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Lactate Threshold in Taekwondo through Specifics Tests

G.R. da Mota[1], C.G. Magalhães[2], P.H.S.M. de Azevedo[3], B.N. Ide[4], C.R. Lopes[4], E. Castardeli[5], Neto Barbosa, O[1], M. Marocolo Junior[1], V. Baldissera[2]

[1]Department of Sport Sciences, Federal University of Triângulo Mineiro, Uberaba, MG, Brazil, [2]Department of Exercise Physiology, Federal University of São Carlos, São Carlos, SP, Brazil, [3]Department of Physical Education, Federal University of São Paulo, São Paulo, SP, Brazil, [4]Department of Biology, State University of Campinas, Campinas, SP, Brazil, [5]Department of Sports, Federal University of Espírito Santo, Vitória, ES, Brazil

ABSTRACT

da Mota GR, Magalhães CG, de Azevedo PHSM, Ide BN, Lopes CR, Castardeli E, Barbosa Neto O, Marocolo Junior M, Baldissera, V. Lactate Threshold in Taekwondo Through Specifics Tests. **JEPonline** 2011;14(3):60-66. The purpose of this study was to verify the possibility of determining the intensity of the lactate threshold (LT) of two specifics tests for taekwondo (TKD) and to compare them. Ten male TDK competitors (age 23.3 ± 9.8 yrs, body mass 70.2 ± 9 kg, and height 1.74 ± 7.7 m) were submitted to the incremental test (IT) and to the lactate minimum test (LMT), both equally using the kick bandal chagi in different days. For both tests, the LT was determined by visual inspection. IT consisted in steps with 2 min each, starting with 15 kicks·min^{-1} (increments of 15 kicks·min^{-1}) until exhaustion. Blood was collected after each step for the lactate analysis. The LMT protocol was equal to the IT one, but started after a hyperlactatemia. There were no differences in the values of kicks at the LT ($P > 0.05$) between tests (IT 60 ± 17.3 vs. LMT 71.2 ± 10.6 kicks·min^{-1}). Besides, there was good agreement for IT and LMT. Therefore, the data indicate that it is possible to identify the LT in specific TKD tests, with no difference in the intensity at LT between IT and LMT.

Key Words: Martial arts, Lactic Acid, Wrestling

INTRODUCTION

Taekwondo (TKD) is characterized by fast, high, and spinning kicks of maximum exercise alternating with low-intensity periods (13). It has been practiced in 182 nations (23). In general, the competitions have three rounds of 2 min and 1 min of brake. Although it is a modern Olympic sport, relatively few studies have provided physiological bases for a training prescription. While the TKD performances are more dependent on muscle power (5), in some moments of the training the aerobic capacity must be emphasized. This is the case during the general preparation phase and during recovery after high loaded microcyles or competitions. After all, aerobic capacity is very important for the improvement of phosphocreatine (PC) regeneration (10) and lactate removal (9).

Considering this point of view, the lactate threshold (LT) is considered an ideal physiological index for aerobic capacity (14). However, the majority of protocols that are used to evaluate LT are applied in cyclic movements (i.e., running and cycling), even in sports that have predominantly non-cyclic movements. This usual practice for the evaluation of all sports can be viewed as questionable because it infringes on the specificity of training principle (8).

The gold-standard for aerobic evaluation using blood lactate [La] parameters is the maximal lactate steady-state (MLSS) test. But, the determination of MLSS is expensive and time consuming (16). Therefore, the validity of MLSS prediction from a single test session has been the focus of researchers (20). Among the methodologies used to predict the MLSS intensity, both the lactate minimum test (LMT) (19, 20) and the normal incremental test (IT) stand out. However, as to our knowledge to date, there have been no systematic studies with TKD specific movements during the tests whether LMT, IT or MLSS. Thus, the purpose of this study was to verify the possibility of determining the intensity of the LT on two specifics tests (IT and LMT) for TKD and to compare both. We hypothesized that it would be possible to find the LT through specifics tests.

METHODS

Subjects and Procedures

This study was approved by local Ethics Committee and was performed in accordance with the international ethical standards. Besides, the volunteers signed a free consent form. Ten male from Sao Paulo's TKD state championship were recruited. Sixteen athletes wanted to participate, but only 10 of them met the criteria (Table 1). The inclusion criteria for participating were: (1) aged between 16 and 33 yrs; (2) have at least 2 yrs of experience in TKD; (3) engaged in TKD State championship; (4) no intake of nutritional supplements or potential ergogenic aids of any kind (exogenous anabolic androgenic steroids); (5) non-smoker; (6) normal blood pressure; and non-diabetic; Being familiarized with the exercises at least once before the start of this work. All data were obtained at the beginning of the season, and they trained 12 hr per week (5 days per week).

Table 1. Descriptive data of the subjects (n = 10).

