Agreement between ECG values obtained in the sternal recumbent position and right lateral recumbency in goats

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Summary

The aim of the study was to analyze if body positioning during electrocardiogram recording has an influence on the results in goats. Forty-seven Polish White Improved and Polish Fawn Improved goats from a large dairy herd selected for sanitary culling due to caprine arthritis-encephalitis virus (CAEV) infection, ranging from 2-12 years (median 5.5 years) were included in the study. ECG records were obtained from each goat in the sternal recumbent position and in right lateral recumbency using ASPEL AsCARD Mr. Silver machine with a frequency range of 0.05-150 Hz. The signals from leads I, II, III, aVR, aVL and aVF were recorded for 30 seconds. The mean values of P, QRS, T, PQ, QT, P-R duration (in sec) and P, Q, R, S, T waves amplitude (mV) were measured and analyzed. Values obtained in both positions did not differ significantly.

Keywords: electrocardiography, goat, agreement, position

Electrocardiography provides information on the electrophysiological function of the heart, mainly on rhythmicity, conduction, depolarization and repolarization. In dogs (and some other animal species) electrocardiogram (ECG) recordings are obtained in different positions: right or left lateral recumbency, standing freely or in a sling, sitting position, anaesthetized and placed in dorsal recumbency (2, 4, 6, 13). It is well known that many factors may influence ECG recordings. One of these factors is the body position of the patient. Body position changes in humans may cause QRS and ST-T changes and trigger false alarms (9). Such effects have also been recognized in dogs (6, 13, 15) and even position-specific reference ranges were suggested for this species to avoid misinterpretation (13). The Academy of Veterinary Cardiology recommended that ECGs should be obtained from dogs placed in right lateral recumbency with the forelimbs perpendicular to the long axis of the body and the dog lightly restrained by an assistant. The main advantage

of recording an ECG in lying position is that muscle tremor artefacts are reduced (2). On the other hand, lateral recumbency is usually more stressful for the animal.

Publications about the technique of ECG recording in goats and reference values for this species are sparse. Normal ECG values were determined on 16 Jamunapari goats (8), 50 Markhoz goats (3), 20 Black Bengal goats (12), 48 Black Bengal goats (1), 118 Iranian Najdi goats (11) in standing position, 19 Saanen goats in right lateral recumbency (10). In some studies, possible breed differences in ECGs obtained from healthy goats have been suggested (8, 10) as well as the need for better understanding of the caprine ECG, especially with regards to its variability (8). To date, the optimal position for obtaining an accurate and reproducible ECG in goats has not been investigated. Therefore, the aim of this study was to compare the results obtained from the same goats in the sternal recumbent position with recordings in right lateral recumbency.

Material and methods

Forty-nine female Polish White Improved and Polish Fawn Improved goats from a large dairy herd were enrolled into this study. Their age ranged from 2 to 12 years with a median of 5.5 years and interquartile range (IQR) between 3.7 and 7.1 years. They were all intended for sanitary culling due to infection by caprine arthritis-encephalitis virus (CAEV) as confirmed by ELISA (ID Screen MVV/CAEV Indirect – Screening test, ID.vet Diagnostics, France) detecting anti-CAEV antibodies. The auscultation of all 49 goats were normal. Standard 6-lead ECGs were recorded with leads I, II, III, aVR, aVL and aVF. Using alligator clips the electrodes were attached in the same places for both positions studied: on both chest limbs directly behind the elbow on the skin fold between the limb and chest, and on both abdominal limbs cranially to the pelvic limb on the skin fold between the limb and abdomen. Ethyl alcohol and electrocardiography gel (Aquasonic, Parker Laboratories) were applied to aid transmission of electro activity. From each animal ECGs were recorded in 2 positions: right lateral recumbency and sternal recumbency. Keeping the animals in the lateral position required gentle restraint by 2 persons. In the sternal position only one person was needed. ECGs were obtained using an ASPEL AsCARD Mr. Silver machine with a frequency range of 0.05-150 Hz. The signals from all 6 leads were recorded for 30 seconds and the ECGs strips were printed at 50 mm/s and 10 mm/mV parameters. For each goat in each position the mean of 3 consecutive values of P, QRS, T, PQ, QT, P-R duration (in sec) and P, Q, R, S, T waves amplitude (mV) were calculated by two independent evaluators. Records with severe tremor artefacts disturbing interpretation of the P and T waves were excluded from the evaluation.

The mean ECG values obtained in the 2 positions were expressed as the median, interquartile range (IQR) and range and were compared using the paired-sample t-test or Wilcoxon's signed-rank test unless their differences were normally distributed according to the Shapiro-Wilk W test. Correlation between heart rate (HR) and ECG measurements was calculated separately for each position using Spearman's rank-order correlation coefficient (r_s). A significance level (α) was set at 0.05. The statistical analysis was performed using Statistica 12 (StatSoft, Inc.).

Results and discussion

Among the 49 obtained ECGs, 2 were illegible in both positions because of severe tremors. The values of the remaining 47 goats are presented in Table 1. No significant differences between the values obtained in the two positions were found (Tab. 1). In most goats left hearth axis deviation was observed regardless of the

Tab. 1. ECG measurements (median, IQR, range) in 47 dairy goats in sternal recumbency versus right lateral recumbency

