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Impact of age on Blood pressure and Electrocardiographic changes in Healthy German shepherd Dogs

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Ageing is related to a reduction in cardiovascular reserve and adaptability. It is well documented that the frequency of cardiovascular disorders increases with ageing in dogs (Bonagura, 1981; Hamlin, 2005). Age, gender and breed-dependent mortalities are seen in cardiovascular disorders of dogs. In mid of life, cardiac output gradually decreases and can still drop by up to thirty percent in geriatric dogs (Bright *et al*., 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 (Detweiler, 1965; Carpenter, 2005). Arrhythmias, conduction abnormalities and the function of the myocardium can all be evaluated with electrocardiography. Due to kidney disorders, hyperthyroidism, hypothyroidism, hyperadrenocorticism, hyperparathyroidism and diabetes mellitus, systemic hypertension is commonly seen as secondary to these disorders in dogs (Mosier, 1989).So screening for these disorders in aged dogs is very important to rule out secondary systemic hypertension, as primary systemic hypertension is less commonly noticed in dogs. Only limited scientific data is available on changes in blood pressure and ECG pattern with ageing. Purpose of the present study is to compare the variation in blood pressure and electrocardiogram (ECG) parameters in healthy German shepherd dogs among various age groups, so that it helps the clinician to know age related changes in Electrocardiography.

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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. The animals were divided into 4 groups (groups 1 to 4), each group having 6 animals (n=6). Groups were based on age in years. Group I consisted of birth to one year, II consisted of 1 to 8 years, III consisted of 8-10 years and IV consisted of >10 years age (Geriatric). All 24 German shepherd dogs included in the study were apparently healthy.

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 the ECG. Positive (+ve) and –ve 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.

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 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 ± SE.

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 German shepherd dogs are depicted in Table 1. Heart rate, respiratory rate and blood pressure in various age groups of dog were well within the standard reference range (Detweiler and Erickson, 2004; Reece, 2004). Significant ($P<0.05$) decrease in heart rate was observed in group IV dogs compared to group I dogs, significant ($P<0.05$) decrease in respiratory rate was noticed in groups II, III and IV dogs compared to group I dogs. No significant difference was noticed in systolic blood pressure and mean arterial pressure with ageing in German shepherd dogs. Significant ($P<0.05$) decrease in diastolic blood pressure was noticed in groups III and IV compared to group I. With ageing, stiffening and loss of elasticity will occurs in blood vessels; thereby reducing the effect of vascular recoil in maintaining diastolic blood pressure, therefore causes fall in diastolic blood pressure in geriatric dogs (Meurs *et al*., 2000).

Mean ± SE of P wave amplitude, Q wave amplitude, R wave amplitude, S wave amplitude and T wave amplitude in various age groups of German shepherd dogs were depicted in Table 1. Significant ($P < 0.05$) decrease was noticed in R wave amplitude in groups III and IV as compared to group I dogs of various age groups. Significant ($P < 0.05$) increase was observed in T wave amplitude in group IV compared to groups I, II and III dogs of various age groups of German shepherd

Table 1: Electrocardiographic parameters in different age groups of German shepherd dogs. (Mean ± SE)

Parameters	Group I (n=6)	Group II (n=6)	Group III (n=6)	Group IV (n=6)
Body weight	29.50±3.04^{a}	33.20±0.57^{a}	33.00±0.63^{a}	36.00±1.46^{a}
HR	120.33±3.03^{a}	109.00±4.81^{ab}	100.50±1.46^{bc}	94.00±2.67^{c}
RR	54.33±2.01^{a}	42.67±2.11^{b}	41.67±1.69^{b}	40.67±1.26^{b}
SBP(mmHg)	138.67±2.76^{a}	140.33±2.16^{a}	142.50±2.31^{a}	140.00±2.02^{a}
DBP(mmHg)	84.33±2.08^{a}	82.33±1.76^{ab}	76.67±1.20^{bc}	71.17±1.68^{c}
MAP(mmHg)	104.67±3.02^{a}	103.00±3.61^{a}	97.33±2.91^{a}	94.67±2.58^{a}
P ampl (mV)	0.22±0.017^{a}	0.22±0.017^{a}	0.22±0.031^{a}	0.30±0.026^{a}
Q ampl (mV)	0.38±0.044^{a}	0.35±0.067^{a}	0.45±0.041^{a}	0.37±0.022^{a}
R ampl (mV)	2.02±0.119^{a}	1.92±0.070^{ab}	1.61±0.108^{b}	1.20±0.073^{c}
S ampl (mV)	0.13±0.021^{a}	0.15±0.022^{a}	0.16±0.013^{a}	0.18±0.010^{a}
T ampl (mV)	0.26±0.013^{b}	0.25±0.014^{b}	0.29±0.012^{b}	0.36±0.010^{a}
P dur (s)	0.04±0.000^{a}	0.04±0.003^{a}	0.04±0.003^{a}	0.04±0.000^{a}
QRS dur(s)	0.06±0.003^{a}	0.06±0.001^{a}	0.05±0.003^{ab}	0.04±0.004^{b}
T dur (s)	0.04±0.000^{a}	0.04±0.002^{a}	0.04±0.002^{a}	0.04±0.000^{a}
PR Int (s)	0.09±0.007^{b}	0.12±0.014^{ab}	0.14±0.010^{a}	0.16±0.007^{a}
QT Int (s)	0.16±0.014^{a}	0.19±0.007^{a}	0.18±0.012^{a}	0.22±0.024^{a}
ST Int (s)	0.06±0.016^{a}	0.06±0.010^{a}	0.07±0.008^{a}	0.08±0.007^{a}

