2010). As observed in one study, a dog with congestive heart failure may have normal ECG (12 dogs with CHF had normal ECG) and a completely normal animal may have nonspecific ECG abnormalities (Deepti *et al.*, 2015). Aged animals have many physiological and pathological disorders as compared to young animals. In dogs, impulse generation and conduction disturbances increase as they become older which may be the reason for abnormal rhythm and abnormal ECG morphology even in healthy dogs. With ageing, collagen between the tissue cells of AV node and common bundle of this increases which will slow down the intensity of impulse formation and conduction (Schmidlin *et al.*, 1992).

Mean ± S.E. of Right lateral Vertebral heart Score (RLVHS) and Left lateral Vertebral heart Score (LLVHS) in Labrador retriever are depicted in Table 2 and Fig. 5. No significant change was observed in RLVHS and LLVHS with ageing. RLVHS and LLVHS with various age groups were within the normal reference range as indicated by earlier workers (Gulanber *et al.*, 2005; Spasojevic *et al.*, 2017). Similar non significant variation in VHS in relation to age and sex was noticed by earlier authors (Gulanber *et al.*, 2005; Spasojevic *et al.*, 2017).

From the present study, it was observed that ECG parameters are affected by the age of dog with predominant abnormalities seen in rhythm and ECG morphology. In this regard, age of the animal should be considered as an important parameter during evaluation of cardiac status basing on electrocardiogram. Repeated monitoring over a period of time is more essential in determining the functional status of heart.

REFERENCES

Boswood, A. (2001). Rationale for the use of drugs in the treatment of cardiovascular disease. *Antiarrhythmic Drugs In. Pract.* **23**: 63-73.

Bright, J.M. and Mears, E. (1997).Chronic heart disease and its management. *Vet. Clin. North. Am. Small. Anim. Pract.* **27**: 1305 -1329.

Buchanan, J.W. and Bucheler, J. (1995). Vertebral scale system to measure canine heart size in radiographs. *J. Am. Vet. Med. Assoc.* **206**: 194-199.

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

Davies, M. (2012). Geriatric screening in first opinion practice-results from 45 dogs. *J. Small. Anim. Pract.* **53(9)**: 507-513.

Deepti, B.R., Yathiraj, S., Ramesh, P.T., Kamran, C.A., Ranganath, L. and Narayanaswamy, H.D. (2015). Electrocardiographic studies in congestive heart failure in dogs. *Indian J. Vet. Sci. Biotech.* **11**: 52-55.

Gugjoo, M.B., Hoque, M., Saxena, A.C. and Zama, M.M. (2014). Reference values of six-limb-lead electrocardiogram in conscious Labrador Retriever dogs. *Pakistan J. Biol. Sci*. **17(5)**: 689-695.

Gulanber, E.G., Gonenci, G., Kaya, U., Aksoy, O. and Birsik, H.S. (2005). Vertebral scale system to measure heart size in thoracic radiographs of Turkish Shepherd (Kangal) Dogs. *Turk. J. Vet. Anim. Sci.* **29**: 723-726.

Hamlin, R.L. (2005). Geriatric heart diseases in dogs. *Vet. Clin. North. Am. Small. Anim. Pract.* **5**: 597-617.

Kumar, Y.R.S., Roa, P.M. and Yathiraj, S. (2003). Electrocardiography studies in different age groups of dogs. *Indian Vet. J.* **80**: 1125-1127.

Meurs, K.M., Miller, M.W., Slater, M.R. and Glaze, K. (2000). Arterial blood pressure measurement in a population of healthy geriatric dogs. *J. Am. Anim. Hosp. Assoc.* **36**: 497–500.

O'Connor, M., McDaniel, N. and Brady, W.J. (2008). The pediatric electrocardiogram. Part I: Age-related interpretation. *Am. J. Emerg. Med.* **26**: 221-228.

Rezakhani, A., Atwell, R.B. and Webster, J. (1990). Electrocardiographic values of German shepherd dogs. *Aust. Vet. J. Aug.* **67(8)**: 307-9.

Schmidlin, O., Bharati, S., Lev, M. and Schwartz, J.B. (1992). Effects of physiological aging on cardiac electrophysiology in perfused Fischer 344 rat hearts. *Am. J. Physiol.* **262**: p. 97.

Shah, N., Behera, S.K., Arya, R.S., Lalmuanpuii, R., Chang, L., Basaiawmoit, M., Ali, M.A., Sarma, K., Rajesh, J.B. and Jamlianthang. (2020). Clinico-pathological and necropsy findings in a Great Dane dog with dilated cardiomyopathy. *Haryana. Vet.* **59(2)**: 294-296.

Shah, N., Behera, S.K., Gonmei, C., Gali, J.M., Ankan, D.E., Chaudhary, J.K., Prasad, H., Das, G.A. and Jamlianthang (2021). Hospital prevalence of congestive heart failure in dogs at Aizawl and its effect on hemato-biochemical and oxidant-antioxidant status. *Haryana. Vet.* **60(SI)**: 10-15.

Spasojevic, K., Trailovic, D.R. and Krstic, N. (2017). Age-dependent electrocardiographic and echocardiographic changes in German Shepherd dogs. *Iran. J. Vet. Res.* **18(1)**: 43–48.

Tilley L.P. (1992). Essentials of Canine and Feline Electrocardiography: interpretation and treatment. (3rd Edn.), Lea and Febiger, Philadelphia. p. 470.

Woolley, R., Smith, P., Munro, E., Smith, S., Swift, S., Devine, C., Corcoran, B. and French, A. (2007). Effect of treatment type on vertebral heart size in dogs with myxomatous mitral valve disease. *Int. J. Appl. Res. Vet. Med.* **5(1)**: 43-48.