ECG parameter	Position		Normality of difference distribution	p
	Sternal	Right lateral		
HR [bpm]	100, 90-130 (80-160)	100, 90-120 (70-180)	0.037	0.537 ^b
P _{dur} [s]	0.04, 0.04-0.05 (0.03-0.07)	0.05, 0.04-0.05 (0.03-0.06)	0.361	0.168 ^a
P _{amp} [mV]	0.11, 0.07-0.14 (0.02-0.20)	0.10, 0.09-0.13 (0.05-0.18)	0.943	0.129 ^a
PQ _{dur} [s]	0.09, 0.08-0.10 (0.05-0.63)	0.09, 0.08-0.10 (0.06-0.17)	< 0.001	0.073 ^b
QRS _{dur} [s]	0.06, 0.05-0.07 (0.04-0.07)	0.06, 0.05-0.06 (0.03-0.08)	0.315	0.372 ^a
Q _{amp} [mV] ^c	0.09, 0.05-0.16 (0.03-0.30)	0.13, 0.06-0.17 (0.05-0.23)	0.360	0.901 ^a
R _{amp} [mV]	0.05, 0.04-0.10 (0.02-0.45)	0.05, 0.03-0.14 (0.01-0.6)	< 0.001	0.451 ^b
S _{amp} [mV]	0.33, 0.14-0.50 (0.01-2.00)	0.33, 0.17-0.38 (0.05-1.08)	< 0.001	0.978 ^b
QT _{dur} [s]	0.29, 0.25-0.31 (0.12-0.35)	0.29, 0.25-0.31 (0.08-0.35)	0.001	0.806 ^b
ST _{amp} [mV]	0, 0-0.03 (-0.5 – 0.13)	0, 0-0.04 (-0.08 – 0.58)	< 0.001	0.404 ^b
T _{dur} [s]	0.07, 0.06-0.09 (0.04-0.12)	0.07, 0.06-0.09 (0.05-0.21)	< 0.001	0.717 ^b
T _{amp} [mV]	0.39, 0.23-0.6 (0.08-1.60)	0.47, 0.27-0.57 (0.05-1.65)	0.330	0.468 ^a
Axis [°]	-73.7, -101-50.7 (-165.3-172.3)	-50.7, -121.7-71.7 (-173.3-178.7)	< 0.001	0.966 ^b

Explanations: a – paired-sample t-test; b – Wilcoxon's signed-rank test; c – measured in 7 goats only

Tab. 2. Hearth axis and its deviation in 47 dairy goats in sternal recumbency versus right lateral recumbency

Heart axis	Position	
	Sternal	Right lateral
Normal	5 (11%)	9 (19%)
Left axis deviation	33 (70%)	28 (60%)
Right axis deviation	9 (19%)	10 (21%)

position during ECG recording (Tab. 2). The median HR was 100 beats per minute (bpm) in both positions (Tab. 1). Correlation between HR and ECG findings in 47 goats in the sternal recumbent position versus right lateral recumbency is presented in Table 3.

Our study showed no HR differences in goats examined in the sternal recumbent position or in lateral recumbency (Tab. 1). A similar comparison in dogs examined in standing or in lateral recumbency also showed no differences in the HR. The median value in our goats was 100 bpm (range 80-160), which was similar to the mean values reported by Szabuniewicz for cross-bred goats (96 bpm) (16), and for Black Bengal goats (101 bpm) (1), lower than mean rates obtained by Pogliani et al. for Saanen goats (129 bpm) (10), Mohan et al. for Jamunapari goats (127 bpm) (8) and Fakour et al. for Markhoz goats (110 bpm) (3), but

Tab. 3. Correlation between heart rate (HR) and ECG findings in 47 dairy goats in sternal recumbency versus right lateral recumbency

ECG parameter	Sternal r_s	p	Right lateral r_s	p
P_{dur} [s]	-0.15	0.321	-0.02	0.919
P_{amp} [mV]	-0.16	0.294	-0.04	0.788
PQ_{dur} [s]	-0.02	0.919	-0.19	0.194
QRS_{dur} [s]	-0.19	0.207	0.02	0.909
Q_{amp} [mV]c	-0.73	0.063	-0.20	0.598
R_{amp} [mV]	-0.19	0.190	-0.05	0.722
S_{amp} [mV]	-0.16	0.270	0.08	0.585
QT_{dur} [s]	-0.75	< 0.001*	-0.64	< 0.001*
ST_{amp} [mV]	-0.11	0.466	-0.14	0.364
T_{dur} [s]	-0.33	0.024*	-0.05	0.718
T_{amp} [mV]	-0.24	0.103	-0.12	0.429
Axis [°]	0.20	0.182	-0.17	0.241

higher than those observed by Kant et al. for cross-bred goats (90 bpm) (7). These differences can reflect breed specificity; however, goats of different age were used in the studies mentioned above, and age is an important factor determining the HR. As shown in Table 3 the only ECG measurements linked to HR in our goats were QT duration and T duration: QT duration was negatively correlated with HR (i.e. decreased as HR was rising), and this was observed in both positions. A similar effect was found in beagles (6). Additionally, T duration in our goats was also negatively correlated with HR, but only in animals examined in the sternal position.

It has been suggested that the electrical axis may not have a good clinical value to monitor pathological heart alterations in goats, as a wide range of this value is usually observed in normal animals (1, 8, 10). Our results seem to support this suggestion, as only 11% to 19% animals had normal electrical axis, depending on the body position at recording (Tab. 2).

Some studies in dogs demonstrated that the position of the body, and especially of the forelimbs, may influence the ECG records (13, 15).

In right lateral recumbency the cardiac silhouette moves closer to the right lung and to the electrodes potentially augmenting voltages on the right side of the patient (14). Some studies have shown, that this position results in dogs also in a rightward shift in the mean electrical axis, as compared with records obtained in standing (13-15). However, this seems not to be a general rule, as the effects of lateral versus sternal recumbent positions for ECG recording in cats of various breeds and age could hardly be demonstrated (5). Moreover, we did not find significant differences in ECG values obtained in goats in sternal recumbency and in right lateral recumbency (Tab. 1). This would mean that position-specific reference ranges of ECG values are not necessary in goats.

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