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Some Electrocardiographic Parameters of the Kangal Dogs

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Abstract: The purpose of this study is to demonstrate some electrocardiographic parameters of adult and puppies of Kangal dogs. A total of 50 Kangal dogs, 25 pups and 25 adults were used in the study. Bipolar extremity leads, unipolar extremity leads and unipolar chest leads were recorded in dogs. Duration and amplitude of the p-wave, amplitude of Q and R waves and duration of QRS complex, duration and amplitude of T wave, duration of PR and QT intervals, heart rate in the lead II and electrical axis were calculated for each animal. Configuration of the P and T waves and QRS complex was also studied. Significant differences were identified among groups in terms of duration of the p-wave, amplitude of Q and R waves, duration of PR, QT intervals and heart rate ($p<0.05$).

Key words: Kangal, dog, electrocardiography, wave, puppy, adult

INTRODUCTION

Standardized normal electrocardiographic values must be put forward at these animals for early diagnosis and treatment of cardiovascular diseases of which incidence increases recently (Kovacevic *et al*., 1999) and diversity is observed in electrocardiographic parameters among dog breeds. It has been reported in literature that besides breed factor, age causes electrocardiographic diversity in some literatures both age and sex.

There is no enough data in order to make the distinction of healthy and sick animals in the electrocardiographic field in Kangal dogs breeding of which has become increasingly common. Some electrocardiographic parameters such as different wave and range values, configurations of waves, heart rate and mean electrical axis of heart will be presented in this study. The aim is to provide reference data for researchers and veterinary clinicians.

MATERIALS AND METHODS

A total of 50 Kangal dogs were used in the study after the approval of the local ethics committee. The dogs were divided into three groups: 1-3 months (17 puppies), 4-7 months (8 puppies) and the adult dogs over the age of one and a half (25 Kangal dogs). The Nihon-Kohden, Cardiofax ECG-6851 K-type single-channel electrocardiograph was used in this study. The dogs were held in a position of right lateral recumbency and it was waited for the dogs being calmed down.

Electrode paste was applied in the areas of where the electrodes will be placed in order to reduce resistanceof skin and to facilitate the conduction of the current between tissues and electrodes. Standard bipolar limb leads (I, II, III) and augmented unipolar lads (aVR, aVL, aVF) and unipolar chest leads (CV_6LL, CV_6LU, V_{10}) were recorded at a study speed 50 mm sec^{-1} with a sensitivity of 1 mV = 10 mm. Thus nine leads were recorded at dogs.

P-wave duration and amplitude, QRS complex duration, Q and R wave amplitude, T wave duration and amplitude, the duration of PR and QT intervals, the number of mean heart rate were determined in lead II of obtained electrocardiogram; I and III leads were used to mean electrical axis was calculated. Configuration of the P and T waves and the QRS complexes were also studied in all leads.

Statistical analysis: Since there is no difference in the distribution of the data between groups, obtained values were evaluated by one-way Analysis of Variance (ANOVA) and groups which have significant differences were evaluated by the TUKEY's test (SPSS 15.0 package program for MS Windows). Results were given in the form of mean±Standard Error (SE).

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RESULTS AND DISCUSSION

Electrocardiographic parameters calculated in the lead II in the electrocardiogram recorded from Kangal dogs by taking into account the ages of animals and they were examined in three different groups (Table 1) and numerical findings were evaluated statistically.

While sinus rhythm was observed in puppies, usually sinus arrhythmia was determined in adults (sinus rhythm in 5 animals).

It was detected that p-wave is positive in leads II, aVF and CV_6LL in general and is negative in aVR lead in animals in first age group it is positive in leads I, II, III, aVF, CV_6LL and CV_6LU in second age group and is negative in aVR lead and it is positive in leads I, II, III, aVF, CV_6LL and CV_6LU in adults and is negative in leads aVR, aVL, V_{10}.

Standard nomenclature was used to describe QRS morphology (Yilmaz, 2000). It was determined that generally qRs (41) and qR (41%) morphology was observed in lead II in the first age group and qRs (38%) and qR (38%) morphology was observed in the second age group.