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

dogs. No significant difference was observed in P, Q wave amplitude and S wave amplitude between various age groups.

Mean ± SE of P wave duration, QRS duration, T wave duration, PR interval, QT interval and ST segment in various age groups of German shepherd dogs were depicted in Table 1. Significant ($P < 0.05$) decrease in QRS duration was noticed in in group IV in contrast to group I & II in German shepherd dogs. Significant ($P < 0.05$) increase in PR interval was noticed in group III and IV as 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.

In the present study, in more than 10 year age group, abnormal rhythm noticed are Atrial premature complexes (Fig. 1) and arrhythmia (Fig.3) and abnormal ECG morphology noticed is low QRS voltage complexes. In 8-10 year age group abnormal rhythm noticed is arrhythmia and abnormal ECG morphology noticed are noticed are Q dipping (Fig.2). In 1-8 year age group abnormal ECG morphology noticed are, ST coving and biphasic P wave and in less than one year age group Q dipping was the predominant change in ECG morphology. Changes in cardiac 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 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 T wave amplitude and PR interval was noticed with ageing. Kumar *et al*. (2003) also made similar observations with ageing P and T wave amplitudes increased, R wave amplitude decreased, where as duration of PQ interval, ST segment and QT interval increased with age. These observations were similar to current findings. Rezakhani *et al*. (1990) reported prolonged PR and QT interval in German shepherd dogs may attributed to slower heart rate in these breeds. Variance to this, non significant changes in P wave amplitude and PR interval was reported in old dog but comparatively higher values in old dogs was observed than young (Spasojevic *et al*., 2017). First degree AV block in geriatric dog may cause prolongation of PR interval. Ageing leads to changes in cardiac electrical characteristics, impulse conduction disturbance increases as age advances.

Atrial premature complexes and arrhythmia were

Fig. 1. Electrocardiogram (Lead II) of a 10 year old German shepherd dog showing Atrial premature complexes (Paperspeed : 50 mm /sec, Sensitivity : 1 mV = 1 cm)

Fig. 2. Electrocardiogram (Lead II) of a 9 year old German shepherd dog showing Q wave dipping. (Paperspeed : 50 mm /sec, Sensitivity : 1 mV = 1 cm)

Fig. 3. Electrocardiogram (Lead II) of a 11 year old German shepherd dog showing arrhythmic pattern (Paperspeed : 50 mm / sec, Sensitivity : 1 mV = 1 cm)

predominantly recorded in groups III and IV along with high incidence of low QRS voltage complexes noticed in the same. ST coving and biphasic P wave are noticed group II dogs, one dog exhibited Q dipping in Group I. Spasojevic *et al*. (2017) reported similar findings 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. Low R wave amplitudes are also associated with obesity (Deepti *et al*., 2015). Nonspecific electrolyte changes also cause ST segment depression (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 (Paddleford, 1999). In dogs, impulse conduction disturbances increases as they become older this may be the reason for abnormal rhythm and abnormal ECG morphology even in healthy dogs. The structural and functional variations in cardiac pacemaker and its conduction system are related to ageing. With ageing increase in collagen between the tissue cells of AV node and common bundle of His, slow down the intensity of impulse formation and conduction (Schmidlin *et al*., 1992).

From the present study diastolic blood pressure, ECG parameters (amplitudes and duration) are affected by age. Abnormal rhythm and abnormal ECG morphology were also predominant in aged animals. All these findings highlight that age should be taken into account in the assessment of cardiac status by ECG morphology. The observation of the present study can be used for monitoring the cardiac health status among German shepherd breed of dogs.

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Conflict of interest

Authors declare there is no conflict of interest

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