	Age (yrs)	Weight (kg)	Height (m)	BMI ($kg \cdot m^{-2}$)	Training (yrs)
Athletes	23.3 ± 9.8	70.2 ± 9.0	1.74 ± 7.7	23.5 ± 1.8	5.2 ± 4.3

The data are mean ± standard deviation. BMI = body mass index

The kick Bandal Chagi technique was selected because it is the most decisive in competitions (11). To individualize the height of the kicks, there were two horizontal white lines signalizing the local that was allowed to touch the foot in an area of impact of a punching bag (90 cm and 70 kg).

The LT determination was performed by the method of visual inspection of the lactate curve. This determination occurred for IT and LMT and the sessions were randomized. In both tests, the curve inspection was performed individually and independently by two experienced researchers. In IT the LT was defined as the intensity just before an abrupt and sustained increase in [La] in relation to the workload (22). Moreover, in the LMT the LT was considered as the intensity corresponding to the lowest [La] (20) (Figure 1).

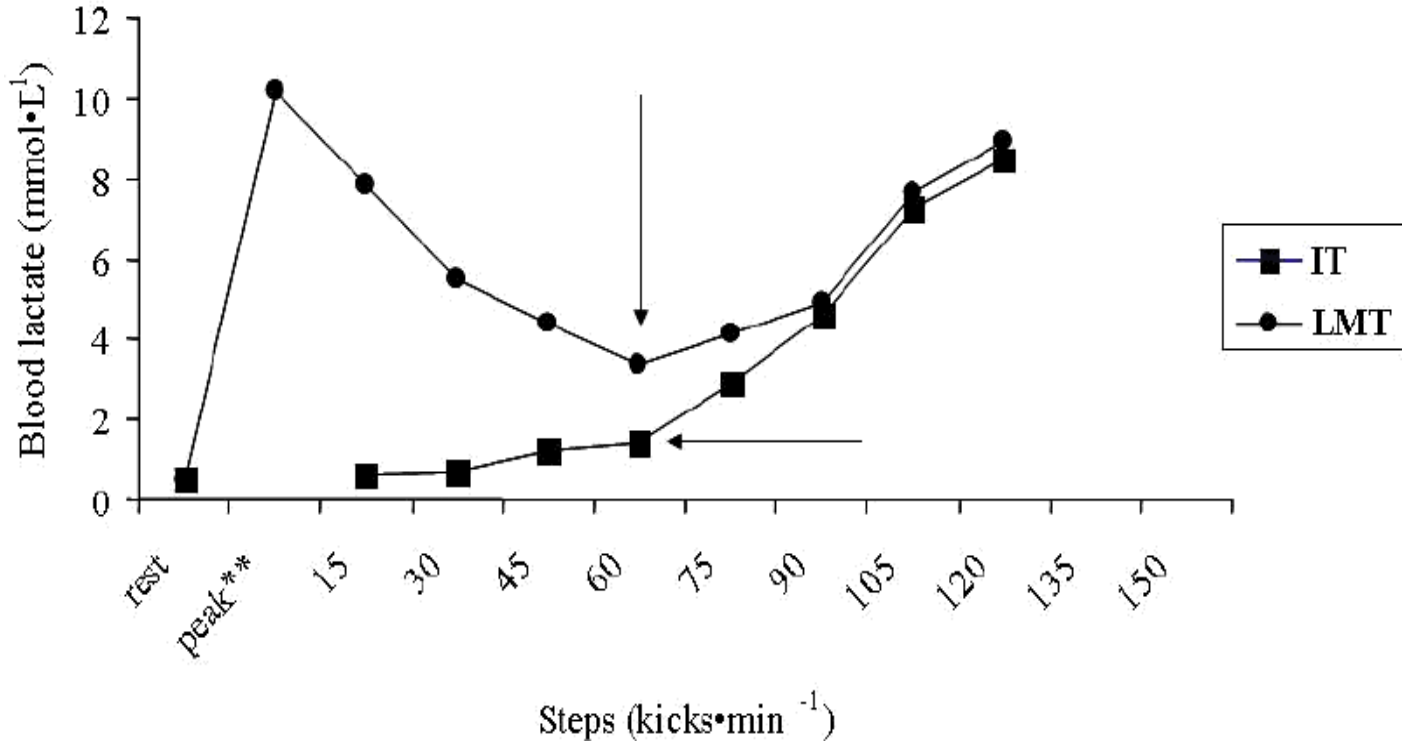

Figure 1. Lactate threshold (60 kicks·min^{-1}) determined by IT (incremental test) and LMT (lactate minimum test) for a single participant on different days. **peak: [La] after 7 min of passive recovery from maximum kicks performed during 1 min.

The participants were instructed to arrive at the laboratory in a rested and fully hydrated state, at least 2-hr postprandial, and to avoid strenuous exercise in the 48-hr preceding and to fast after 11 p.m. Each participant was tested at the same time of the morning (between 9:30 and 12:00 a.m. with 23 ºC temperature). The tests were performed on different days, one week apart.

