EFFECTS OF ACUTE HIGH-INTENSITY INTERVAL TRAINING ON 500M ROWING TIME AND LACTATE CURVES

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Introduction: High-intensity interval training (HIIT) is currently the most common training method for athletes and normal persons. Martin et al., (2012) proposed that HIIT training improves skeletal muscle function and reduces glycogen use and lactate production. Under acute hypoxia, the adaptation of physiological mechanisms in response to the physical strain. It is very important to elicit the training effects and improve the overall health of an individual. Thus, the aim of this study is to investigate the impact of acute HIIT on dynamometer load and blood lactate levels.
Methods: Six active postgraduate subjects (25.3 ± 3.7 years, 170.3±9.7cm, 70.5±14.9kg, four male two female) completed a plyometric rowing (maximum power output 446 ± 169 Watt) in this study. All subjects were in good health and did not take any medications. The experiments methods were divided into 500 m rowing dynamometer and acute HIIT (2x2x300 m) for three consecutive days. The blood lactate, speed would be collected after the exercise.
Results: The average blood lactic concentration (BLC) in the first minute (E1) of dynamometer 500 m pretest (T-1) was 11.0 ± 1.8 mmol / L. At T-2 it was 10.1 ± 1.9 mmol / L, with a mean difference of -0.9 mmol /L ($p < 0.05$). Recovery E5, at T-1 and at T-2 were 16.9 ± 2.8 mmol / L, 13.7 ± 2.0 mmol / L, with the individual variance of -3.2 mmol / L ($p > 0.05$). The mean difference in lactate concentration at recovery E15 was -2.24 mmol / L ($p < 0.05$). The mean velocity of the T-1 500 m dynamometer was 109 ± 16.9 s, that of the T-2 was 108.1 ± 14.6 s, and the difference between the two averages was -0.6 ±23 s.
Conclusions: The results of the study show a declining trend in the blood lactate level of rowing athletes at T-2. This change is an adaptive response to acute HIIT exercise, due to increased skeletal muscle anaerobic metabolism, which started to improve as a function of time. Thus we propose that acute high-intensity interval training can be applied to improve the adaptive responses of athletes to exercise training or competition.

INTRODUCTION

(Gibala, Little, MacDonald, & Hawley, 2012) introduced beside increased skeletal muscle oxidative capacity, HIIT also increased resting glycogen content, a reduced rate of glycogen utilization and lactate production during matched-work exercise. Exclusion of lactic, began at the fifth minute after the end of the exercise, reached to 10 mmol/l in 15 min(H. Heck, 1990), and returned to pre-exercise lactic acid values within an hour (張嘉澤, 2008). The blood lactic acid (LAC) exclusion during exercise is based on the degree of conversion of aerobic metabolism and the concentration of lactic acid. The higher of these two elements, the greater exclusion of lactic acid(H. Heck, 1990). The optimal lactic acid curve analysis is based on: 1) whether the lactic acid concentration has reached to maximum of the first minutes after the exercise; 2) the highest lactic acid concentration appears (as late as possible); the lactic acid difference between the highest lactate concentration occurrence time and the last collected time(G. Neumann, 1991; Georg Neumann, 1991).

(Stegmann, Kindermann, & Schnabel, 1981) mentioned that training with the lactic acid domain is equivalent to intense endurance training. Using this intensity to train, can shortening the distance from 200 kilometers per week to 150 kilometers that improve the performance more efficiently. (冯炜权 & 翁庆章, 1990; Stegmann et al., 1981)The blood lactate response during exercise has been shown to accurately predict athlete endurance. Also considered a standard measure of endurance adaptation. It is more useful than the VO2max in exercise prescriptions(Weltman, 1995).

