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Original Research

Acute Phase Responses of Different Positions of High-Goal (Elite) Polo Ponies

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ABSTRACT

The aim of this study was to investigate the acute phase response (APR) in 15 horses by quantifying physiological venous blood variables and serum acute phase proteins (APP) at 5 minutes and 6 and 12 hours after a training match of high-goal polo. The horses were divided into three experimental groups based on their team positions, including defense (n = 6), midfield (n = 5), and attack (n = 4). Serum proteinograms were obtained by sodium dodecyl sulfate polyacrylamide gel electrophoresis (SDS-PAGE). Data were evaluated using analysis of variance for repeated measures. The match represented a high-intensity stimulus for all positions. Defenders appeared to use the anaerobic pathway more than the other positions, as shown by their lower pH and greater lactatemia. Alterations in muscle membrane permeability were observed in all horses, as seen by the increase in serum creatine kinase activity without a correlation with APR. Significant elevations in total serum protein, albumin, ceruloplasmin, haptoglobin, alpha-1 antitrypsin, and 23-kDa protein were seen only during the course of the physical exertion of the match, although there were no differences in these values among positions of the team. After 6 hours of the match, the concentration of transferrin declined, whereas that of alpha-1 acid glycoprotein remained unaltered at all assessed times. These results demonstrated that the defenders required the most use of the anaerobic pathway during the match, and that equestrian polo exercise triggers an acute phase response of relatively short duration; this APR is characterized as noninflammatory, as APR appears to be a physiological alteration related to the stress inherent in physical exercise.

1. Introduction

Physical exercise is one of the most physiologically stressful stimuli an animal can undergo; during physical exertion, the animal experiences reversible alterations in various homeostatic variables that are detectable by the quantification of laboratory variables.

The scientific community is currently interested in comparing the biochemical and hematological changes that result from physical exercise [1] with those that occur during an acute phase response (APR). Changes during APR occur in a quick, refined and nonspecific way and are caused by numerous diseases such as infection, inflammation, trauma, or immune disorders that result in

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various degrees of tissue damage [2]. Generally, acute phase proteins (APPs) are biomarkers [3], synthesized by the liver and mediated by cytokines; their concentration in the blood can increase (positive APP) or decrease (negative APP) as a consequence of an inflammatory stimulus.

The first response of an organism to an immunological stimulus is innate and nonspecific and precedes a specific immune reaction. Systemically, proinflammatory cytokines (mainly interleukin-6 [IL-6]) are released into the vascular system, where they activate inflammatory cells. The sympathetic adrenal and hypothalamic-pituitary-adrenal axis can have a significant impact on this process [4], by activating the production of more cytokines that when released, activate receptors in different target cells. This produces a systemic reaction resulting in the activation of physiological or pathological responses, with muscle catabolism being the most relevant to exercise [5]. However, during exercise, studies have reported that the role of IL-6 in intramuscular biological function is to promote glucose homeostasis. In this case, IL-6 is termed "myokine" (or a muscle cytokine) and essentially possesses anti-inflammatory activity [6,7].

There is currently a controversy whether physical exercise can provoke a response similar to the APR. A study of ultramarathon runners reported evidence that APR, as a consequence of exercise, can produce conditions similar to those observed in clinical or surgical morbid conditions [8]. It is well established in the literature that high-intensity exercise causes elevations in serum creatine kinase (CK) activity [9]. Evans and Cannon [10] affirmed that APR, as a result of exercise, can be related to skeletal muscle damage and its consequent inflammation, as shown by increase in serum CK activity.

Various sprinting sports such as soccer [11] and polo [12] are characterized by periods of high-intensity activity such as racing and body contact interspersed with periods of low-intensity activity such as walking or active or passive recovery periods. Monitoring the bodily responses produced by competition can determine the type of effort inherent in each equestrian discipline [13]. Various studies in humans have focused on determination of the metabolic demand of different positions of soccer players through quantification of physiological variables [14,15]. As mentioned previously, the positions in polo are similar to those in soccer, consisting of attack, midfield, and defense, also known as positions 1 and 2 and 3 and 4, respectively. In a brief review of the literature, almost no scientific works could be found investigating the equine metabolism of different polo positions and their relation to possible APR.

From a clinical perspective, documentation of the extent and nature of APR in the play of various equestrian disciplines is important. Other studies along this line have monitored acute phase proteins in different equestrian disciplines, including endurance [16,17] and racing [1]. Quantification of the proteins resulting from the exertion of these horses can provide valuable information to identify the possible occurrence of APR in a game of polo. This study tested the hypothesis that the physical exertion produced in a training match can induce an APR in healthy horses and sought to determine whether the response differed by position on the of high-goal polo team.

2. Materials and Methods

2.1. Horses

Fifteen clinically healthy “high-goal” polo ponies of a Brazilian elite polo team (10 geldings and 5 females) were used. The horses had a mean ± SE body weight of 442 ± 28 kg and were 7.4 ± 2.2 years old. These animals had participated in another study [10] conducted by our laboratory. All horses began the 2009 season in the month of March; they underwent the same weekly training program, consisting essentially of aerobic exercises (taqueio and vareio), 6 times a week. A training match, the target activity of our study, was played once a week. The animals were kept in individual stalls, with free access to water and supplemented with *Medicago sativa* hay and mineralized salt. The concentrate diet was composed of 30% ration (Supra-Tonnus, São Leopoldo, Rio Grande do Sul, Brazil) and 70% oats, and each horse was furnished with 6-8 kg/day of this ration. All riders had international experience and a mean body weight of 83 ± 3 kg. These horses had previously participated in another study [12].

2.2. Groups

The horses were divided into three groups according to their positions on the team, namely, defense (n = 6), midfield (n = 5), and attack (n = 4).

2.3. Training Match and Sampling

After 6 weeks of training, the horses were entered into a training match in preparation for a tournament of 25 goals; the training match consisted of six 7-minute periods (chukkas). Each horse participated in only one chukka. The match was played outdoors on a grassy area 275 m by 180 m in dimension, located at south latitude −23°05′ 25″, west longitude 47°13′ 05″, and altitude 624 m. A standard operating procedure for blood sample collection was established to ensure proper procedures for collection, processing, and storage. After a period of 48 hours of inactivity (18 hours before the training match), blood was collected from the jugular vein; blood was then collected again at 5 min and 6 and 12 hours after the match.

2.4. Blood Analysis

Immediately after blood samples were collected, a portable chemical analyzer (Heska Corp., Fort Collins, CO) was used to determine the pH, total carbon dioxide (TCO_2), and base excess (BE). An electroenzymatic method was used to determine lactatemia of the whole blood in duplicate with an automated lactate analyzer (YSI Inc., Yellow Springs, OH). Ten milliliters of blood was collected in tubes without anticoagulant for later analysis of CK activity and immediately centrifuged under refrigeration (multispeed refrigerated centrifuge PK121R model; ALC, Princeton, NJ)