



Original Contribution

EFFECT OF THE JUMPING ACTIVITY IN THE COURSE OF TRAINING EXERCISE ON THE LEVEL OF SERUM CORTISOL, BLOOD LACTATE AND HEART RATE IN HORSES

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ABSTRACT

The aim of the study was to evaluate the influence of the routine training program on the level of serum cortisol, blood lactate concentrations and heart rate in jumping horses. The study was carried out with six Hanoverian show-jumpers. The biochemical analyzes were performed in blood samples taken twice as follows: before and immediately post jumping exercise. Heart rate was measured at the beginning and after completing of the training activity.

As a result of the investigation a statistically significant increase in the pulse, cortisol and lactate concentrations was noted.

Key words: equine, exercise, cortisol, lactate, heart activity

INTRODUCTION

In last years there has been an inconceivably lively interest in the physiology of exercised horses. Numerous studies have been performed to increase knowledge about the physiologic response of horses to the different types of muscular load. Most of them were based on measurement of heart rate, blood lactate and some other biochemical parameters (1, 2, 3, 4).

Some of these parameters are closely related to intensity of the workload and help in quantifying of training regime, but are poorly reflected of the duration of the exercise. For example, during the exhausting endurance ride, heart rate reaches a mean value of 100 ± 20 beats/ min (5), whereas lactate concentrations after the completion of the corse remain quite low- 3 ± 0.9 mmol/l (5), 1.25 ± 0.38 mmol/l (6). However, the studies concerning the influence of the jumping exercise on the biochemical parameters and heart rate are limited. In some studies the main task has been concentrated

predominately on observation of physiological indices during the sport events (7, 8) or experimental tests (9). There is no information concerning the daily-applied training exercise of show-jumping horses under field condition.

On the other hand, the hypotalamo-pituitary-adrenocortical axis (10, 11) or symphoadrenal system (12) plays a key role in adjustment to exercise. Almost 90 % of the circulating corticoids consist of cortisol (10). In contrast to lactate, the cortisol level is depended upon the intensity and duration of the exertion (7, 12, 13). Therefore, the exercise-induced changes of serum cortisol levels could be interpreted as a physiological response of a physical loading (7). The stress of transport, new background pre-ride preparing and unknown horse meeting plays undoubtedly an important role for high cortisol concentrations. The inexperienced jumpers are under more stressful conditions during the ride compare to older and experienced horses. The stress level rose markedly during the first mounting of a rider (1, 14).

The aim of this study is to examine the influence of routine training exercise on

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cortisol and lactate blood levels and the heart rate frequency. The results of the investigation could be a basis for the improvement of training program and assessment of the possible developed pathological processes induced by the training regime.

MATERIAL AND METHODS

The study was performed at the Trakia University Stud, Stara Zagora, Bulgaria, April 10-15, 2008. Six Hanoverian show-jumping horses, three mares and three geldings between the ages of four and six years were tested on open arena. All of the horses were in the beginning of their career with limited experience, clinically sound, vaccinated and dewormed according to the schedule. Body weight was between 485 and 540 kg. The horses were housed in boxes (10 m²) with permanent water access. The forage used consisted of hay, oat (70%) and barley (30%). All horses were in training for twenty days. The conditions of weather were: air temperature 15 °C -18 °C, humidity 58 %-70 %. The same rider rode the animals the same time of the day. The warming-up period consisted of 10 min walk (100 m/min), 10 min trot (200 m/min) and gallop (400-420 m/min) alternately with trot for 10 min. The phase of intensive work was composed of twenty jumps through obstacles 1-1.10 m high for about 15 min. Relaxing period of trot followed by walk for 10-15 min was a final stage of training procedure. During the study any kind of steroids was not applied to the animals. The investigation was performed before the start and immediately after the final of the exercise.

Heart rates were measured with a stopwatch and stethoscope.

Blood samples were taken via jugular venipuncture into tubes not containing anticoagulant. Lactates were determined directly in a fresh whole venous blood via a biochemical analyzer "Accutrend® Plus" (Roche Diagnostics, Mannheim, Germany). The serum probes for cortisol assay were separated as soon as possible and immediately frozen at -20°C. Automated Chemiluminescence System (ACS 180 Plus, Chiron Diagnostics, UK) at The Central Clinical Laboratory (Medical Faculty, Stara Zagora) was used for establishment of cortisol levels.

