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TESTS AND ESTIMATION CRITERIONS OF ANAEROBIC CAPACITY IN TOP-CLASS ATHLETES*

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ABSTRACT

The purpose of this study is to determine the standard conditions of carrying out effort trials aiming at quantitative estimation of anaerobic lactate capacity. A group of 10 sprinters, displaying a high level of performance in the 100 m (10.54 - 10.92 sec.) was subjected to a cyclergometer trial. Taking into account the relationship between power and exercise time, the power magnitudes were determined for the 5th, 10th, 15th, 30th, and 45th second of exercise. The sprinters performed the trials with maximal intensity, during which the following parameters were recorded: VO_2, $ExcCO_2$, $\sum RO_2$, $_{TOT}O_2D$, HLa. The obtained data as well as the procedures of anaerobic capacity central included in monitoring the subjects' training process indicate that maximal intensity trials of 30-second duration (Wingate Test) and of 60 - second duration equally well estimate anaerobic lactate capacity. The latter enables also to capability which was confirmed by the values of $ExcCO_2$, $\sum RO_2$, $_{TOT}O_2D$, HLa

The results indicate that anaerobic lactate power and capacity should be estimated on the basis of: maximal intensity exercise lasting for 60 seconds or threefold repetition of 60-second exercise which equally long intervals. The above procedures ought to be separated e.i. the trials must be performed on different days and with maximal intensity.

Key Words: *Anaerobic capacity, anaerobic test, athletes, estimation criterions*

ÜST DÜZEY SPORCULARDA ANAEROBİK KAPASİTE TESTLERİ VE TAHMİN ÖLÇÜTLERİ

ÖZET

Bu çalışmanın amacı; anaerobik laktat kapasitesinin niteliksel tahminini amaçlayan, devam eden egzersiz (carry-out effort) protokollerinin standart durumlarının belirlenmesidir.

100 m. derecesinde yüksek performans düzeyi (10.54 - 10.92 s) sergileyen 10 kişilik bir sprinter grubu bisiklet ergometresi testine alınmıştır. Güç ve egzer-

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siz süresi arasındaki ilişki dikkate alınarak egzersizin 5., 10., 15., 30., ve 45. saniyeler içerisindeki güç çıktıları belirlenmiştir. Aşağıdaki parametreler sprinterler, denemeleri maksimal şiddette uygularken alınmıştır: VO_2, $ExcCO_2$, $\sum RO_2$, $_{TOT}O_2D$, HLa.

Elde edilen veriler ki aynı zamanda anaerobik kapasite merkezi ölçüm yöntemleridir ve bireyin antrenman sürecinin takip edilmesinde kullanılmıştır; maksimal şiddette yapılan 30 s (Wingate) veya 60 s süreli denemeler, anaerobik laktat kapasitesini aynı düzeyde tahmin ettiğini göstermektedir. Hatta sonraki test $ExcCO2_2$, $\sum RO_2$, $_{TOT}O_2D$, HLa değerleri ile kanıtlanmış kapasite değerlerinin belirlenmesini sağlar.

Sonuçlar, anaerobik laktat gücü ve kapasitesinin; 60 s süren maksimal şiddetli egzersiz veya 60 s egzersizin 3 katı sürede, eşit aralıklı egzersizler baz alınarak tahmin edilmesi gerekliliğini göstermektedir. Yukarıdaki yöntemde denemeler mutlaka başka günlerde ve maksimal şiddette yapılmalıdır.