METHODS

Six active postgraduate subjects (25.3 ± 3.7 years, 170.3±9.7cm, 70.5±14.9kg, four male two female), maximum power output 446 ± 169 Watt (TABLE 1)

TABLE 1 : Subjects anthropometer data

Anthropometer	
Age (years)	25.3±3.7
High (cm)	170.3±9.7
Weight (kg)	70.5±14.9
$Watt_{max}$	446±169
95 % (watt)	376±150

The experiments were divided into 500 m rowing dynamometer and acute HIIT (2x2x300 m) for three consecutive days. a) 500 m rowing: is used for the Pre-Post Test analysis. b) Acute High-Intensity Interval Training (2x2x300 m rowing): an acute HIIT method was used to train a single 2x2x300 m rowing ergometer. Each sets of 600-meter sprints with 10 minutes rest. Acute repetition of 300 m sprint with 90 seconds rest. Individual's maximum 10 paddles's average watt of 95% as the workloads of two exercises. Subjects were divided into 2 groups and performed in a balanced order. All intervened in two tools of high-concentration oxygen (80%) and hypothermia in 10 minutes rest.

The blood lactate, speed would be collected after the exercise. a) 500 m rowing: lactic, NH3, RPE, heart rate will be collect during recovery time. b) 2x2x300 m rowing: record the heart rate and average power output (watt) while exercise. Lactic, NH3, will be collect during recovery time. **Statistical Analysis:** Independent-sample t-tests were performed to determine the differences in all data.

RESULTS

The average blood lactic concentration (BLC) in the first minute (E1) of dynamometer 500 m pretest (T-1) was 11.0 ± 1.8 mmol / L. At T-2 it was 10.1 ± 1.9 mmol / L, with a mean difference of -0.9 mmol /L ($p < 0.05$). Recovery E5, at T-1 and at T-2 were 16.9 ± 2.8 mmol / L, 13.7 ± 2.0 mmol / L, with the individual variance of -3.2 mmol / L ($p > 0.05$). The mean difference in lactate concentration at recovery E15 was -2.24 mmol / L ($p < 0.05$) (see FIGURE 1). The mean velocity of the T-1 (pre-test) 500 m dynamometer was 109 ± 16.9 s, that of the T-2 (post-test) was 108.1 ± 14.6 s, and the difference between the two averages was -0.6 ±23 s (see FIGURE 2).

DISCUSSION

Analysis of the results showed that during the recovery period of T-2 (post-test), the accumulation of lactic in E1 was lower than T-1(pre-test). This phenomenon shows that muscle lactic in exercise does not show a lot of accumulation. Therefore, the amount of blood lactic entering the body are not too much. This data was based on findings from a previous study, anaerobic glycolytic efficiency in muscles can be improved by intermittent anaerobic loads(Hermann Heck, Schulz, & Bartmus, 2003).

In this study, it was also found that the recovery period of blood lactic concentration in T-2 (post-test) was significantly lower than that of T-1 (pre-test). This symptom shows a single acute high-intensity interval stimulation. It can rapidly increase the metabolism of muscle anaerobic energy, reduce the accumulation reaction of lactic, and delay muscle fatigue.

The results of the analysis also found that the speed of the T-2 dynamometer (500 m) was also improved. This rapid increase in athletic ability may result from a decrease in the accumulation of lactic in muscles. In the past, (Mader, 1991) found that the improvement of anaerobic energy pathways in muscles, requires the use of extremely high exercise stimuli to enhance PFK enzymes and improve glycolysis efficiency. And also the resistance exercise pattern is superior to other exercise methods.