When QRS morphology was investigated in adults, it was determined that mostly qR (64%) sample was observed in lead II.

Similarly, form of T wave was determined as (88%) positive and (12%) diphasic in the first age group and as (38%) positive, (12%) negative and (50%) diphasic in the second age group in lead II. T wave was detected at the rate of (28%) positive, (36%) negative and (36%) diphasic in the adults in lead II.

There were significant difference among p-wave duration, Q and R wave amplitudes, PR and QT interval duration and heart rate between age groups ($p<0.05$). Since well know effect of anesthetic agents on electrical activity of heart (Piskin *et al*., 1999; Simeonova, 2004; Duerr *et al*., 2007), no drugs have been applied during present study in which it was aimed to present some of the electrocardiographic parameters belonging to Kangal breed dogs. The animals were divided with respect to their ages for the reason that it was notified that during the process of determining the electrocardiographic parameters, breed and age factors have significant roles, while sex doesn't make an important difference (Rezakhani *et al*., 1990; Bernal *et al*., 1995; Paslawska, 1998; Hanton and Rabemampianina, 2006). In this study submitted, it has been observed that age made significant difference in some parameters when animals were divided into age groups. On the contrary, Eckenfels and Trieb (1979) as well as Gonul and Kaymaz (2002) noted that neither age nor sex had an effect on electrocardiographic values. The reason for that age did not make any difference in electrocardiographic parameters in both studies may be seen as that Beagle dogs used by Eckenfels and Trieb (1979) in these literatures were older than 6 months and that Kangal dogs in Gonul and Kaymaz (2002) study were between 1 month and 10 years old with no clear age distribution. On the other hand, electrocardiographic evaluations were carried out after having separated the puppies into two groups between each other as a 1-3 months group and as a 4-7 months group, since it was noted that more apparent changes occurred in electrocardiographic parameters in dogs during their first months of their lives (Kubo *et al*., 1985; Shimizu *et al*., 1986; Bernal *et al*., 1995).

In the study submitted, a decrease in average heart rate values has been observed between 1-3 month old puppies and other animals ($p<0.05$), respectively. Since, it was noted that sympathetic nervous system activity which is dominant in new-born puppies is replaced by parasympathetic nervous system through years and as a result of this a decrease in heart rate occurs (Davidowski and Wolf, 1984), it was considered in this study that the difference heart rate values between 1-3 months old, 4-7 months old and adult Kangal dogs was caused by changing nervous system activity. Obtained values are in accordance with standard data

Table 1: Some electrocardiographic parameters of 1-3 months old pupies (I, n = 17), 4-7 months old pupies (II, n = 8) and adult Kangal dogs (III, n = 25) of lead II

	Mean±Standard Error		
Parameters	I	II	III
p-wave duration (sec)	0.028±0.002^a	0.035±0.002^b	0.040±0.001^c
p-wave amplitude (mV)	0.14±0.01	0.18±0.02	0.18±0.007
QRS complex duration (sec)	0.04±0.002	0.04±0.004	0.05±0.002
R wave duration (mV)	1.26±0.13^a	1.45±0.20^b	1.65±0.08^b
Q wave amplitude (mV)	0.42±0.05^a	0.42±0.08^a	0.27±0.03^b
T wave duration (sec)	0.05±0.003	0.06±0.01	0.05±0.003
T wave amplitude (mV)	0.22±0.02	0.19±0.03	0.31±0.03
PR interval duration (sec)	0.10±0.003^a	0.12±0.004^b	0.12±0.003^b
QT interval duration (sec)	0.16±0.004^a	0.21±0.007^b	0.20±0.011^b
Heart rate (/min)	169.82±6.33^a	125.75±3.87^b	116.20±2.88^b
Mean electrical axis (°)	77.41±3.99	69.88±9.77	79.52±2.80

Within each line, different letters indicate significant difference ($p<0.05$)

(Bolton 1975; Tilley *et al*., 2008), while values belonging adult Kangal dogs are higher than stated values for Mongrel dogs (Schneider *et al*., 1964) and lower than values calculated for Doberman Pinscher dogs (Kovacevic *et al*., 1999). It was noted that breed average of age of examined animal and the stress impacted by applied ECG method on the animal would cause differences in heart rate (Minors and O'grady, 1997; Upeniece, 2004). When these information were taken into consideration for dogs with very variable heart rates, it has been thought that breed of the animals which were used and whether they went under stress, while recording electrocardiograms might be affective on that submitted data are different than the values calculated in other studies.

