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A comparative evaluation of the base apex lead electrocardiogram in young and adult crossbred cows of Odisha

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Abstract

The study was carried out to compare the electrocardiographic outline of young and adult crossbred Jersey cows of Odisha. ECG was taken in all the animals in standing position. The lead I electrocardiogram was analyzed and data was compared using student's t-test. The P wave had a positive configuration in both young and adult animals. As far as the amplitude and duration of P-wave was concerned, the young animals recorded non-significantly higher values than adults. The same trend was observed for QRS complex amplitude and duration of T wave. The duration of QRS complex and amplitude of T wave recorded almost similar values in young and adults without any significant difference. The amplitude of QRS complex measured between 0.4 mV and 1.5 mV in young animals with a QS configuration (below the baseline) in 5 out of 6 animals. All QRS complexes and majority of T waves in lead I of adult animals presented a negative configuration. However, the T wave in most of the young animals had a positive configuration. The P-R interval was significantly lower in young animals. With respect to Q-T interval, the young animals and adults revealed no significant difference between each other with higher values recorded in adults. R-R interval was significantly lower in young animals. The heart rate in young animals was found to be significantly higher than adults. The study establishes normal reference values of different ECG parameters.

Keywords: Electrocardiogram, base apex lead, crossbred Jersey cows

Introduction

Electrocardiogram (ECG) is the recording of the potentials generated by the electrical current due to the passage of cardiac impulses through the heart ^[1]. Heart disease in cattle remains medically challenging both to diagnose and to treat ^[2]. Heart disease may ultimately lead to heart failure (HF) if the heart becomes overwhelmed by the progressively intensified compensatory neurohumoral response ^[3]. Electrocardiography can be used as a convenient mode for diagnosis of cardiac problems in cattle ^[4]. The crossbred Jersey cows are one of the most preferred populations of cow for farmers in Odisha, India. This study was carried out to analyze the electrocardiograms of normal healthy crossbred Jersey cows both in young and adult animals. The measured electrocardiographic values can be used as a standard reference guide for diagnosing cardiac problems in crossbred Jersey cows. To the best of our knowledge this is the first study ever on the electrocardiogram pattern of crossbred Jersey cows of Odisha, India.

Materials and Methods

Female young animals (less than six months of age, n=12) and cows (more than one year of age, n=12) constituted the study material. The animals were clinically examined and the animals having no history of any cardiac disorder or abnormal heart sounds were selected. Animals were kept in a standing position on a rubber mat without any sedative. A twelve-lead standard ECG recorder, Cardiart 108 MK-VII (BPL India) was used to record ECG. The electrocardiograph was set with a paper speed of 25mm/sec and sensitivity of 1 (1 cm= 1mv) and the 50 HZ filter of the electrocardiograph was turned "On". The positive electrode of lead I (left arm) was attached to the skin of the fifth intercostal space just caudal to olecranon and the negative electrode (right arm) on the jugular furrow about 1/3rd of the left side of the neck ^[5] (Figure 1). The lead I electrocardiogram was analyzed and data was compared using student's t-test.

The study had been conducted in a non-invasive manner by just attaching painless clips to the animal body.

Results

The Mean ± SE values of the ECG parameters in young and adult crossbred cows are given in Table 1a and Table 1b. The amplitude of P wave measured between 0.1 mV and 0.3 mV and had a positive configuration (above the baseline) in young and adult crossbred cows. The duration of P wave ranged between 0.04 sec and 0.08 sec in both young and adult animals (Table 1a).

The amplitude of QRS complex measured between 0.4 mV and 1.5 mV in young animals with a QS configuration (below the baseline) in 5 out of 6 animals. However, in adults it varied from 0.4 mV to 2 mV with QS configuration in all the animals (Table 1a). The QRS duration ranged between 0.04 sec and 0.12 sec in young animals while in adults it ranged from 0.04 to 0.08 sec (Table 1a).

The amplitude of T wave recorded positively (ranging from 0.1 to 0.4 mV) in 4 out of 6 young animals and 1 out of 6 adult animals (ranging from 0.1 to 0.3 mV) (Table 1a). The duration of T wave measured between 0.04 sec and 0.12 sec in young animals while it ranged from 0.04 sec to 0.08 sec in adult animals (Table 1b).

