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Standard electrocardiographic values in Holstein calves

[*Valores eletrocardiográficos normais para bezerros holandeses*]

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ABSTRACT

This paper presents electrocardiographic values in 25 Holstein calves using the standard bipolar limbs leads (I, II and III), augmented unipolar limb leads (avL, avR and avF) and a bipolar chest lead (V_{10}). Two groups with different ages were compared (newborn - 18 to 72 hours and calves - 27 to 33 days old). It was concluded that no differences between age groups in P, Q, R, S and T waves, in the PR, QRS, QT and ST intervals and in axis orientation were observed.

Keywords: Calf, newborn, eletrocardiography, ECG

RESUMO

Este artigo apresenta valores eletrocardiográficos de 25 bezerros da raça Holandesesa, utilizando-se as derivações bipolares de membro (I, II, III), unipolares aumentadas de membro (avL, avR e avF) e uma derivação bipolar de torax (V_{10}). Dois grupos com animais de diferentes idades foram comparados (18 a 72 horas e 27 a 33 dias de idade). Conclui-se que não houve diferença significativa entre os grupos nas ondas P, Q, R, S e T, nos intervalos PR, QRS, QT e ST e no eixo cardíaco.

Palavras-chave: Bezerro, neonato, eletrocardiograma, ECG

INTRODUCTION

Electrocardiography is a noninvasive, inexpensive technique that yields useful information in classification of arrhythmias, diagnosing conduction abnormalities and it also is a valuable aid in prognostic and therapeutic considerations (Fregin, 1985; Claxton, 1988).

The electrocardiogram (ECG) provides a record and measure of the varying potential difference that occurs over the surface of the body as the result of electrical activity within the heart. This is associated with depolarization and repolarization of the myocardium. In the normal heart, depolarization and repolarization of the myocardium occurs in a definite pattern and sequence and then the ECG can be used to measure and time these events. Thus discharge of the sinoatrial node results in a wave of

depolarization over the atria to produce a P wave in the ECG. The delay in conduction at the AV node is registered by no electrical activity at the body surface and an isoeletric P-R interval on the ECG. Depolarization of the ventricles occurs with several sequential fronts to produce the QRS complex which is followed by another isoelectric period before repolarization represented by the T wave (Radostits et al., 1994).

Following birth and during early growth of the foal there are age-dependent increases in the electrocardiographic intervals and changes in the orientation of the mean electrical axis (Lombard et al., 1984; Ayala et al., 1998).

The standard bipolar limb leads recorded are right foreleg and left foreleg (lead I), right foreleg and left hind leg (lead II), and left foreleg and left hind leg (lead III). In the augmented unipolar limb leads, two of the three limbs used in the standard bipolar leads are paired against the third limb and are labeled as aVR (right foreleg), aVL (left foreleg) and aVF (left hind leg). In the unipolar chest lead (V_{10}) the electrode are positioned over the dorsal spinous process of the seventh thoracicvertebrae (Fregin, 1985).

The potential use of electrocardiography in cattle is well recognized (De Roth, 1980) and limited information exists regarding to the evolution of the electrocardiogram in calves (Amory et al., 1993) because most ECG studies in young animals have been carried out in horses (Lombard et al., 1984; Ayala et al., 1998).

The purpose of this study was to establish normal electrocardiographic values in the Holstein calf, using the standard bipolar limb leads (I, II and III), augmented unipolar limb leads (avL, avR and avF) and a bipolar chest lead (V_{10}).

MATERIALS AND METHODS

The study was carried out on 25 clinically healthy male Holstein calves divided into two groups. In the group one, 12 newborn calves aged between 18 to 72 hours and in the group two, 13 calves aged between 27 to 33 days.

Electrocardiograms were obtained with one-channel recorder (CD-60M) (Berger, Brazil), with a 50 mm/s paper speed and calibrated 10 mm/mV. The standard bipolar leads, augmented unipolar leads and a unipolar chest lead were used. The electrodes were fixed directly to the skin with alligator clips after application of an electrode paste.

The calves stood on a rubber mat for insulation during the recording sessions and the electrocardiogram was only recorded when the calf was calm and standing in a square position. The animals were not sedated.

The heart rate was calculated from the electrocardiographic records. The waves P, Q, R, S and T, and the duration of intervals PR, QRS, QT and ST, were measured and averaged from successive beats and the morphology of P, QRS and T complexes was analyzed following the usual conventions (DeRoth, 1980).

Mean and range (confidence interval 95%) were calculated for each parameter (waves, intervals and axis). An analysis of variance was carried out to examine the effect of age on each parameter, at 5% probability level. For statistical analysis a computer programme was used (Sigma Stat) (Jandel Scientific, USA).