Anahtar Kelimeler: *Anaerobik kapasite, anaerobik test, sporcular, tahmin ölçütleri.*

INTRODUCTION

Identification and estimation of anaerobic capacity in athletes is strictly connected with a proper choice of reliable test and informative estimation parameters in correspondence with requirements of research procedures. Full and comprehensive estimation of anaerobic capacity is conditioned by determining, by means of test procedures, the values of the parameters of anaerobic lactate and alactate capacity. Each of the above functional abilities is submitted to estimation in accordance with three parameters: power, capacity and effectiveness (Margaria 1966). The greatest investigation of anaerobic lactate metabolism occurs during maximal intensity exercise between 30th and 90th second. The intensification of anaerobic glycolysis in the working muscles begins immediately after the depletion of substrata fueling anaerobic alactate metabolism e.i. after the first 5-6 s of exercise. The speed of lactate accumulation in the working muscles and total blood lactate accumulation during exercise constantly alter proportionally to obtained power and maximal time of exercise. Appointing conditions for conducting effort tests and trials aiming at quantitative estimation of anaerobic capacity requires, apart from continuous monitoring levels of power, observing and examining the dynamics of blood lactate concentration (which is the function of changing values of the parameters of exercise).

METHODS

A group of 10 sprinters, displaying a high level of performance in the 100m (10.54-10.92 sec.) was subjected to a cyclergometer trial. Taking into account the relationship between power and exercise time, the power magnitudes were determined for the 5th, 10th, 15th, 30th and 45th second of exercise. The sprinters performed the trials with maximal intensity, during which the following parameters were recorded: VO_2, $ExcCO_2$, $\sum RO_2$, $_{TOT}O_2D$. Gasometric analysis was carried out by means of Sensormedic (USA) gasometer. Blood lactate concentration (HLa) was measured using a photometry method (Dr Lange, Germany).

RESULTS

The greatest values of the dynamics of VO_2 during exercise and restitution variables were recorded during exercise of 20 s of duration. With an increased duration of exercise the level of VO_2 does not increase its value but stabilizes. Significant changes in the level of VO_2 are identified post the cessation of exercise. It is so-called "the phenomenon of delayed effect" (Konrad, 1978; Straz, 1978). Comparing the curves of VO_2 one may notice "plato" at the level of maximal anaerobic power and a slowed down, exponential increase of its value. After longer exercise the peak is reached immediately post the cessation of exercise and afterwards one may observe a rapid, exponential decrease of the value of this parameter. The curves characterizing the $ExcCO_2$ values are listed in Fig.1. The discussed parameter is characterized by increases in its value along the course of exercise time achieving the peak value after 45 s of work. During exercise at the level of maximal anaerobic power (duration 5 s) no $ExcCO_2$ was lower in comparison to the one observed during the trial itself. Post the cessation of exercise the level of $ExcCO_2$ kept on increasing, obtaining its maximum value in the 75th second of recovery, after which a slow decrease of the recorded values proceeded. The characteristics of dynamics of blood lactate concentration (HLa) recorded at the cessation of exercise of different times of duration are presented in Fig. 2. Both figures illustrate differences in the localization of "delayed" maximal value in the curve outlining the kinetics of HLa. After exercising at the level of maximal anaerobic power (duration 5 s) the greatest value of HLa was observed after 247.8 (± 49.8) s (8.61±1.49 $mmolxl^{-1}$) and it was maintained up to the 360th s of recovery. After 10-s maximal intensity trial, the peak HLa (11.62±1.24 $mmolxll^{-1}$) was obtained in the 276th s (±31.8); after 360 s its value decreased slightly to the value of 10.14±0.68 $mmolxl^{-1}$, stabilizing in the 9th minute of recovery. During 15, 20 and 30-s exercises, differences in HLa were slight with the maximal value of HLa reaching 10.17 $mmolxl^{-1}$. The time of obtaining the peak HLa was 300 s ± 120 s. After completing a 45-s exercise, the HLa value amounted to the level of 12.13 ± 1.24 $mmolxl^{-1}$ within (on average) 465 s ± 124.2 s. The average value of $\sum RO_2$ demonstrates a rapid increase in the first 10-s of exercise followed by a steady increase topping after the completion of 45-s maximal intensity exercise. The level of R^*O_2 decreases in proportion to the prolongation of exercise time. The level of HLa concentration is on the significant increase within the scope of 10-s of exercise. Afterwards (up to the 30th s of exercise) the range of changes in HLa is statistically insignificant and in the following 15 s (after 45 seconds of exercise) it achieves the maximum value. As far as the $\sum$HLa level is concerned it increases during efforts of 5-20 s of duration. If exercise extends beyond that period, it decreases. The magnitude of $_{TOT}O_2D$ increases up to the 10th se-

