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Original Research

Effects of 3-Barrel Racing Exercise on Electrocardiographic and on Blood Parameters of Quarter Horses

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ABSTRACT

Evaluation of performance of equine athletes depends on the correct interpretation of clinical and laboratory tests performed on animals in a workout session. The objectives of the study were to evaluate the influence of barrel racing exercise on the complete blood count, serum biochemistry, and electrocardiographic parameters of Quarter horses. Twenty-eight Quarter horses, 4.5 ± 2.6 years old and 438.5 ± 34.6 kg, were evaluated before (T0) and immediately after exercise (T1) (barrel racing activity) and after 30 minutes (T2) and 120 minutes (T3) of recovery. At these time points, heart rate (HR), respiratory rate (RR) and body temperature (BT) were measured. Blood samples were taken to determine packed cell volume (PCV), red blood cell (RBC) count, hemoglobin concentration, mean corpuscular volume and mean corpuscular hemoglobin concentration, serum aspartate aminotransferase, creatine kinase, and plasma lactate. Electrocardiographic variables were analyzed at T0 and T1. All variables were analyzed for normality through Kolmogorov–Smirnov test, and comparisons were made using the Tukey test for hematological variables and *t*-test for electrocardiographic parameters, considering $P \leq .05$. The actual exercise challenge significantly altered HR, RR, BT, PCV, RBC, hemoglobin concentration, and plasma lactate, with higher values recorded at T1. Rhythm analysis revealed a sinus rhythm in 89.3% of horses and a sinus arrhythmia in 10.7% of horses, with mean HR of 39.5 ± 8.2 beats/min at rest and sinus tachycardia in 100% of horses, with mean HR of 107.6 ± 9.2 beats/min after exercise. Other findings included significant reductions in P wave duration, PR interval, QT interval and QTc, and significant increases in P wave amplitude and HR. The physical activity during barrel racing led to important alterations in the studied variables. These results can be used to evaluate the athletic conditioning of horses trained under tropical conditions.

1. Introduction

Performance evaluation of equine athletes depends on the correct interpretation of clinical and laboratory tests performed on animals in a workout session, as exercise induces a variety of physiological and laboratorial changes depending on its duration and intensity, and on the fitness and training level of the athlete [1,2]. Therefore, it is important to define normal responses to a specific type of exercise that will allow differentiation of changes from normal exercise with exhaustion or other disease processes.

Evaluation of cardiovascular stress imposed by physical exercise can be done through electrocardiographic parameters. Electrocardiograph (ECG) is an easy to perform noninvasive and inexpensive test, which provides information

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about cardiac rate and rhythm [3]. Electrocardiographic parameters have specific patterns for each species and breed-based upon morphology and physical fitness of the animals [4,5]. Studies have already been published to establish breed differences in both Thoroughbreds [5] and Mangalarga Marchador horses [3], but only the latter used athletic animals.

Blood variables most commonly used for evaluation of workload effort include plasma lactate, packed cell volume (PCV), and hemoglobin concentration [6]. Increased PCV, hemoglobin concentration, and red blood cell (RBC) count occur in response to work intensity, hemoconcentration, and/or splenic contraction [7]. This physiological response is desired, particularly in equine athletes, because it increases aerobic capacity and blood flow to the microcirculation of the muscles during activity [1]. Lactate is one of the most important biochemical parameters in sport medicine, as it is related to the intensity of effort and fitness and training level [8–10]. High intensity and short duration exercises lead to plasma lactate levels above 4 mmol/L, suggesting predominance in anaerobic energy production. Submaximal intensity exercises lead to plasma increases below 4.0 mmol/L, indicating aerobic energy production [11].

Evaluation of muscle enzymes, such as aspartate aminotransferase (AST) and creatine kinase (CK), is extremely useful for the diagnosis of skeletal muscle damage. Levels are influenced by breed, age, environmental factors, and management, in addition to training phase and exercise type [12]. Some authors describe an increase of these enzymes with exercise; others have shown no change with exercise [1,13,14]. McCurtchen et al [15] reported that elevation of AST and CK is a consequence of an increased sarcolemma and mitochondria permeability, which occurs during physical activity and their increase would be lower in horses that have been adequately trained and/or conditioned.

