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LEAD II ELECTROCARDIOGRAPHY IN STANDING AND RIGHT LATERAL RECUMBENCY IN DOGS WITH NORMAL ECHOCARDIOGRAPHIC HEART CHAMBER VALUES

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Abstract

The electrocardiographic (ECG) exam has been routinely used in veterinary cardiology with reference values available for the right lateral recumbent position. Many situations require the exam to be performed in the standing position. The study presents that the quality of the ECG recording is comparable for the standing and right lateral recumbent positions, as well as significant differences of the P, S and T waves recorded in two positions.

Key words: dog, electrocardiography, standing, lateral recumbency.

Electrocardiography (ECG) allows the measurement of the electrical activity of the heart and is routinely used in veterinary cardiac diagnostics since 1913. Indications for the ECG examination include brady- and tachyarrhythmias, or an irregular rhythm that do not meet the criteria for a sinus arrhythmia, as well as syncope or collapse (3, 6). In situations when the arrhythmia might be periodic, a 24 h ECG might be indicated (Holter examination). Holter exam is also useful for the assessment of some heart disease treatment and effect of antiarrhythmic therapy (3, 4).

The ECG should be carried out in a quiet place so that the environment does not influence too much the animals' heart rate (HR). The present guidelines indicate that the ECG should be performed in the right lateral recumbency (RL) as reference values have been published for recordings in this position (5). In addition, the front and back legs should be held perpendicular to the long axis of the body and parallel to each other. Bipolar and augmented unipolar limb leads are used in the basic ECG (4). However, there are many situations in veterinary medicine that make performing the ECG according to these guidelines difficult. The most frequent difficulty is the patient's temperament, which can prevent placing the animal in the RL position in such a way, so that it will not move or pant excessively. Sever dyspnoea can also be problematic as forcing the animal into this position can be life threatening (3). A specific difficulty in the veterinary practice is a lack of animal cooperation or any mistakes made by technicians, which can cause an inappropriate positioning for the ECG exam.

For such reasons, publications on different ECG examination techniques have appeared in recent years. The previous studies have documented values for ECG exams in healthy animals recorded in RL and left lateral recumbency, in the sternal, standing, and sitting positions. The aim of the study was to determine if there are significant differences in lead II of the ECG recording performed in dogs in right lateral recumbency and in the standing position. All measurements were performer in lead II, as in the veterinary practice this is the lead routinely used for the analysis and normal values for dogs are published for this (1, 4).

Material and Methods

Dogs. The study was carried out on 22 dogs, including 18 German Shepherds, one Labrador retriever, one Fox terrier, one Rottweiler, and one Jack Russell Terrier. All the dogs were kept in the same environment; they were owned by and housed at the police criminal laboratory in Warsaw. Most of the dogs were male (18) only three were female. The average age of the dogs was 6 years (from 3 to 9.5 years). The examinations were carried out in the presence of the dogs' guardians at the housing facility. Dogs were not sedated. A full clinical examination, followed by an ECG (BTL-08 MD) was performed.

Dogs that were included in the study did not reveal any clinical signs typical for cardiovascular disease nor did they exhibit abnormalities in their clinical examinations. No arrhythmias, other electrical abnormalities, or signs of ventricular or atrial enlargement were recorded during the ECG recordings. An echocardiographic examination was also performed in each animal.

Electrocardiographic examination. The ECG was always carried out in the standing position first, then in right lateral recumbency to minimise stress.

Measurement of the amplitude and time of each wave was carried out by hand, by one of two veterinarians performing the ECG. All measurements were performed in lead II. The mean electrical axis was calculated with the use of a mean electrical axis calculator based on lead I and III reference axis superimposed on the Einthoven triangle. The average of three consecutive measurements was used in further analysis. The quality of both ECG recordings were compared subjectively for each animal, taking into consideration the presence and number of artefacts resulting from muscle tremors or animal movement; however, no further analysis was performed.