When electrocardiograms obtained from all the animals were examined sinus rhythm in puppies and sinus arrhythmia generally in adult Kangal dogs (80% of adults) were diagnosed. In literatures, it was stated that related to decrease in heart rate, physiologically-accepted sinus arrhytmia diagnosis rate in dogs increased (Hanton and Rabemampianina, 2006), while sinus arrhythmia vanished in particular when minute heart rate went over 120 value (Buchanan, 1965). Moreover, a lower sinus arrythmia rate was diagnosed in non-brachycephalic dogs compared to brachycephalic dogs (Doxey and Boswood, 2004). However, in the study submitted, even though Kangal dog is not a brachycephalic breed, a higher sinus arrhythmia rate has been observed in the adult one. Consequently, it has been deemed in this study that heart rate decreased as autonomous nervous system changes through years ands sinus arrhytmia diagnosis rate increased in parallel with decreased heart rate.

Kittleson and Kienle (1998) noted that p-wave in dogs must be positive in leads I, II, III and aVF and negative in aVR lead, while Upeniece (2004) stated that p-wave direction is positive in leads I, II, aVF, CV_6LL and CV_6LU generally, negative in leads aVR and V_{10} and both positive and negative in aVL lead. When electrocardiograms were examined with regard to p-wave configuration, p-wave was in positive direction in leads II, aVF and CV_6LL generally in positive direction and isoelectric in leads I and III for 1-3 months old Kangal dogs in positive direction in leads I, II, III, aVF, CV_6LL and CV_6LU for 4-7 months old Kangal dogs. In both groups, it was negative in aVR lead. In adults it was positive in leads I, II, III, aVF, CV_6LL and CV_6LU, negative in leads aVR, aVL and V_{10}. This fact is consistent with the former statements (Too and Umemoto, 1959; Zhang *et al*., 1986; Upeniece, 2004). In this study, statistical difference during p-wave ($p<0.05$) has been found between 1-3 months old puppies, 4-7 months old puppies and adult Kangal dogs. A difference in p-wave time is an inevitable situation to be noticed between age groups since, an increase would occur in p-wave time in relation to heart muscle development within the period from birth to physical maturity (Smith *et al*., 1965). It has been observed that detected time and amplitude values accorded with previously stated standard data (Bolton, 1975; Tilley *et al*., 2008) and values belonging to adult Kangal dogs were lower than the values stated for Greyhound dogs used as race dogs (Schneider *et al*., 1964). Since it was noted that exercise would cause an increase in heart muscle mass and consequently it would change some electrocardiographic parameters for Greyhound dogs (Schneider *et al*., 1964), it is an expected situation to observe higher wave values in these dogs. As a result, since there was no breed difference considering the animals used for this study it has been thought that the increase found in course of p-wave may be related to heart rate decreasing with age or to put it more accurately, animal's heart growing as it grows bigger and need for a longer time for excitation wave from sinoatrial node to spread.

When QRS morphology in lead II recorded from all the animals was examined, it has been observed that the adult ones had a higher rate of diphasic QRS complexes compared to the puppies and this situation show similarity with QRS complex configuration noted in lead II in Mastin Espanol dogs (Bernal *et al*., 1995). It has been also determined that the morphology belonging to adult Kangal dogs accorded with literature data (Too and Umemoto, 1959; Rezakhani *et al*., 1990; Bernal *et al*., 1995; Sato *et al*., 2000).