Data were statistically analyzed by 1-way ANOVA (inerSTAT-a v1.3). The level of significance was set at $p < 0.05$.

RESULTS

The resting serum cortisol level was 86.135 ± 3.972 nmol/l. The post-exercise level showed a markedly increase to 199.061 ± 2.648 nmol/l. The deviation of cortisol values was significant - $p < 0.01$.

The mean blood lactate concentration of included horses before and after the completing of the test was 1.037 ± 0.123 mmol/l and 8.307 ± 0.155 mmol/l respectively. The significance of changes was - $p < 0.01$.

Markedly increase of heart beat rate was observed. The pulse raised from 37 ± 1.211 h.b./min in rest to $102,666 \pm 4.022$ h.b./min immediately post exercise ($p < 0.01$). The quotations are listed in **Figures 1, 2 and 3**.

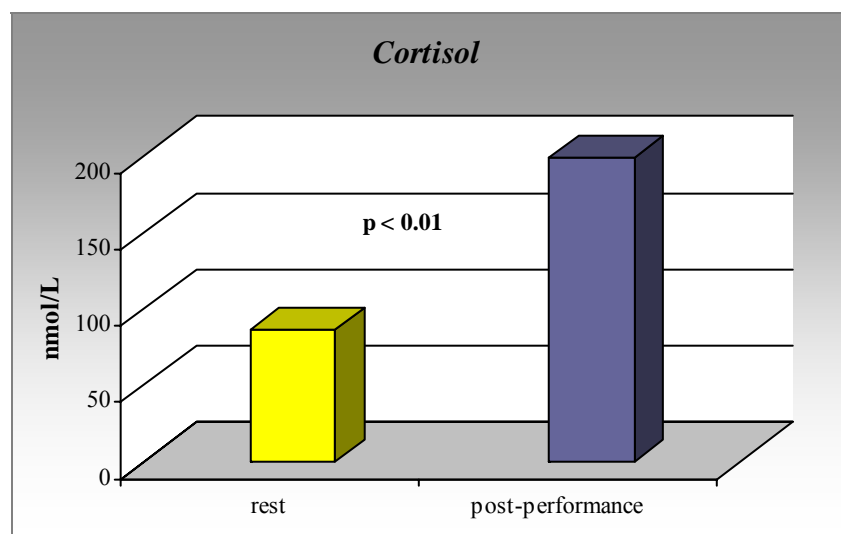


Figure 1. Cortisol levels

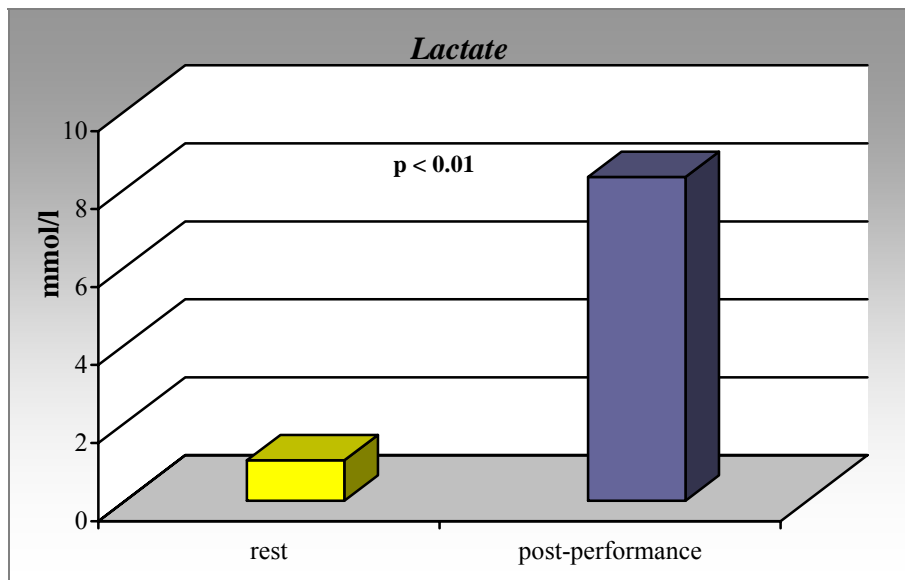


Figure 2. Lactate concentrations

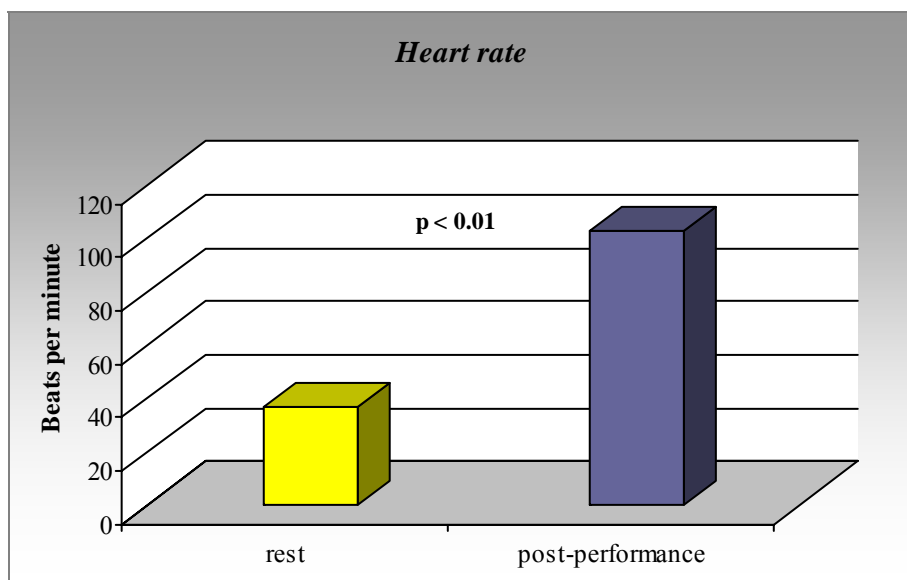


Figure 3. Heart rate

DISCUSSION

Circadian rhythm in resting cortisol values has been evaluated to be extremely large fluctuated. Some authors reported about the peak at 6.00-9.00 and nadir at 18.00-21.00 (15) and others found the peak at 8.20 to 10.20 and nadir at 20.19-22.19 (16). In fact, there are some periods of days in horses when no rhythm is distinguishable. The individual rhythms could be quite variable from horse to horse and within the same horse (17).

Therefore, to limit as much as possible the variations due to diurnal rhythm, the resting samples were taken between 8.00-8.30. As expected, cortisol concentrations increased

with exercise more than twice. The changes recorded after the physical load in the present study are in agreement with published before (1, 7, 14). Compare with 3-fold rise, following endurance ride (18) and 2-fold rise in galloping races (11), the elevation of cortisol in this study was definitely high. In general the moderate