LACTATE THRESHOLD AND ONSET OF BLOOD LACTIC ACID CHANGES DURING TRAINING PERIOD OF FOUR MONTHS

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Abstract

During a digestive trial, four Standardbred horses were subjected to standardized exercise test on an 800 meter training track. Running speed and heart rate were determined at Lactate Threshold (LT) and Onset of Blood Lactic Acid Accumulation (OBLA = 4 mmol/l). During four months of endurance training, running speed and heart rate corresponding to LT and OBLA were not improved in a similar manner as expected. Therefore, training may have caused different effects on both exercise intensities. Properly designed endurance training should include the continuous monitoring of both parameters (i.e. speed and heart rate at LT and OBLA). The results of this study suggest that it is important to carry out the standardized exercise test to produce an initial HR of no more than 120 b/min. To obtain an adequate lactate curve, at least five or more running speeds are recommended.

Key Words: equine standardized exercise tests, lactate threshold, OBLA, endurance training effects

Introduction

It is well known that increasing running speed results in a linear increase in heart rate (HR) and an exponential increase in blood lactate [LA] (1). These responses are dependent on the exercise test characteristics such as the initial running speed and the increase in running speed at each step. The relationship between running speed and lactate accumulation clearly differentiates endurance ability in humans (1,5) and horses (3). The most popular criteria used to estimate running endurance in humans are lactate threshold (LT) and Onset of Blood Lactic Acid (OBLA) (2,3,5,8). Only OBLA is frequently used in horses (3). LT determines the initial increase of LA in a diagram of LA vs. running speed (5,8). On the other hand, OBLA is defined as the running speed which will produce LA = 4 mmol/l (3,5,8). Contrary to the hypothesis that OBLA determines running speed of maximal LA steady state, some experiments show poor prediction of this phenomenon in man (5,8) and horses (3). While LT and OBLA
estimate different running speeds, both predict running endurance very well (3,5,8).

The goal of this study was to determine whether LT and OBLA could be obtained in a field test with horses and to find if training over a four month period caused similar changes in running speed and heart rate as they related to both criteria.

Methods

Four Standardbred horses (3-5 years old) participated in the study. Each horse performed an exercise test which consisted of repetition of 500m work bouts at a controlled running speed. Running speed increased from low to moderate running intensity in five repetitions. After each work bout, horses were stopped until HR recovered to 120 beats per minute. Blood sampling from the jugular vein was performed in the third minute after stopping. Each sample (2 ml sodium fluoride blood) was centrifuged to obtain plasma. Then a microsample of 7 microliters of plasma was used to determine the LA using an Analox GM7 analyser (Analox, Great Britain). Heart rate was measured continuously with an onboard heart rate meter (Polar Electro, Finland). The LT and OBLA were determined using the diagrams of LA dependence to running speed (figure 1) (8). Heart rate corresponding to running speed determined by LT and OBLA, were calculated on the basis of linear interpolation from the graphs of heart rate dependence to running speed.

Results

In the experimental period, from July to October, training altered the relationships between running speed and HR corresponding to LT and OBLA (figures 2 and 3). The initial running speed that corresponded to LT averaged 6.33 m/s (SD=0.30 m/s) and to OBLA was 7.22 m/s (SD=0.26 m/s) (figure 2). HR at the LT averaged 180 b/min (SD=20 b/min) and at OBLA was 201 b/min (SD=16 b/min) (figure 3).

One month later, the training effects were non significant. The running speed at LT increased about 0.49 m/s and at OBLA about 0.5 m/s (figure 2). HR at the level of LT decreased about 5 b/min. At the level of OBLA, HR decreased about 16 b/min (figure 3). Training during this period had the tendency to positively affect selected physiological parameters.

Training in September caused negative but non significant changes. The running speed that corresponded to LT decreased by about 0.82 m/s in relation to results obtained in August and by about 0.3 m/s in relation to results obtained in July (figure 2). The running speed corresponding
to OBLA was also non significantly decreased by about 0.17 m/s (figure 2). The HR that corresponded to LT decreased by about 7 b/min (NS) (figure 3). Conversely, the HR that corresponded to OBLA showed a tendency to increase by 7 b/min (NS) (figure 3).

![Figure 2. Speed at LT and OBLA during SET](image1)

![Figure 3. HR at LT and OBLA during SET](image2)

Training in October caused an increase in running speed at the level of LT by about 0.6 m/s (p < 0.05) (figure 2), which was the greatest change in experiment. At the level of OBLA there was no significant change in running speed which averaged about 0.08 m/s (figure 2). HR at the level of the LT increase by about 29 b/min (p < 0.05) (figure 3) but at the level of OBLA it only showed a tendency towards an increase because of a change of 10 b/min (NS) (figure 3).

**Discussion**

Different training methods: long slow distance, interval training and distance training affect running endurance performance in horses (6,7,9). The aim of training in our study was to increase the running endurance performance of four Standardbred horses. Changes in their performance was evaluated by the LT and OBLA that corresponded with running speed and HR. The results did not show similar changes at different levels of both criteria. So it is possible to make two hypotheses: a) prior training affected the results differently at both levels of running intensity; b) one of the criteria used did not estimate running endurance as well as the other. According to data in the literature, both criteria should estimate running endurance very well (3,9), so it is more possible that first hypothesis was correct. Exercise tests where increased running speed is used should start at a running speed slow enough to produce a HR < 120 b/min and increase at least five steps at moderate running intensity, so LA can increase to more than 5 mmol/l. This will help to analyze the kinetics of LA and to find more than only one criterium for estimating running performance which, as we know very well, depends on different endogenous and exogenous factors.
Literature