Statistical analysis. Statistical analysis was performed using the SPSS 19.0 from 2010 statistical packet. Distribution of the variables was determined using the Kolmogorow Smirnow test. The dependence of measurements from ECGs performed in right lateral recumbency and in the standing position for variables with normal distribution was analysed with the Student's *t*-test and for variables without a normal distribution, with the Wilcoxon and McNemara test.

Results

Only healthy animals were considered for the ECG analysis. Nine of the dogs (eight German Shepherds and one Labrador) had trivial mitral regurgitation (the regurgitant jet was smaller than 1/5 of the left atrium and there was no left atrial or ventricular enlargement) with no lesions visible on the mitral leaflets. Statistically significant differences were noted in the amplitude and time of the P wave, amplitude of the S wave, and amplitude of the T wave when measurements from right lateral recumbency and standing position were compared. These differences were noted in different ECG strips and did not always occur in the same dogs. There were no statistically significant differences between the remaining parameters, including the heart rate, amplitude of the Q and R wave, time of the QRS complex, PQ and QT segment, and T wave as well as the mean electrical axis (Table 1).

The differences in quality of the ECG recordings were minimal between two positions. A cleaner recording in the standing position was noted in two dogs (Figs 1a and 1b), and in two other dogs a cleaner recording was noted in the right lateral recumbent position (Figs 2a and 2b). In the remaining dogs there was no visible difference between recording in two positions (Figs 3a and 3b).

No significant arrhythmias were noted. A sinus arrhythmia was seen more often when dogs were in right lateral recumbency. All the dogs that had a sinus arrhythmia in the standing position had this arrhythmia in the right lateral recumbency position.

Discussion

It is important to emphasize that even though some parameters had statistically significant differences between recordings in two positions, all the measurements were within published normal ranges.

Table 1
Comparison of average values of lead II ECG parameters recorded
in right lateral recumbent and standing positions in 22 dogs

ECG value (ave. ±SD)	HR/min	PmV*	Psec	PQs	qmV	RmV	smV*	QRSs	QTs	STmV	TmV*	Ts	MEA
right lateral position	114 (±32)	0.205 ±0.126	0.04 ±0.007	0.096 ±0.021	0.553 ±0.443	1.376 ±0.606	0.142 ±0.087	0.065 ±0.047	0.21 ±0.026	-0.107 ±0.142	-0.936 ±2.294	0.062 (±0.026)	61.273 ±45.434
standing position	117 (±26)	0.123 ±0.264	0.037 ±0.006	0.095 ±0.02	0.611 ±0.377	1.410 ±0.523	0.114 ±0.072	0.054 ±0.007	0.215 ±0.023	-0.108 ±0.135	-1.323 ±2.343	0.065 (±0.021)	49.742 ±53.866
P value	0.45	0.05	0.019	0.708	0.383	0.625	0.04	0.092	0.147	0.96	0.01	0.501	0.239

P - probability, n - number of animals, SD - standard deviation. Statistically significant differences (*P≤0.05) were noted in the amplitude and time of the P wave, amplitude of the S wave, and amplitude of the T wave