exercise is thought to cause little alteration in the cortisol level, whereas the exhaustive exercise produced a marked increase (19). High cortisol level may be attributed to the less experienced horses included in the study. In spite not so intensive type of muscular load the regular training program presents a stressful factor for not well-accustomed jumping horses.

The level of lactate in the blood is highly depended to the degree of duration of muscular effort. The anaerobic metabolism contributing to energy production plays a key role to accumulation of lactate (20, 21, 22). The correlation between the speed of movement and lactic acid concentration has been established in different type horse discipline (5, 6, 23, 24, 25). The results in this study differ from obtained in the same discipline by other authors (7, 26). The reason for this discrepancy is considered the lack of fitness in horses included in a present study. In one report were announced the similar high values for lactate in untrained jump horses (27).

Post exercise heartbeats were significantly enhanced compared with the rest heart frequency. This finding confirmed the data published by other authors (3, 27). The moderate rise of pulse rate in the studied horses after the completing of training procedure suggests a relatively increased workload. More pronounced enhance of this index (180-190 beats/min) has been measured by heart rate recorder placed under the saddle (27).

The results of this study demonstrate that training procedure in inexperienced horses plays a role of stress factor and although the speed and duration of such an exercise are low, the show jumping represent a vastly exertion requiring the use of anaerobic metabolism. With aim to promote the fitness of jumping horses, the training schedule must include such exercises, which will improve their anaerobic capacity.

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