The PQ interval which indicates atrioventricular conduction time was recorded to vary between 0.16 sec and 0.20 sec in young animals whereas in adults it ranged from 0.20 sec to 0.28 sec (Table 1b). QT interval in young animals ranged from 0.2 sec to 0.32 sec and in adults ranged from 0.2 sec to 0.36 sec (Table 1b). The RR interval which represents a cardiac cycle had a wide range of 0.52 sec to 0.84 sec in young and 0.76 sec to 1.28 sec in adults (Table 1b).

The heart rate varied from 71 beats per minute (bpm) to 115 bpm in young animals and between 53 bpm and 85 bpm in adults (Table 1b).

Discussion

With respect to P-wave amplitude and duration, the young animals recorded non-significantly higher values than adults. Rezakhani *et al.* (2004) [5] also recorded almost similar values of P-wave amplitude in dairy cows.

Although the young animals recorded non-significantly higher

values than adults for QRS complex amplitude and T wave duration but the duration of QRS complex and amplitude of T wave recorded almost similar values in young animals and adults without any significant difference. The duration of QRS complex and T-wave recorded in our study were lower than those reported for adult animals [6]. All QRS complexes and majority of T waves in lead I of adult animals presented a negative configuration. The configuration of QRS complex amplitudes presented negative form because the waves Q and S were frequent in the major cases and R wave was short [7]. However, the T wave in most of the young animals had a positive configuration. Similar results were recorded in lead II Electrocardiogram in young and adult crossbred cows of Odisha [4]. The variation in T wave configuration between young animals and cows might be due to difference in anatomical distribution of Purkinje fibres resulting in variable re-polarization time of the ventricles.

The P-R interval was significantly lower in young animals than adults indicating faster atrioventricular conduction time in young animals. In addition, the values recorded in the adults are in agreement with studies made by Rezakhani *et al.* (2004) [5]. Age dependant increase in electrocardiographic interval and changes in orientation of mean electrical axis in foals were also reported [8].

With respect to Q-T interval, the young and adults revealed no significant difference between them although higher values were recorded in adult animals. Similar values of QT interval were reported by using lead II of Dubois lead [9].

R-R interval in young animals was significantly lower than adults. The heart rate in young animals was found to be significantly higher than adults and in line with those recorded in adult lactating Brown Swiss cows [6]. However, Mir *et al.*, 2000 [10] reported higher heart rates in lambs in comparison to adult animals and suggested short PQ interval and shorter interval between cardiac cycles being the reason behind this.

This study not only highlighted the variation in the electrocardiogram of young and adult crossbred cows but also laid down specific values of ECG parameters as well as the configuration of different ECG waves which could be referred by veterinary clinicians to diagnose abnormalities in the electrocardiogram of crossbred cows.

Table 1a: The mean ± SE values of the ECG parameters (lead I) in young and adult crossbred Jersey cows.

Animals	P-wave amplitude (mV)	P-wave duration (sec)	QRS complex amplitude (mV)	QRS complex duration (sec)	T-wave amplitude (mV)
Young	0.15±0.02 ^a	0.07±0.01 ^a	1.02±0.17 ^a	0.05±0.01 ^a	0.2±0.04 ^a
Adult	0.12±0.01 ^a	0.05±0.01 ^a	0.8±0.26 ^a	0.05±0.01 ^a	0.2±0.03 ^a

*Means having different superscripts in a column differ significantly (*p*<0.05).

Table 1b: The mean ± SE values of the ECG parameters (lead I) in young and adult crossbred Jersey cows.

Animals	T-wave duration (sec)	P-R interval (sec)	Q-T interval (sec)	R-R interval (sec)	Heart rate (beats per minute)
Young	0.07±0.01 ^a	0.14±0.01 ^a	0.28±0.02 ^a	0.68±0.05 ^a	91.23±7.15 ^a
Adult	0.06±0.01 ^a	0.22±0.01 ^b	0.33±0.03 ^a	1.02±0.07 ^b	61.33±5.34 ^b

*Means having different superscripts in a column differ significantly (*p*<0.05).



Fig 1: Placement of leads in a recording Electrocardiogram.

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