Although several studies have been performed on athletic horses, the response of cardiac and blood values for three-barrel racing horses managed in hard weather is limited [16–18]. Therefore, the aim of this study was to evaluate the influence of barrel racing on electrocardiographic patterns, complete blood count (CBC), plasma lactate, and serum AST and CK in Quarter horses trained under tropical conditions. This information will contribute to a better understanding of the effects of this particular discipline over cardiometabolic parameters and contribute to the well-being of barrel horses when working in tropical weather.

2. Material and Methods

This research project was approved by the Ethics, Bioethics and Animal Welfare Committee at the University Vila Velha (CEUA—UVV-ES) and recorded under the number 318/2014, approved on July 2, 2014.

2.1. Animals

Twenty-eight Quarter horses were used, 12 females and 16 males, with an average weight of 438.5 ± 34.6 kg and between 2.5 and 15 years of age (average 4.5 ± 2.6 years), all considered healthy in previous physical examinations and blood work [19]. These animals belong to three farms located in Espirito Santo, Brazil.

All horses underwent same food and health management. Diet consisted of *Tifton* sp. hay and inorganic mineral salt (Essencefós, Nutrimentos Presence, Paulínia, SP, Brazil) ad libitum and commercial feed (1.2 kg/100 kg body weight—DoEqui TopQuality, Nutriave Alimentos, Viana, ES, Brazil) with 12% crude protein (3,500 kcal energy), divided into three times daily. Water was always available.

All horses were in a similar advanced training stage and had been performing physical exercises for at least 6 months. The weekly training consisted of 45–60 minutes of daily exercise from Monday to Saturday, divided between warm-up and performance of the courses at a trot and canter.

2.2. Exercise

Horses performed a three-barrel racing test, which consists in navigating three barrels distributed along the course in the shortest time possible. The barrels were distributed in a triangular shape, with a distance of 27.5 m between the first and second barrels, and a distance of 32 m from the third to the other barrels. Physical activities were performed between 6 AM and 11 AM from November to March. Animals were evaluated for 3 days, eight animals per day, with local mean temperature records of 29.5°C and mean relative humidity of 67.8%, typical of tropical regions. The sand arena was dry during all evaluation days. Three riders with mean weight of 80 kg and mean height of 1.85 m were used.

2.3. Cardiac Evaluation

Electrocardiograms, each lasting 3–5 minutes, were obtained from each horse at T0 (before exercise) and T1 (immediately after exercise) using a 12-channel ECG-PC electrocardiograph (Tecnologia Eletrônica Brasileira–TEB, São Paulo, SP, Brazil), being careful to keep animals with their limbs parallel to each other and perpendicular to body axis. Alligator clips fixed to electrocardiographic electrodes were attached directly to skin. Electrodes were placed on caudal aspect of forelimbs on the level of olecranon and on hind limbs, lateral to stifle joint to record bipolar leads I, II, and III and unipolar leads aVR, aVF, and aVL. All recordings were taken adjacent to the arena with the horse still saddled and without the rider. Tracings were obtained, recorded, and standardized with N sensitivity and 25 mm s^{-1} speed, and bipolar lead DII was used for interpretation of electrocardiographic tracings. Evaluation of tracings involved measurement of P, R, and T wave amplitudes (in mV) and duration (in ms) of P wave, QRS complex, PR and QT intervals, as well as determining the heart rate (HR) and rhythm. Corrected QT (QTc) was calculated according to the formula by Bazett ($QT/\sqrt{RR}$).

During exercise, horses used a heart monitor with GPS (RS800CX-G3, Polar Electro, Lake Success, NY, USA) in order to record the speed and distance achieved by each animal. Data were analyzed using the ProTrainer 5 program (Polar Electro, Lake Success, NY, USA).