RESULTS

The results obtained from different electrocardiographic parameters are shown in Tables 1 and 2. The measured heart rates were not significantly different from each other during the first month of life (mean G1 = 127 ± 22 and mean G2 = 112 ± 22). All the animals had a normal sinus rhythm.

The duration of P wave (mean ± SD) was 0.06s ± 0.02 in both groups and its amplitude was 0.18mv±0.11 and 0.13mv±0.11 in group 2. The P wave in lead II, persisted positive in major time, however in a few cases it was negative**.** The duration of PR and QRS segments were 0.13s±0.03 and 0.06s±0.01 in both groups, respectively. The amplitudes of Q, R and S were -0.42mv±0.12, 0.22mv±0.13 and -0.73mv±0.57 in group 1 and -0.25mv±0.12, 0.23mv±0.13 and -0.57mv±0.57 in group 2, respectively. The configuration of QRS complexes amplitudes presented negative form because the waves Q and S were frequent in the major cases and R wave was short .

Table 1. Values of heart rate, waves (P, Q, R, S and T) and interval segments (PR, QRS, QT and ST) of Holstein newborn calves aged 18-72 hours [mean ± standart deviation (SD)].

	Heart rate	P (sec)	P (mV)	PR (sec)	QRS (sec)	Q (mV)	R (mV)	S (mV)	QT (sec)	ST (sec)	T (sec)	T (mV)
1	130	0,06	0,2	0,12	0,06	-0,65	0,2	-0,05	0,24	0,12	0,08	0,2
2	150	0,08	0,2	0,14	0,06			-1,6	0,24	0,06	0,08	0,5
3	160	0,06	0,2	0,08	0,06	-0,35	0,5		0,24	0,1	0,06	-0,15
4	140	0,06	0,45	0,16	0,1			-0,9				-1,1
5	100	0,08	0,15	0,14	0,06	-0,4	0,25		0,28	0,12	0,12	-0,4
6	110	0,06	0,2	0,14	0,04		0,15		0,26	0,14	0,08	-0,1
7	150	0,02	0,1	0,08	0,06				0,24	0,14	0,06	-0,2
8	90	0,04	0,05	0,14	0,06	-0,4	0,15		0,26	0,14	0,08	
9	130	0,08	0,2	0,12	0,06			-0,5	0,26	0,12	0,08	
10	120	0,06	0,2	0,08	0,06		0,05	-0,6	0,28	0,12	0,1	-0,6
11	135	0,04	0,05	0,14	0,04	-0,3	0,25		0,26	0,12	0,12	0,6
12	110	0,04		0,16	0,06	-0,4	0,2		0,24	0,12	0,06	0,2
Mean	127	0,06	0,18	0,13	0,06	-0,42	0,22	-0,73	0,25	0,12	0,08	-0,11
SD	22	0,02	0,11	0,03	0,01	0,12	0,13	0,57	0,02	0,02	0,02	0,51

Table 2. Values of heart rate, waves (P, Q, R, S and T) and interval segments (PR, QRS, QT and ST) of Holstein calves aged 27-33 days [mean ± standart deviation (SD)].

	Heart rate	P (sec)	P (mV)	PR (sec)	QRS (sec)	Q (mV)	R (mV)	S (mV)	QT (sec)	ST (sec)	T (sec)	T (mV)
1	110	0,06	0,01	0,16	0,06	-0,3	0,15		0,3	0,16	0,08	0,25
2	170	0,08	0,02	0,12	0,08			-1,7	0,22	0,04	0,16	0,6
3	140	0,04	0,15	0,1	0,03			-0,65	0,16	0,08	0,06	0,55
4	140	0,04	0,15	0,12	0,06		0,9		0,24	0,12	0,06	
5	90	0,02	0,05	0,14	0,06	-0,6	0,05		0,28	0,16	0,12	0,4
6	90	0,06	0,15	0,12	0,06		0,1	-0,55	0,28	0,12	0,12	0,5
7	130	0,06	0,25	0,1	0,06			-0,75	0,24	0,12	0,1	0,5
8	100	0,08	0,2	0,14	0,08	-0,05	0,2		0,28	0,14	0,1	0,6
9	80	0,08	0,2	0,14	0,06			-0,5	0,28	0,16	0,08	0,3
10	80	0,08	0,2	0,12	0,04		0,1	-0,25	0,32	0,18	0,1	0,55

