Electrocardiographic Profile of Low Handicap Polo Horses


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Abstract: Several changes in electrocardiographic examination may arise from training in horses, since changes in heart rate, heart rhythm and conduction system, until changes in ventricular depolarization and repolarization. The knowledge of the electrocardiographic profile specific to each modality allows the physical monitoring, distinguishing physiological responses from pathological conditions. In this context, this study aimed to describe the electrocardiographic profile of polo horses by determining the heart rate and rhythm, P-wave duration, QRS complex duration, P-R, Q-T and S-T intervals duration, T-wave amplitude, and still to establish the QTc and heart score. The results allow concluding that polo horses presented a pattern appropriate to the type of effort they played. The electrocardiographic profile revealed prevalence of sinus rhythm as the physiological one, wandering pacemaker, sinus bradycardia and second degree atrioventricular block. These alterations were considered as physiological ones. As for the morphology, positive bifid P-waves and negative-positive bifid T-waves predominated. The comparison between the sexes detected a significant difference only in QT interval, which was longer for females.

Key words: Cardiology. Equus caballus. Exercise.

INTRODUCTION

The ability of the heart to pump enough blood to meet the requirements of the horse during exercise is essential to maintain athletic performance of these animals. In order to meet demand, the heart adjusts to the required increases in metabolic and mechanical activities, resulting in electrical and morphological adaptations, providing an improvement in its function. These adaptations reduce the stress on the ventricular walls and at the same time, tend to promote greater demand for blood supply, allowing the animal to achieve maximum performance.

Electrocardiographic changes can be found in trained individuals, since alterations in heart rate, heart rhythm and conduction system, until changes in ventricular depolarization and repolarization (NEGRÃO & BARRETO 2010). In this way, cardiac indices of Mangalarga Marchador horses (DINIZ et al. 2008) and of endurance horses (DUMONT et al. 2010), assessed by echocardiography and electrocardiography, underwent changes after training period.

The electrocardiogram (ECG) aids the diagnosis of disorders of impulse formation and conduction and in evaluation of heart diseases, but its application must be carefully assessed as orientation, amplitude and duration of the ECG waves depend on several factors, including age, breed, sex, derivation examined and fitness level of the animal (REEF, 2009). The knowledge of the electrocardiographic profile specific to each sport practiced by horses is of utmost importance because it allows physical monitoring, distinguishing physiological responses from pathological conditions that may disqualify or even endanger the lives of these animals.

Cardiac adaptations are closely related to the type of training, providing electrocardiographic characteristics for different equestrian modalities. In this context, this study aimed to describe the heart rate and rhythm, P-wave duration, QRS complex duration, P-R, Q-T and S-T intervals duration, T-wave amplitude, and still to establish the QTc and heart score in horses trained to polo modality.

MATERIAL AND METHODS

This study used 33 clinically healthy, mixed breed, horses (14 females and 19 males), aged 4-16 years, average weight of 422.14 ± 36.19 kg and 425.25 ± 29.89 kg respectively, subjected to polo training, according to the routine of the 1st Cavalry Guard Regiment. The study was evaluated by the Ethics Committee on Animal Use (CEUA) of the Institute of Biological Sciences, University of Brasilia-52412/2010.

The animals were part of the polo squad of the 1st Cavalry Guard Regiment and were subjected to the same nutritional management and athletic training for at least one year. The study was conducted during regular
training in order to participate in the Army Championship of Polo/2010, considered low handicap. The weekly training consisted of four matches and each animal played just one chukker by training match for 30 days. Assessments occurred in the dry period with relative humidity of approximately 43% and average ambient temperature of 25ºC.

Electrocardiographic examination was performed on the day that the animals had not performed any physical exercise for at least 24 hours. Measurements were obtained with the animals in station restrained by halter. The device used was a C10 TEB and software ECGPC Veterinary 2.27. Electrodes were connected to the skin by conductive metallic type clips, moistened with alcohol. The electrocardiographic tracings lasted 60 seconds.