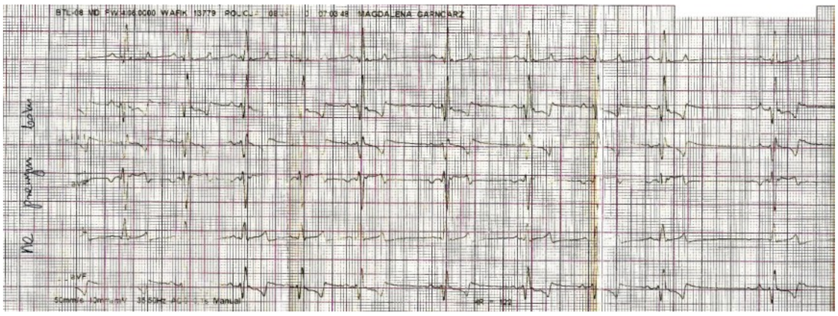

Fig. 1a. Right lateral recumbency

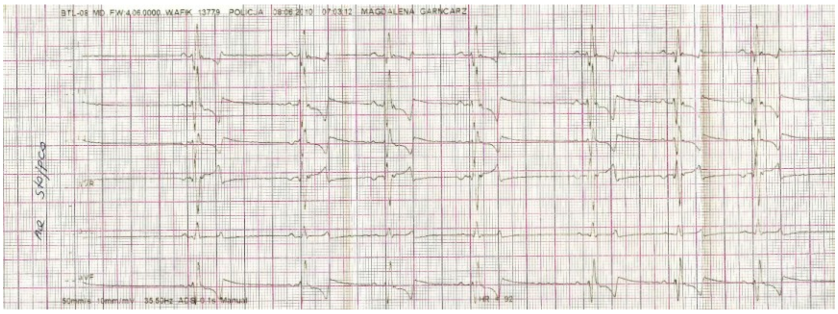

Fig. 1b. Standing position

Figs 1a and 1b. Electrocardiogram of a dog in standing (b) position and in right lateral recumbency (a)

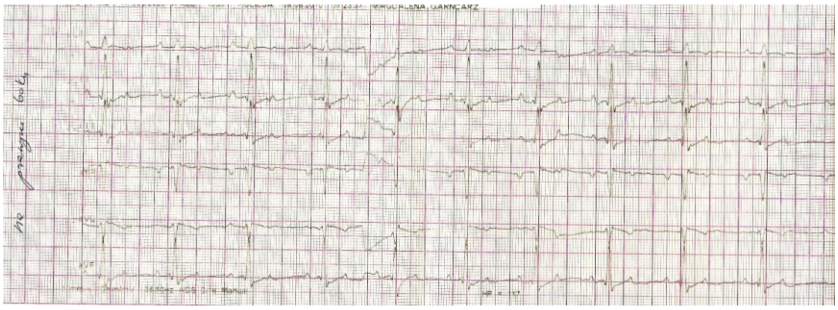

Fig. 2a. Right lateral recumbency

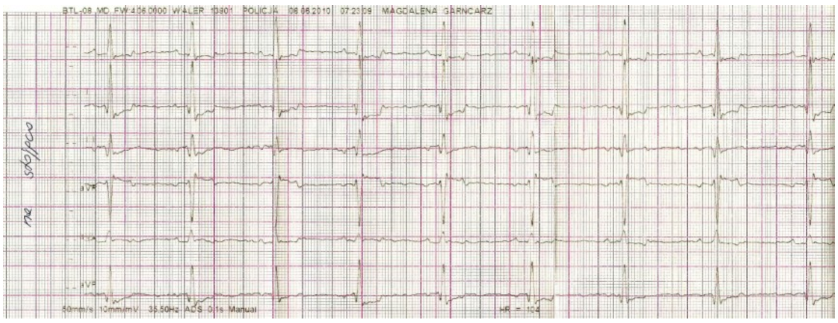

Fig. 2b. Standing position

Figs 2a and 2b. Electrocardiograms of a dog in right lateral recumbency (a) and in standing position (b)