11	80	0,08	0,25	0,2	0,06			-0,1	0,28	0,12	0,1	0,3
12	120	0,06	0,15	0,12	0,04			-0,4	0,24	0,12	0,1	0,4
13	120	0,04	0,1	0,1	0,04	-0,05	0,1	-0,25	0,24	0,12	0,12	0,6
Mean	112	0,06	0,14	0,13	0,06	-0,25	0,23	-0,57	0,26	0,13	0,10	0,46
SD	22	0,02	0,11	0,03	0,01	0,12	0,13	0,57	0,02	0,02	0,02	0,51

The duration of QT and ST segments was 0.25s±0.02 and 0.12s±0.02 in group 1 and 0.26s±0.02 and 0.14s±0.02 in group 2, respectively. The duration of T wave was 0.08s±0.02 in group 1 and 0.10s±0.02 in group 2 and its amplitude was -0.11mv±0.51 in group 1 and 0.46mv±0.51 in group 2. The configuration of the T wave can be positive or negative. The axis was - 82°±57 in group 1 and -60°±57 in group 2.

No significant differences between age groups were found for P, Q, R, S and T waves, and for PR, QRS, QT and ST intervals and for axis orientation.

DISCUSSION

Electrocardiography is the clinical method of choice to evaluate cardiac problems associated with the production and conduction of electrical stimuli. It is also a useful tool in evaluating electrolyte disturbances. Additional information can be derived from ECG as to the various modifications of cardiac volume (DeRoth, 1980). This standard electrocardiographic values allowed an electrocardiographic diagnosis of tetralogy of Fallot in one Holstein calf (Mendes et al., 1999).

Few studies have been performed in cattle, when compared to studies performed in horses and dogs. We were able to find only one study with values for calves, but with more emphasis on the vectorcardiogram. This absence of values considered normal, makes the interpretation of ECG difficult, leading us to extrapolate values of another ages, breeds and even of different species, emphasizing the importance of this study.

The values for electrocardiographic parameters in calves are similar to those reported by Amory et al. (1993). In contrast, the duration of interval segments (PR, QRS and QT) and P waves of normal Holstein cows (DeRoth, 1980) and Jersey cattle (Upadhyay et al., 1976) were longer than calf values in this study. This can be explained by the cardiac area enlargement and by the heart rate decreasing that naturally occurs during the animal growth, because these studied parameters, except PR interval, were dependent on heart rate (Amory et al., 1993).

Due to these differences, standard electrocardiographic values are important to avoid mistakes during the electrocardiogram interpretation, mainly when this is based on adult animals values.

Values of the two groups were not statistically different, so that future comparison of data could be tested with these two groups. Extrapolation values of another ages, breeds or species may lead to errors of interpretation of ECG, because the bovine ECG is strikingly different from human and canine ones. This distinction derives from anatomical and physiological characteristics from bovine heart (DeRoth, 1980).

The data obtained indicated that the electrocardiography is a simple technique that can be easily used in calves and the results could be used as reference values for clinical evaluations of cardiac diseases.

REFERENCES

AMORY, H., GENICOT, B., ROLLIN, F. et al. Normal electro- and vectocardiographic data in the growing friesian calf using a semi-orthogonal lead system. *J. Vet. Med.,* v.40, p.81-92, 1993.

AYALA, I., MONTES, A., BENEDITO, J.L. et al. Modifications of the form and amplitude of electrocardiographic QRS complex during growth in the spanish-bred horse. *J. Vet. Med.*,v.45, p.309-317, 1998.

CLAXTON, M.S. Electrocardiographic evaluation of arrhythmias in six cattle. *J. Amer. Vet. Med. Assoc.,* v.192, p.516-521, 1988.

DeROTH, L. Electrocardiographic parameters in normal lactating Holstein cow. *Can. Vet. J.,* v.21, p.271-277, 1980.

FREGIN, F.G. Electrocardiography. *Vet. Clin. North Am. - Equine Pract.,* v.1, p.419-432, 1985.

LOMBARD, C.W., EVANS, M., MARTIN, L. et al. Blood pressure, electrocardiogram and cardiogram measurements in the growing pony foal. *Equine Vet. J.,* v.16, p.342-347, 1984.

MENDES, L.C.N., BORGES, A.S., ALVES, A.L.G. et al. Tetralogia de Fallot em bovinos. *Arq. Bras. Med. Vet. Zootec.,* v.51, p.35-38, 1999.

RADOSTITS, O.M., BLOOD, D.C., GAY, C.C. Special examination of the cardiovascular system. In: *Veterinary Medicine.* London: Baillière Tindall. p.336-340, 1994.

UPADHYAY, R.C., SUD, S.C., JOSHI, H.C. et al. Electrocardiographic studies in Jersey cattle. *Indian Vet. J.,* v.53, p.953-961, 1976.