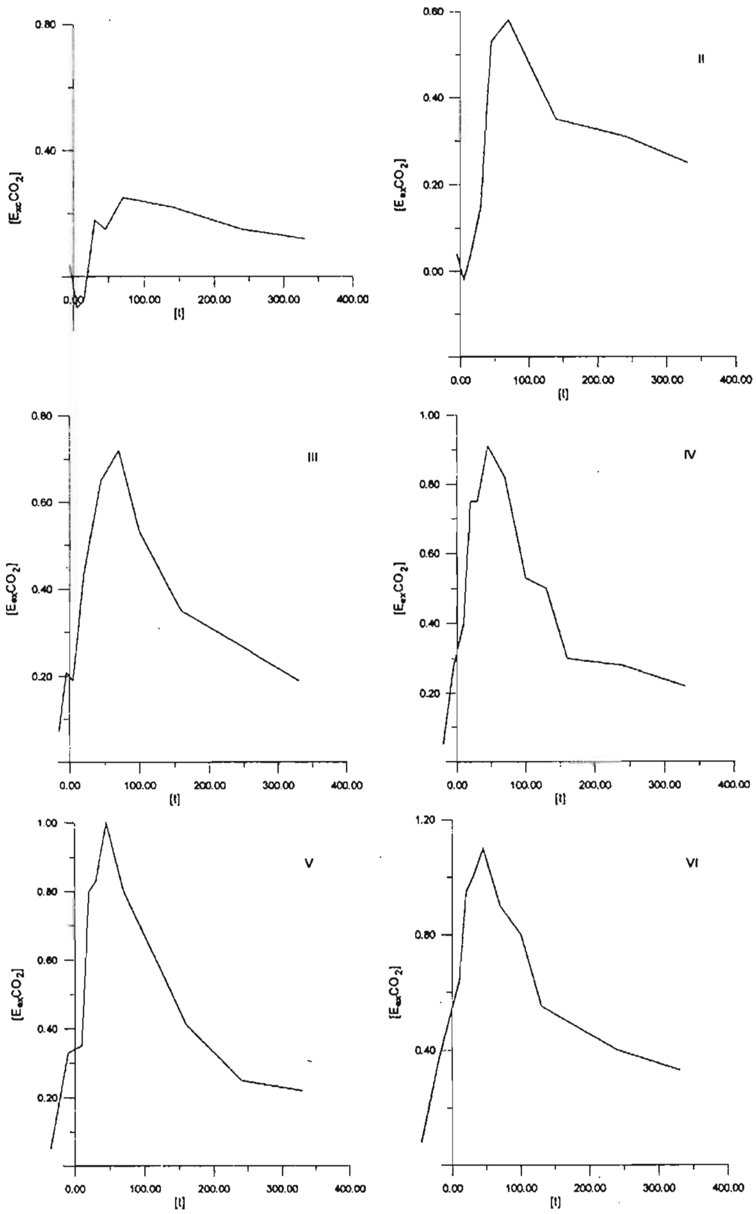

Fig. 1 The dynamics of $ExcCO_2$ during exercise of different power and duration (I – 5 s, II – 10 s, III – 15 s, IV – 20 s, V – 35 s, VI – 45 s); X-intercept - time [s]; Y-intercept - $ExcCO_2$ [l/min]