The record speed of tracings was 25 mm/s with sensitivity of the device set at 1mV = 1cm. We evaluated: heart rate and rhythm (Figure 1), duration (seconds) of the P-wave (Figure 2) and the QRS complex, duration of P-R, Q-T and S-T intervals, T-wave amplitude; and calculated the QTc. The heart score (HS) was calculated using the formula: EC = QRS (ms) DI+QRS (ms) DIH+QRS (ms) DII/3, and the QTc by the formula: QTc (ms) = QT (ms) /√RR (s). Electrodes were placed according to Dubois System in leads XED (xiphoid process toward the right scapula) and XEG (xiphoid process toward the left scapula). It was employed the precordial leads V4 in the sixth intercostal space (ICS) near the costochondral junction and V10 near the spinous process of the seventh thoracic vertebra.

A descriptive analysis provided the mean values and standard deviations. Then the Kolmogorov-Smirnov test checked for data normality, followed by a Tukey’s test, with significance level of 5%, when compared the sexes (Table 2).

**Results:**

The different arrangements observed in relation to cardiac rhythms, i.e., sinus, sinus bradycardia, wandering pacemaker and second degree atrioventricular block were expressed in Graph 1.

**Graph 1:** Relative distribution of cardiac rhythms in the electrocardiogram of polo horses.

Absolute values (mean and standard deviation) for the different sexes, found for heart rate, duration and amplitude of the waves P, Q, R, S and T, QRS and QT complexes duration and the heart score of the polo horses are shown in Table 1.

<table>
<thead>
<tr>
<th>Indices</th>
<th>Female</th>
<th>Male</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart rate (bpm)</td>
<td>35.00±4.24</td>
<td>39.77±8.84</td>
</tr>
<tr>
<td>P duration (ms)</td>
<td>138.35±18.61</td>
<td>148.27±19.88</td>
</tr>
<tr>
<td>PR duration (ms)</td>
<td>299.28±41.18</td>
<td>301.88±47.63</td>
</tr>
<tr>
<td>QRS duration (ms)</td>
<td>139.50±15.35</td>
<td>136.61±13.08</td>
</tr>
<tr>
<td>QT duration (ms)</td>
<td>504.14±37.71*</td>
<td>473.05±40.43*</td>
</tr>
<tr>
<td>QTc duration (ms)</td>
<td>383.50±29.32*</td>
<td>382.88±24.85*</td>
</tr>
<tr>
<td>P1 (+) amplitude (mV)</td>
<td>0.229±0.07</td>
<td>0.215±0.05</td>
</tr>
<tr>
<td>P2 (+) amplitude (mV)</td>
<td>0.311±0.07</td>
<td>0.29±0.05</td>
</tr>
<tr>
<td>R (+) amplitude (mV)</td>
<td>0.234±0.11</td>
<td>0.25±0.21</td>
</tr>
<tr>
<td>S (-) amplitude (mV)</td>
<td>2.151±0.48</td>
<td>2.07±0.47</td>
</tr>
<tr>
<td>T1 (+) amplitude (mV)</td>
<td>0.696±0.37</td>
<td>0.58±0.40</td>
</tr>
<tr>
<td>T2 (-) amplitude (mV)</td>
<td>0.545±0.20</td>
<td>0.49±0.17</td>
</tr>
<tr>
<td>Heart score (ms)</td>
<td>107.82±10.10</td>
<td>102.67±7.46</td>
</tr>
</tbody>
</table>

bpm=beats per minute; ms=millisecond; mV=millivolt; °=degree; * = (p<0.005).
The morphology of P and T waves in the electrocardiogram of polo horses is illustrated in Graph 2.

Discussion:

The electrocardiographic evaluation revealed sinus rhythm. This rhythm was observed in 64% of electrocardiographic tracings (Table 1). The prevalence of this rhythm corroborated reports of Fernandes et al. (2004), Diniz et al. (2008), Dumont et al. (2010) and Marr & Bowen (2010).

Sinus bradycardia occurred in 9% of tracings (Table 1). This arrhythmia was verified for 1.7% of horses in gait tests (Diniz et al., 2008), for 5% of endurance horses (Dumont et al., 2010) and in horses trained on a treadmill (Marr & Bowen, 2010). On the other hand, it was not evidenced in jumper horses (Diniz et al., 2011). In humans, this arrhythmia was considered as a change in heart rate commonly found in resting electrocardiogram of trained individuals (Negrão & Barreto, 2010).

