THE ELECTROCARDIOGRAPHIC PARAMETERS EVALUATION OF THE SPORT HORSE

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Abstract

A group of 24 sport horses was surveyed for the characteristic elements of the electrocardiograms done before and after a period of 5 months of physical exercises specific to the competition trainings. The sportive performance was positively correlated with the morphology of the ECG waves: the biphasic aspect of wave P, the sS-type aspect of the QRS complex, the monophasic aspect of the T wave. After the training, the average amplitude of P_2 biphasic wave increased by 14.7%, the average duration of the QRS complex increased by 16%, of the S wave increased by 21.8% and of the monophasic T wave increased by 22.2%.

Key words: *sport horse, ECG parameters, adaptative capacity*

Introduction

Many authors (Landolsi et al., 1997; Pellecia et al., 2000; Kronfeld, 2001; Piccione et al., 2003; Fernandez, 2004; Lightowler et al., 2005) determined correlations between some morphological modifications of the electrocardiographic parameters with the athletic performance of the sport horses and characterized the bioelectric activity of the heart in relationship to some pathological aspects (electrolyte misbalances, hypoxia, epitasis, syndrome), conditioned by intense, unbalanced trainings. The study aimed to characterise the specific morphological traits of the electrocardiographic parameters in sport horses before the physical training and after 5 months of training.

Materials and Methods

The experiment was conducted on 24 sport horses (12 females and 12 males), clinically healthy, aged between 3.5-8 years, managed by a private equitation club. In January 2007, the horses started the training program for the sportive competitions of the year. Before the start of the training session, the first electrocardiographic recording was performed at rest, while standing, with a portable DELTA 1 PLUS electrocardiograph. We used the technique of the uni-and bipolar derivations of the limbs; the working parameters were the amplitude of 10 mm/mV and the speed of 25 mm/sec. The second electrocardiographic recording was done under the same conditions as before, in June 2007, after 5 months of physical exercises progressive as intensity and duration, corresponding to the age and stage of training of the trained horses. The experimental results were interpreted statistically using the Student test.

Results and Discussions

Before the training, while recording the bioelectrical activity of the heart, we also calculated the average value of the heart beat frequency (40 beats per minute) and of the breathing frequency (18 breathings per minute). Table 1 shows the average values defining the amplitude and duration of the electrocardiographic parameters.

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Table 1

Characteristics of ECG waves and intervals
(uni- and bipolar derivations of the limbs)
in sport horses before the training program

ECG parameters	Duration (sec)		Amplitude (mV)	
	M	SD	M	SD
monophasic P	0.128	0.010	0.180	0.020
biphasic P_2	0.130	0.012	0.176	0.018
P-R	0.265	0.020	-	-
QRS	0.100	0.010	1.420	0.480
S	-	-	0.780	0.082
R-T	0.230	0.020	-	-
monophasic T	0.135	0.035	0.310	0.028
biphasic T_2	0.210	0.040	0.505	0.051

The normal morphology of P wave had two characteristics: the positive monophasic aspect observed in DII and a VF, in 15% of the individuals; the biphasic aspect, with the first deflection (P_1), positive, and the second (P_2), negative, observed in the other derivations (DI, DIII, aVR, aVL), in 75% of the individuals. The 10% difference, characterized the abnormal P wave, with biphasic aspect, in which P_1 wave was negative.

The average duration of the monophasic P wave was 0.128 sec, and of the biphasic P_2 wave was 0.130 sec. There were no major statistical differences between the average values of the duration.

The average amplitude of the monophasic P wave was 0.180 mV, and of the biphasic P_2 wave was 0.176 mV (while P_1 had the amplitude of only 0.080 mV). The difference between the average amplitude of the monophasic P wave and of the biphasic P_2 wave was not significant.

The P-R interval represents the duration of propagation of the depolarization from the sinusal node to the atrio-ventricular node. The duration of the P-R interval translates the vagal tone, its instability is related to the respiratory sinusal arrhythmia or to the atrio-ventricular block which doesn't always have a pathological significance (Fernandez, 2004).

The QRS complex corresponds to the ventricular depolarization wave. In derivations DIII and aVF the QRS complex appears as rS type in 68% of the individuals. The average duration of QRS complex duration is 0.100 sec, and of its amplitude is 1.420 mV (of which 0.780 mV is the amplitude of wave S).

T wave is the ventricular repolarization. The predominant morphology of T wave was monophasic positive, observed in DII, DIII and aVR, in 65% of the individuals, then biphasic with the first deflection (T_1), negative and the second one T_2), positive, observed in aVF in 25% of the individuals. Much seldom, in 10% of the individuals, was observed the negative monophasic aspect of T wave in DI and aVL.

After 5 months of training, the horses were in the competition period for the obstacle race, being at their height of physical condition. The second electrocardiogram

was done 30 minutes after the end of the effort when the average value of the cardiac frequency was 36.5 beats/minute and of the respiration was 16 breathings/ minute. Table 2 shows the average values of the ECG parameters in horses.