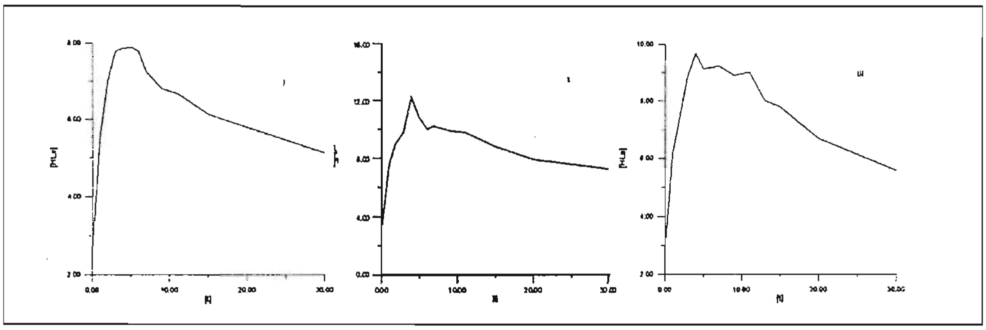

Fig. 2 The dynamics of HLa during exercise of different power and duration (I – 5 s, II – 10 s, III – 15 s); X-intercept - time [s]; Y-intercept - HLa [mmolxl-1]

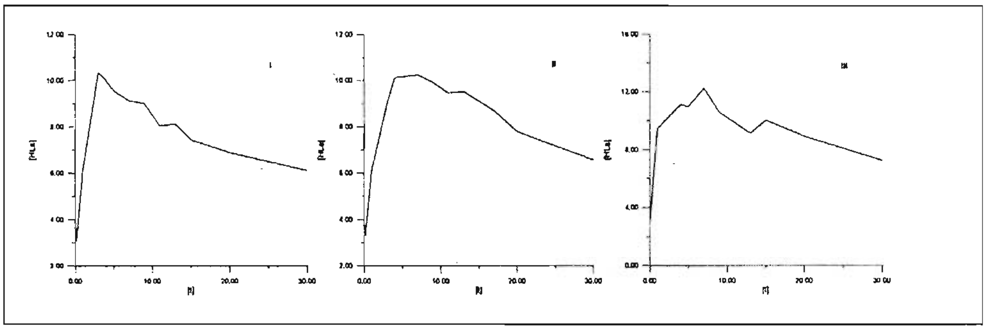

Fig. 3 The dynamics of HLa during exercise of different power and duration (I – 20 s, II – 10 s, III – 15 s); X-intercept - time [s]; Y-intercept - HLa [mmolxl-1]

cond of exercise, soon afterwards it fluctuates insignificantly to obtain its peak after the completion of 45-s exercise.

CONCLUSION

Taking into account the results of this study and the control procedures of anaerobic capacity included in monitoring the subjected athletes' sports training it may be concluded that both maximal intensity trials (30-s Wingate Test and 60-s Test) equally well (effectively) estimate anaerobic lactate power. Furthermore, the 60-s effort trial enables also to determine simultaneously anaerobic lactate capacity levels, what is demonstrated by values of HLa, Exc-CO_2 and $_{TOT}O_2D$ recorded during such trials. Effort trials based on single maximal intensity exercise enable to determine the magnitude of anaerobic lactate power with great accuracy. However, this type of exercise does not let determine parameters of anaerobic lactate capacity with the same degree of accuracy. The values of $_{TOT}O_2D$, HLa and pH recorded during unreiterated trials show a wide range of variability. A limited range of quantitative estimation of anaerobic lactate capacity is associated with the protective mechanism of inhibition, triggered by the central nervous system, which develops during the stimulation of receptors reacting at general magnitude of metabolic transformations and their speed. As it was shown in the studies of Volkov (1968), Volkov et al. (1998) and Hermansen et al. (1971, 1972) a higher level of reliability was identified not during single trials but in many-fold effort trials involving maximal intensity exercises and strictly assumed recovery breaks. On the basis of the results of the study it may be concluded that the following principles should be observed in determining anaerobic lactate power and capacity:

- Maximal intensity exercise performed within 60 s;
- Threefold repetition of a 60-s exercise of maximal intensity with recovery breaks equaling.

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