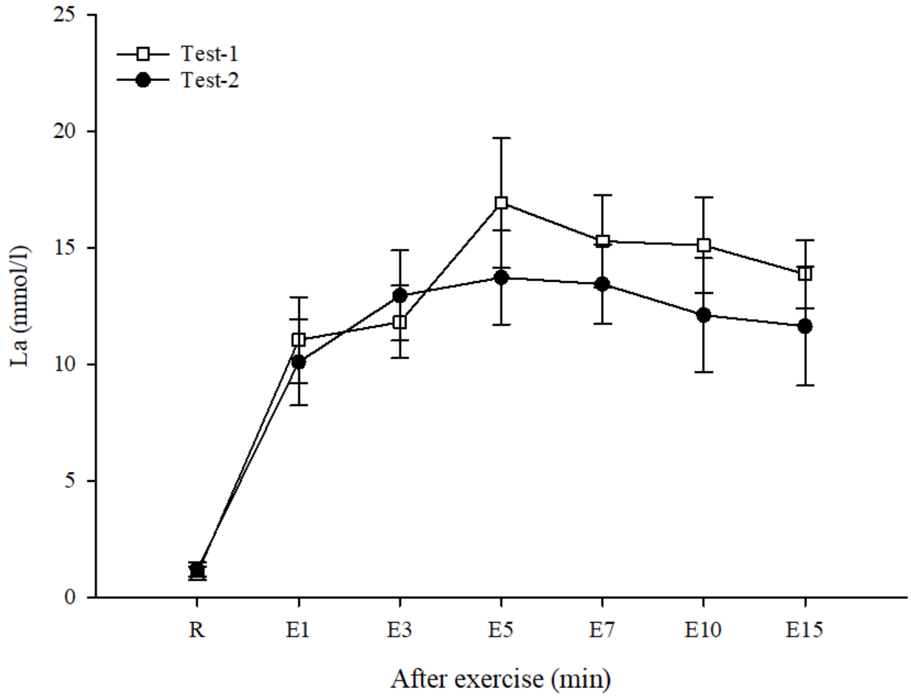

FIGURE 1 Analysis of Lactic Acid Accumulation Curve during Recovery Period of 500 m Rowing

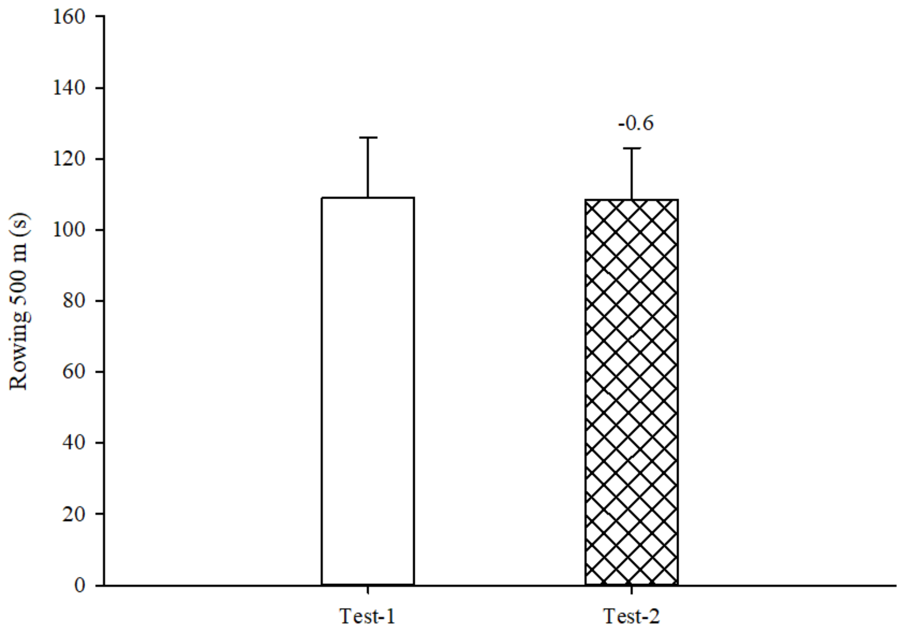

FIGURE 2 Analysis of 500 m Rowing Difference Speed Between T1 and T2

CONCLUSIONS

The results of the study show a declining trend in the blood lactate level of rowing athletes at T-2. This change is an adaptive response to acute HIIT exercise, due to increased skeletal muscle anaerobic metabolism, which started to improve as a function of time. Thus we propose that acute high-intensity interval training can be applied to improve the adaptive responses of athletes to exercise training or competition.

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