Table 2

Caracteristics of ECG waves and intervals
in sports horses after five months of training programme

ECG parameters	Duration (sec)		Amplitude (mV)	
	M	SD	M	SD
monophasic P	0.125	0.013	0.210	0.020
biphasic P_2	0.128	0.014	0.202	0.020
P-R	0.280	0.024	-	-
QRS	0.116	0.010	1.565	0.350
S	-	-	0.950	0.088
R-T	0.300	0.030	-	-
monophasic T	0.165	0.027	0.360	0.042
biphasic T_2	0.214	0.036	0.514	0.055

The monophasic aspect of P wave persisted, observed in DII and aVF, in 15% of the individuals; the biphasic aspect with positive P_1, observed in the other derivations (DI, DIII, aVR, aVL), increased to 80% of the individuals. The abnormal P wave, with biphasic aspect and negative P_1 was observed only in 5% of the trained horses. The presence of the abnormal P wave, with biphasic and negative P_1 aspect suggests neurovegetative instability, but according to some authors (Landolsi et al., 1997) it is correlated with the poorer performance of some of the trained horses.

The average duration of the monophasic P wave was 0.125 sec, and of the biphasic P_2 wave was 0.128 sec. There were no major statistical differences between the average values of P wave duration between the trained an untrained horses.

The average amplitude of the monophasic P wave was 0.210 mV, and of the biphasic P_2 wave was 0.202 mV (while P_1 had amplitude of only 0.090 mV). A 16.6% increase of the average values was observed in the amplitude of the monophasic P wave and a 14.7% increase of the average values was observed in the amplitude of the biphasic P_2 wave, which correlated positively with the high level of physical performance after the training.

P-R interval varies with the cardiac frequency: it increases when the cardiac frequency decreases. The difference between the value of the P-R interval in the trained and untrained horses was poorly significant statistically. It was observed, however, that the too long duration of the P-R interval (in excess of 0.40 sec) is in a direct relation with a state of hypervagotony and, to a certain extent, with a training unfitted to the stage of the physical training of the horse (Pellecia et al., 2000).

The rS-type morphology of the QRS complex was observed in DIII and aVF in 72% of the horses. The average duration of the QRS complex in horses was 16%

longer after the training than before training. The longer duration of the QRS complex is positively correlated to the mass of the ventricular myocardium. The hypertrophy of the ventricular myocardium which appears subsequently to the sportive training may generate a higher distribution of the Purkinje fibres in the epicardium and therefore, the time of the electric impulse conduction increases. The amplitude of the QRS complex increased by 10% after the training and the amplitude of S wave increased by 21.8%.

R-T interval corresponds to the ventricular electric systole, but also to the atrial repolarization (Dojana, 2000). During the recovery period after the training, the duration of the R-T interval increased by 30%.

After the training most horses (85%) displayed a T wave with monophasic positive aspect, which correlates to the best shape of the functional capacity of the heart in the horses involved in the experiment. The duration of the monophasic T wave increased by 22.2% and the amplitude increased by 16%, which is the increase of the time required for the myocardial repolarization and for the velocity of the electric process.

Conclusions

1. The adaptative modifications of the heart functionality which were observed in the sport horses trained for obstacle jumping have generated changes in the electric activity of the heart, as shown by the specific electrocardiograms.

2. The morphological characteristics of the ECG were the biphasic aspect of P wave, with positive P_1 and negative P_2, observed in most of the uni- and bipolar derivations of the limbs of 80% of the horses; the rS-type aspect of the QRS complex in derivations DIII and aVF, observed in 72% of the horses; the positive monophasic aspect of T wave observed in derivations DII, DIII and aVR, in 85% of the horses.

3. The increase of P, S and T waves voltage was correlated positively with the sportive performance of the horses.

4. The effect of the training also determined increases in duration of QRS and T waves and on the R-T interval.

Bibliography

1. Dojana, N. (2000), *Fiziologia animalelor domestice,* Printech Publishing House, Bucharest.

2. Fernandez, W.R. (2004), *Electrocardiographic Parameters in Clinically Healthy Thoroughbreds Horses,* Arq. Bras. Med. Vet. Zootech., 56, 2, pp. 143-149.

3. Kronfeld, D.S. (2001), *Body Fluids and Exercise: Physiological Responses,* Equine Veterinary Journal, 21, pp. 312-322.

4. Landolsi, F.A. Chabchoub, S. Oueslati (1997), *Paramètres électrocardiographiques de chevaux atteints du syndrome épistaxis induit par l'efort,* Revue de Médecine Vétérinaire, 148, 12, pp. 969-974.

5. Lightowler, C., G. Piccione (2005), *Electrocardiography and Echocardiography as a Means to Evaluate Potential Performance in Horses,* Vet. Bull., 75, 2, pp. 1426-1430.

6. Pellecia, A., B.J. Maron, R., Culasso (2000), *Clinical Significance of Abnormal Electrocardiographic Patterns in Trained Athletes,* Circulation, 102, pp. 278-284.

7. Piccione, G., A. Arcigli, A. Costa, M. Percipalle, G. Caola, (2003), *Acid-base balance Assessment During Exercise in the Show Jumping Horse,* Folia Veterinaria, 47, 2, pp. 91-94.