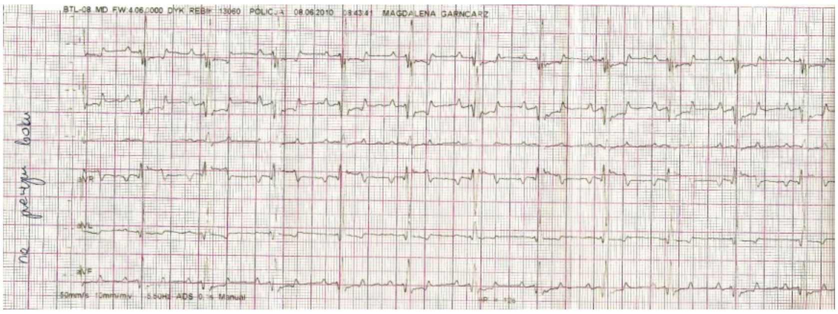

Fig. 3a. Right lateral recumbency

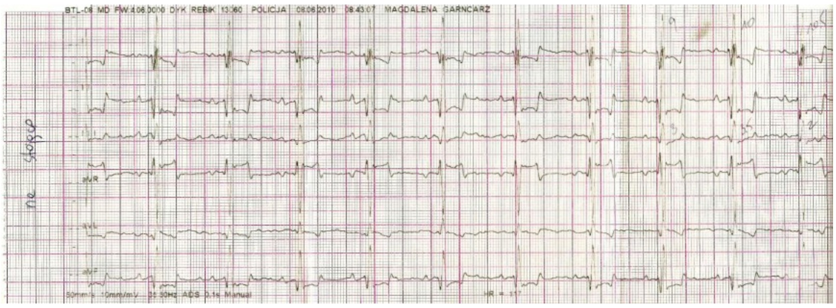

Fig. 3b. Standing position

Figs 3a and 3b. Electrocardiogram of dogs in right lateral recumbency and in standing position

In seven dogs with a sinus arrhythmia in RL recumbency, there was a normal sinus rhythm in standing position with no change in heart rate. As stated previously ECGs were performed first in the standing position to minimise stress, but the fact that the sinus arrhythmia appeared only after the dog was placed in RL position and the HR was not significantly slower proves that this was not achieved. A slower heart rate with a sinus arrhythmia in the standing position was expected. On the other hand, the quality of both recordings was comparable.

Some dogs were included in the study even though echocardiography showed mitral regurgitation. These mild changes were, however, not associated with cardiac chamber enlargement, which was the basis for inclusion, as there would be no reason for signs of chamber enlargement on the ECG.

Published articles relating to ECG recordings performed in various positions described differences in the ECGs, in several leads. However, the differences that were described usually did not have an influence on the interpretation of the ECG recording. The Coleman and Robson's (1) study on 31 dogs showed that there were significant differences in the P, Q, R, and S waves that could have an influence on ECG interpretation; however, these differences were mainly seen in other than lead II. Their study also showed that the sitting position was the most optimal, with readings closest to the referenced RL position. However, recordings performed in the sitting position had the greatest number of artefacts and recording in this position could not be performed in six of the studied dogs.

Rishniw *et al.* (5) showed that there were many differences in ECG recordings from various positions. Similarly to other studies, these changes were noted in all leads. The authors suggest that normal values should be established for several body positions because of these significant differences. Two significant differences that were seen in lead II included higher amplitude of the Q and R waves in the standing position. There was also a shift of the mean electrical axis to the left in the standing position; however, the values remained within a reference range.

Hanton's *et al.* (2) research showed some significant differences between dogs examined electrocardiographically in the standing and hammock hanging position; however, the authors stated that the majority of dogs were of a little significance and were not clinically important. These examinations were carried out on a large population of beagle dogs belonging to two different breeding lines (a relatively uniform study group) and were aimed at establishing ECG reference values for Beagle dogs to be used for toxicity studies. They did not, however, study the difference between standing and right lateral recumbency. The main differences noted between the two positions studied were a shift of the mean electrical axis to the left in the hammock position and a slightly longer QT duration recorded in the standing position (not statistically significant).

On the basis of the study it can be stated that there were no clinically significant differences in ECG lead II recordings performed in RL recumbency and standing positions. The noted differences, even when statistically significant, did not change the results of the interpretation of the recordings. Nowadays, in face of other diagnostic techniques, the ECG plays a minor role when assessing cardiac chamber size. Its role is complementary to echocardiography and radiography, and therefore the authors believe that making the examination easier is valuable, especially when performing the exam without any technical help. The reference values are therefore needed to be established for other positions.

The drawbacks of the study are a small number of dogs, as well as a lack of computer analysis of ECG recordings allowing for a faster and more precise scrutiny. The further studies are also needed on a larger population of dogs in order to provide the needed reference values.

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