Blood lactate profile when highly qualified swimmers perform a special serial test

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Abstract

Objective of the study was to assessment of the relationship between the lactate profile and the level of development of special endurance, which determines the competitive results of highly qualified swimmers.

Methods and structure of the study. Athletes performed a serial swimming test 8x200 m in a 5-minute mode with intensity from low to maximum. The values of the rate of lactate accumulation in the blood determined the nature of the curve depending on the swimming speed. Lactate tolerance was defined as the differential rate between blood lactate concentrations of 5.0 and 10.0 mM (LT 5–10).

Results and conclusions. Analysis of blood lactate levels obtained during the 8x200m swim test revealed significant improvements in endurance performance over a one-year training cycle. Improvement in lactate parameters is associated with an increase in maximum 200 m swimming speed under training conditions; the relationship between the blood lactate profile and changes in competitive results is insignificant.

Keywords: *highly trained swimmers, blood lactate profile, special endurance*

Introduction. In endurance sports, blood lactate profile analysis is widely used to monitor changes in athletes fitness levels. Most of the work is aimed at identifying the lactate threshold (LT), which characterizes the intensity of physical activity at which a rapid increase in blood lactate levels occurs. A stable value of lactate concentration acts as a criterion for assessing special endurance [5].

The traditional approach is to construct curves of the rate of blood lactate accumulation based on repeated exercise tests. In this case, the curves are checked for the significance of improvement, stabilization or deterioration of sports form over time [6].

The characteristic shift of the lactate-velocity curve to the right is hypothesized to reflect training-induced improvements in endurance performance. To provide a more objective approach, researchers have proposed a number of different quantitative procedures to calculate the rate or power output of the lactate threshold [1, 7].

It has been proven that the dynamics of blood lactate and LT are objective criteria for assessing the state of sports form and the basis for modeling the frequency of training and predicting the results of the training process [2, 4].

Despite the fact that a multi-stage construction of a blood lactate profile is representative for diagnosing the functional readiness of swimmers, the question of the relationship between the obtained data and the results of competitions is relevant [3].

Objective of the study was to assessment of the relationship between the lactate profile and the level of development of special endurance, which determines the competitive results of highly qualified swimmers.

Methods and structure of the study. The test group included 10 highly qualified male swimmers

aged 20,5±0,5 years, specializing in various swimming methods.

The educational and training process was carried out on the basis of 10 workouts per week, including a combination of aerobic and sprinting loads. The average training volume of swimming was 50,6±7,4 km per week.

To assess the level of development of special endurance, athletes performed a serial test in swimming 8x200 m in a 5-minute mode with intensity from low to maximum. The final eighth segment was performed with maximum swimming intensity; the speed of its passage was a criterion for assessing the athlete's functional readiness.

The test included step-by-step recording of indicators on the basis of which cardiovascular (heart rate), metabolic (blood lactate) and biomechanical (frequency and number of strokes) responses to an increase in swimming speed were assessed. During the annual macrocycle, swimmers were examined four times. Testing was carried out in a 50-meter pool.

The swimmers were tasked with maintaining an even pace and the same swimming time during the first 100-meter segment and in the final half of the distance.

Immediately after the completion of each segment, heart rate was measured using a Polar Sports PE tester (Finland). Individual perceived exertion (RPE) was assessed using the Borg Perceived Exertion Scale. Lactate concentration was measured using an Accusport blood lactate analyzer (Germany).

Blood lactate values for each test were plotted against swimming speed. Lactate velocity curve analysis included velocity at LT (VLT), calculated as a function of the slope and axis intercept of the lactate velocity curve. Lactate tolerance was defined as the differential rate between blood lactate concentrations of 5,0 and 10,0 mM (LT 5–10).

Results of the study and discussion. The maximum swimming speed at a distance of 200 m during training increased from 139,7 ± 4,2 s to 136,9 ± 3,7 s. The same results, expressed as a percentage of the best personal time of each swimmer, were 91,6 ± 2,6% (1st test); 91,9±0,7% (2nd testing); 92,4±5,5% (3rd testing); and 94,3±2,6% (4th testing).

The obtained lactate values were 69,6±4.3 mM (1st test); 71,7±4,2 mM (2nd testing); 72,7±3,2 mM (3rd test); 71,6±4,1 mM (4th testing).

The lactate tolerance rating (LT 5-10), defined as the difference between the lactate concentration rate of 5,0 and 10,0 mM, decreases mid-season: 5,9 ± 0,3 s/100 m (1st test); 6,8±0,2 s/100 m (2nd testing); 7,7±0,3 s/100 m (3rd testing); 6,4±0.2 s/100 m (4th testing).

The relationship between changes in LT, competition performance and maximum swimming speed in training was studied. A significant relationship was observed between change in VLT and LT 5 (r = 0,78); between change in VLT and swimming speed (r = 0,79); between early season VLT improvement and overall LT improvement 5-10 (r = 0,65). Changes in VLT and LT 5-10 throughout training were also significantly correlated (r = 0,69).

Analysis of blood lactate levels obtained during the 8x200m swim test revealed significant improvements in endurance performance over a one-year training cycle. Derived measures of LT and exercise capacity improved in parallel with maximal training performance, highlighting the representativeness of the use of all three measures of functional status in elite swimmers. While improvements in lactate parameters are associated with increases in maximum 200 m swim speed during training, the relationship between blood lactate profiles and changes in competitive performance is not significant.

The small range of changes observed in swim speed (2,5%) and VLT (3%) throughout the 20-week season indicates little change in swimmers' specific fitness.

The fact that improvements in VLT early in the season correlate with improvements in LT 5-10 late in the season supports the widely held belief that base endurance and LT should be developed in more specific and more intense training regimens that maximize oxygen uptake and tolerance lactate. Deterioration in LT 5-10 mid-season may reflect improved lactate clearance, disruption of glycolytic flux, or possibly chronic depletion of muscle glycogen as a consequence of high training volumes.

Improvements in VLT and LT 5-10 over the course of the season indicate that the training program was effective in developing various aspects of endurance. The parallel improvement in swimming speed during training supports the idea that fitness levels and performance can be improved, including in highly skilled swimmers.

Competition results showed that performance levels remained virtually unchanged between the two main competitions included in this study.

The lack of correlation with improved perfor-

mance may also be due to the relative specificity of the 8x200m swim test when assessing performance in sprint swimming.

Conclusions. The study of the relationships between data obtained during diagnostics, training and competitive results shows that testing is an informative means of monitoring changes in indicators of special preparedness and training results. The results of this study indicate that current physiological testing of blood lactate levels is quite accurate in diagnosing changes in endurance performance in elite swimmers, but these measures are not fully related to competitive performance in sprint swimming.

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