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DETERMINATION OF VALUES OF THE ELECTROCARDIOGRAM'S MAIN COMPONENTS REGISTERED ON CALVES AT DIFFERENT AGES

Marian GHIȚĂ[1], Gabriel COTOR[1], Rosalie BĂLĂCEANU[1], Leonard George TOBĂ[2]

[1]University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59 Mărăști Bd. District 1, Bucharest, Romania
[2]Romanian Academy, National Institute of Economic Research "Costin C. Kiriţescu" Studies and Research Center of Biodiversity "Acad. David Davidescu", No. 13, 13 September Route, District 5, Bucharest, Romania

Corresponding author email: marianvet@yahoo.com

Abstract

This study aims to determine the values of the main components of the calf electrocardiogram (ECG), because we believe that at this age, the knowledge of these values is useful in veterinary medical decisions. Duration of the ECG components (waves, segments and intervals) provides valuable information on electrical phenomena and therefore the mechanical activity of the heart during a cardiac revolution. Also, in our study we calculated the heart rate electrocardiographic (based on R-R interval), this being the main parameter for monitoring the cardiac function. To achieve the objectives we established a group of 10 healthy calves from Romanian Black Spotted breed, to whom we recorded the electrocardiograms at different ages. Electrocardiograms were then interpreted, and the results were compared with results obtained by other authors.

Key words: *age, calf, component, electrocardiogram, value.*

INTRODUCTION

Studying veterinary literature in the field, we found that there is a high incidence of heart disease in calves (myocardium dystrophies, changes in size of the compartments of the heart, pericardial effusion), and also that at this age there is a whole spectrum of pathological conditions (digestive disorders, respiratory, etc.) which are passed on cardiac function (Codreanu et al., 2012). We observed that cardiac pathology is quite present in calves especially after birth, based on the myodistrophy due to the deficiency in Vitamin E and Selenium (Codreanu et al., 2013).All these conditions (cardiac or extra-cardiac) can cause changes in electrocardiographic parameters both in terms of wave amplitude value and values of electrocardiogram's components (Brăslașu et al., 2004).This study is addressed only to the latter aspect, because we appreciate that knowing the electrocardiogram values is a very useful component for the veterinary doctor, allowing him to easily observe changes in heart rate (tachycardia, bradycardia, arrhythmias of various types).

Also, knowing the values of the ECG allows the veterinarian to obtain data on electrical events that occur in the myocardium (atrial depolarization, ventricular depolarization and ventricular repolarization), changes in levels of some components of the electrocardiogram indicating current conduction disorders of cardiac action. For the above reasons, we believe that, in calves, knowing the values of electrocardiogram has a practical significance.

MATERIALS AND METHODS

To register electrocardiogram on calves, we used a portable electrocardiograph (ECG machine), collectors type alligator and contact surface between the animal skin and catcher (rubbing alcohol or gel). For the registration of calves' electrocardiogram it is recommended that the animals are examined in a standing position (ensuring a slight contention by one person is enough) and that the hair is shaved on the area where the collectors are placed (because hair can be a barrier against bio-currents cardiac transmission from the skin to

collectors).The parameters used in our study were the recording speed of 25 millimeters per second and amplitude of 10 mm for one mV. To register electrocardiogram on calf we used limbs leads, which involve placing electrodes on the body surface as follows: red electrode behind the right olecranon, yellow electrode behind the left olecranon, green electrode at the inguinal fold region on the left side, and the black electrode at the inguinal fold region on the right side. By placing electrodes in this way, we can record 6 ECG leads: 3 bipolar leads (D I, D II and D III) and 3 unipolar leads (aVR, aVL and aVF) (Dojana et al. 2015). Electrocardiograms were recorded on a group of 10 calves at the ages of 7 days, 30 days, 60 days, 90 days, 120 days, 150 days and 180 days. The values obtained were used to calculate the length of the main components of the electrocardiogram.

RESULTS AND DISCUSSIONS

In our research, regarding the values of some components of the electrocardiogram we determined the following electrocardiographic parameters: the duration of the P-wave, P-R interval (P-Q) (which represents the atrial systole and diastole), complex ventricular (QRS interval) (representing ventricular systole and diastole), Q-T interval, T-wave, interval P-T (which represents the duration of a heart revolution), the segment T-P (which represents the duration of general diastole), R-R interval (which is the interval between two heart revolutions), the S-T segment and heart rate (calculated based on the R-R interval).

We specify that the duration of electrocardiogram's components does not depend on the lead used for recording ECG where measurements are made, because the time required for the cardiac current action to cross the entire myocardium is the same no matter of the lead system used for recording. For this reason, we analyzed and measured electrocardiograms recorded in D II and D III, these leads giving the highest amplitude ECG waves, therefore giving the electrocardiogram the best aspect regarding the calculation of the components' duration (waves, segments and intervals). Our results are presented in the following table and will be accompanied by brief comments.

Table 1. The average duration of electrocardiogram components recorded in calves of different ages (seconds)

Age	P	P-R P-Q	QRS	Q-T	T	P-T	T-P	R-R	S-T
7 days	0.04	0.12	0.04	0.24	0.06	0.28	0.10	0.4	0.12
30 days	0.04	0.12	0.04	0.24	0.06	0.36	0.12	0.50	0.10
60 days	0.04	0.12	0.04	0.24	0.08	0.36	0.14	0.52	0.12
90 days	0.04	0.12	0.04	0.24	0.06	0.36	0.20	0.54	0.10
120 days	0.04	0.12	0.04	0.24	0.08	0.34	0.20	0.56	0.14
150 days	0.04	0.12	0.06	0.26	0.08	0.40	0.24	0.64	0.12
180 days	0.06	0.14	0.04	0.28	0.08	0.42	0.28	0.72	0.18

Looking at the data shown in Table 1, it is noted that the duration of the electrocardiographic waves resent variations and the values obtained, as well as their interpretation are given below.