In present study, an increase in R-wave amplitude was found between 1-3 months old puppies with 4-7 months old puppies and adult Kangal dogs, while a decrease in R-wave amplitude values ($p<0.05$) was found between 1-3 month-old puppies with 4-7 month-old puppies and adult Kangal dogs. It has been seen that this situation was similar with other literature data (Shimizu *et al*., 1986; Bernal *et al*., 1995; Upeniece, 2004). It may be said that it is an expected situation to observe R-wave with increased amplitudes (Bernal *et al*., 1995) as a result of that right ventricle, which is dominant in a new-born puppy loses its dominance against left ventricle rapid development through years (Kirk *et al*., 1975). At the same time, it is also expected to find lower Q-wave amplitude in the adult ones since it was cited that body fat rate increasing through years reduced Q-wave amplitude by means of modifying heart and body mass rate (Upeniece, 2004). While Q and R-wave values obtained from puppies and the adult ones were in

accordance with normal values (Bolton, 1975; Tilley *et al*., 2008), R-wave amplitude belonging to the adult ones was found lower than the values noted for Greyhound dogs (Schneider *et al*., 1964) and Alaskan sled dogs (Hinchcliff *et al*., 1997) and higher than the values noted for Mastin Espanol dogs (Bernal *et al*., 1995). It is not a surprising situation to find higher wave amplitude in Greyhound and Alaskan Sled dogs used for races due to positive effects of exercise on heart (Schneider *et al*., 1964; Hinchcliff *et al*., 1997) and to find lower wave amplitude in Mastin Espanol dogs due to their wide chest structure.

It was notified that T-wave configuration in dogs might be observed in monophasic, diphasic, positive and negative directions with age (Smith *et al*., 1965; Shimizu *et al*., 2004). In this study, no negative T-wave has been observed in lead II in 1-3 months old puppies, while negative T-wave has been found at 12% rate in 4-7 months old puppies and at 36% rate in the adult ones. It has been observed that negative T-wave rate increased through age and this finding was similar with the situation noted for Mastin Espanol dogs (Bernal *et al*., 1995) and Beagle dogs (Shimizu *et al*., 2004). It has been deemed in this study that negative T wave rates increasing with age appeared in association with growing process for it was noted that some differences has taken shape in T-wave configuration in relation to autonomous nervous system activity changing with age (Shimizu *et al*., 2004). On the other hand, negative T-waves weren't observed in the beginning, while they were observed after the second month in Beagles dogs (Shimizu *et al*., 1986) and after fourth month in Mastin Espanol dogs (Bernal *et al*., 1995). No difference in T-wave time and amplitude has been observed between the puppies and the adults of the breed of Kangal dog.

In this research, statistical difference in PR and QT intervals has been found between 1-3 months old, 4-7 months old puppies and adult Kangal dogs ($p<0.05$). It has been seen that obtained PR and QT interval values were in accordance with normal values noted for dogs (Bolton, 1975; Tilley *et al*., 2008). It has been determined that the changes occurring with age showed parallelism with the situation observed in Mastin Espanol dogs (Bernal *et al*., 1995) and Beagle dogs (Shimizu *et al*., 1986) that were in the same age range. It has been considered that this difference observed between the puppy and adult Kangal dogs was caused by the negative relation noted to have been found between heart rate and PR and QT intervals (Bernal *et al*., 1995; Hanton and Rabemampianina, 2006).

No difference has been found in average electrical axis values of QRS complex in frontal plane between the puppies and the adult ones. Values obtained in this study are in accordance with the standard values noted for dogs (Bolton, 1975; Tilley *et al*., 2008). Values calculated in the adult Kangal dogs have been found in accordance with values noted for German Shepherd dogs (Rezakhani *et al*., 1990) and Golden and Labrador Retriever dogs (Sato *et al*., 2000). This values are however different from the data published for Doberman Pinscher dogs (Kovacevic *et al*., 1999) and Alaskan Sled dogs (Hinchcliff *et al*., 1997) with their heart axis slipping to the left. Increase in heart muscle mass of Alaskan Sled dogs due to exercise through being used for races (Hinchcliff *et al*., 1997), Doberman Pinscher dogs' predisposition to dilate cardiomyopathies as a breed (Kovacevic *et al*., 1999) and that no such situation has been noted for Kangal dogs yet may explain the difference observed in average electrical axis between breeds.

CONCLUSION

The study showed that the duration of the p-wave prolonged, amplitude of the Q wave decreased amplitude of the R wave increased and heart rate decreased whereas PR and QT intervals prolonged with increasing age in the Kangal dogs.

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