Another variant of sinus arrhythmia, wandering pacemaker was observed in 18% of polo horses (Table 1). It was also registered in 22% jumper horses (Diniz et al., 2011), in 5% endurance horses (Dumont et al., 2010) and in 6.7% walker horses (Diniz et al., 2008). Sinus arrhythmia was characterized by the transfer of the dominant focus of the sinoatrial node to latent pacemaker, located in the atria, or atrioventricular junctional tissue, considered benign for the species (Bello et al., 2012).

The second-degree atrioventricular block (2nd AVB) was observed in only 3% of the animals (Table 1). Although considered as a common arrhythmia, this value was 1.7% for walker horses (Diniz et al., 2008) and 4% for jumper horses (Diniz et al., 2011). The study of Dumont et al. (2010) did not report the occurrence of 2nd AVB in any of the endurance horses, tending to disappear during exercise (Marr & Bowen, 2010). Thus arrhythmias detected in polo horses were regarded as physiological ones, thus being in accordance with other modalities (Dumont et al., 2010; Diniz et al., 2011; Bello et al., 2012).

The heart rate verified for polo horses had no significant difference between the sexes (Table 1). In this way, it is still within the desired standards for animals at rest and close to those described for horses of other sport types of (Diniz et al., 2011; Dumont et al., 2010; Melchert et al., 2012). Besides that, heart rate is subject to variations as for sports, sex and breed of the animal (Diniz et al., 2011).

P, Q, R, S and T waves were observed in all tracings. The duration and amplitude of waves, intervals and complexes (Table 1) were in accordance with the models of Marr & Bowen (2010). P-wave was positive bifid (88%), single positive (9%) and biphasic (3%) (Graph 2). The component P1 was positive in 97% of cases and negative in 3%, the component P2 was positive in 100%. The positive bifid morphology of the wave P was characterized as a normal finding, as observed on the electrocardiogram of Thoroughbred Arabian (Yonezawa et al., 2009) and Mangalarga (Diniz et al., 2008) horses. One animal presented biphasic negative-positive P-wave, which according to Souza & Ramos (2007) expresses the occurrence of atrial hypertrophy.

Changes in morphology and amplitude of T-wave were observed, wherein 85% of animals were biphasic and 15% were monophasic positive (Graph 2). Otherwise, different electrocardiographic findings can be determined in different breeds, types of sport and ages. Although biphasic T-wave (-/+) prevail (Diniz et al., 2008; Dumont et al., 2010), it frequently showed varied forms, suggesting that its alternation had no reliable diagnostic significance, being possibly only a clinical finding.

The QRS complex duration was similar between the sexes (Table 1). Especially in relation to the QT interval duration, that is, the ventricular repolarization was significantly different between the sexes, being higher in females. According to Diniz et al. (2008) the ventricular repolarization was inversely proportional to heart rate, confirming our results, since the females presented heart rate lower than males. This then suggests the existence of individual factors in relation to females, possibly due to differences in metabolism, i.e., the lower basal metabolism of females allowed a reduction in heart rate and increased QT interval.

The heart score (Table 1) suggested that the polo horses were well trained. Especially the use of the heart score as a predictor of fitness is risky, as it can be influenced by the physical conformation of each breed,
because the size, length and width of the chest can change the arrangement of the cardiac axis, thus modifying the electrocardiographic tracing (ANDRADE et al., 2006).

For Diniz et al. (2008), the electrical axis expressed the cardiac condition related to the type of training and the type of effort that the animals were subjected to. In polo horses, the cardiac axis was 60 degrees with a negative left shift. This is different from that found by Fernandes et al. (2004), who registered a predominance of positivity on the axis, and still considered that adult horses showed the axis between +30° and +90°. According to Dumont et al. (2010), the shift to the left may suggest a left ventricular hypertrophy, which is consistent with training.

Conclusion:

In summary, it was possible to conclude that the polo horses showed pattern appropriate to the type of effort they played. The electrocardiographic profile revealed prevalence of sinus rhythm as the physiological one, wandering pacemaker, sinus bradycardia and second degree atrioventricular block. These alterations were considered as physiological ones. As for the morphology, positive bifid P-waves and negative-positive bifid T-waves predominated. The comparison between the sexes detected a significant difference only in QT interval, which was longer for females.

REFERENCES