P-wave duration was 0.04 seconds in all the studied age groups, with one exception (in calves older than 180 days atrial depolarization lasted longer, with the value of 0.06 seconds) (Fig. 1). This change can be explained as the calf gets older, a diminution of the cardiac current's speed is located at the excitoconductory system, thanks to the increasing of beat volume.

Regarding the duration of ventricular complex, the values we obtained were 0.04 seconds at calves from all studied age groups, except for calves older than 150 days, observation which we cannot explain. We observed that our values fall between the limits encountered in veterinary literature (Brăslașu, 2000; Mendez et al., 2001). T-wave duration was between 0.06 and 0.08 seconds, with values lower than those found in veterinary literature (Brăslașu et al., 2014; Mendez et al., 2001).

Regarding the length of segments and intervals, the values obtained by us will be listed below accompanied by interpretations and comparisons with results disclosed by other authors.The average duration of the P-R interval was 0.12 seconds at all ages and 0.14 seconds for calves older than 180 days (so, atrial depolarization and repolarization takes longer at this age).

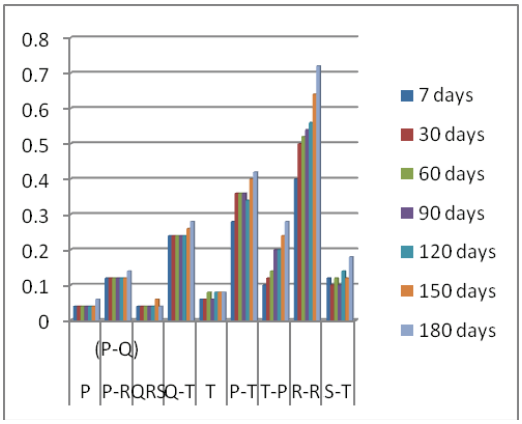

Figure 1. Mean values of electrocardiogram's components of calves at different ages

During the Q-T interval (which represents the ventricular systole and diastole) is ranged from 0.24 seconds (at calves aged between 7 and 120 days) to 0.28 seconds (calves at 180 days).

Regarding the duration of the R-R interval, which is the interval between two heart revolutions, we obtained values varied between 0.40 seconds and 0.72 seconds, which were positively correlated with age calves, and fit within the range found in the literature in the field (Brăslașu et al., 2014; Chalmeh, 2014).

During the P-T interval (which is the duration of a cardiac revolution) was ranged between 0.28 and 0.42 seconds. We observed that the correlation between this growth and calves' age is positive, signifying a prolongation of cardiac revolution along with the growth and development of the myocardium (heart enlargement and thus an increase stroke volume).

In terms of duration T-P segment (which is the duration of general diastole), the values that we obtained ranged in ascending order between 0.10 and 0.28 seconds and were positively correlated with calves' age, falling within the range found in the veterinary literature (Brăslașu et al., 2004; Mendez et al., 2001). This finding could be due to the neurovegetative balance, which is final at weaned calves, moved in compartments addressed to increase youth.

The final analyzed component was S-T segment, whose duration was between 0.10 and 0.18 seconds, with variations between studied age groups.

Values obtained for heart rate (based on R-R interval) are shown in Table 2 and their dynamic evolution can be observed in Figure 2. We mention that the heart rate was calculated at end of the recording, because at that time the animal is calm and accustomed with the sensors and with the presence of the persons who restrained it and recorded the ECG.

So, at this juncture, the heart rate values are lower compared to those from the start of the recording.

Table 2. Electrocardiographic calculated values of heart rate in calves of different ages (bpm)

Age	Mean heart rate	s
7 days	150	2.6
30 days	120	2.4
60 days	115.3	2.1
90 days	111.1	2.01
120 days	107.1	2.4
150 days	93.7	1.8
180 days	83.3	1.7

Studying the data presented, it can be observed that heart rate is negatively correlated with calves' age, the values we obtained falling between 150 bpm at 7 days old calves and 83.3 bpm at 180 old days calves. In calves aged between 30 and 90 days, heart rate changes are less obvious, falling between 120 and 111.1 bpm.

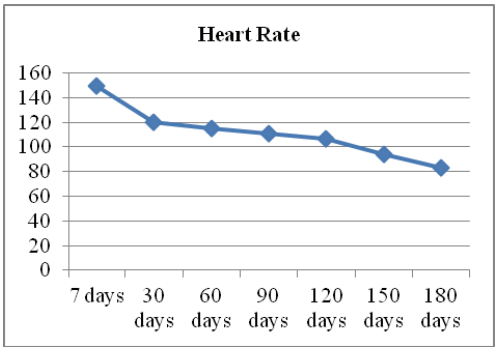

Figure 2. Changes in heart rate electrocardiographicaly calculated on the basis of R-R interval in calves at different ages

CONCLUSIONS

Some of monitored parameters (QT, PT, TP, RR, ST) increased with advancing age of the animals.

Other monitored parameters (P, PR, QRS,T) showed no changes with advancing age.

The heart rate is negatively correlated with the age of calves. In calves aged between 30 and 90 days, the heart rate changes are less obvious falling.

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