The subjects completed an IT consisting of steps with 2 min each and 1 min interval for blood sampling. In the first step, they performed a rate of 15 kicks·min^{-1}. Then, the intensities were incremented in 15 kicks·min^{-1} per step. The execution time for each kick was controlled by a pacer alarm (D'Accord®). The test ended with exhaustion that was voluntary or when the pace could not be kept. On the other hand, the LMT was performed after the elevation of [La] through maximal effort (1 min in the highest possible of kicks). A blood sample (25 µl from the earlobe) was collected between the 7th and 8th min of passive recovery. Then, the participants completed a test similar to the IT

quoted. The [La] was determined by electroenzymatic methods (YSI® 1500 Sport, USA). A heart rate (HR) monitor (Polar® Accurex, Finland) was used to measure HR during the tests.

Statistical Analyses

Shapiro-Wilk test was applied to verify the normality of the data. Those within the normal range were compared using the t-test for paired samples. On the other hand, the data that were not within the normal range were compared using the Mann-Whitney test. Additionally, we applied the Bland-Altman technique (4) to verify compliance methods. Statistical significance was established at $P<0.05$ level.

RESULTS

Two participants were excluded from the results relative only to LMT due to non-attendance. No significant differences were found between the HR values at LT obtained in the IT (165 ± 14.0 beats·min^{-1}), LMT (176.5 ± 10.8 beats·min^{-1}), peakHR for the IT (189.7 ± 8.0 beats·min^{-1}), and LMT (190.4 ± 12.5 beats·min^{-1}). Also, there were no differences in maximum number of kicks between the tests (102 ± 6.3 IT vs. 99.4 ± 7.8 LMT) and within the number of kicks at LT (Figure 2). In addition, Bland and Altman plots showed good agreement between IT and LMT kicks.

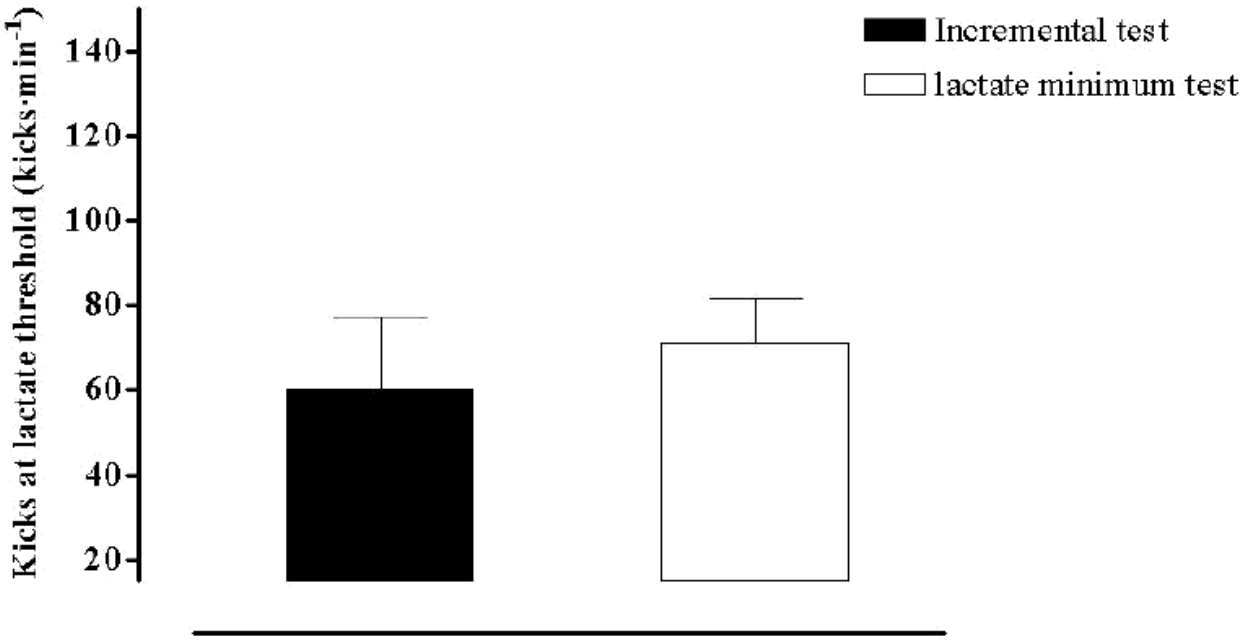

Figure 2. No difference ($P>0.05$) at lactate threshold determined by incremental test (n = 10) and lactate minimum test (n = 8) using specific taekowondo Bandal Chagui kick. The data are mean ± standard deviation.

DISCUSSION

Our main finding is that it was confirmed possible to identify the LT in specific TKD tests. Besides, the intensity at LT was similar between the two protocols used. Thus, it is possible to apply any of these protocols to optimize the evaluation and prescription of TKD training. To our knowledge, this is the first report to test specifics protocols for evaluating the LT in TKD athletes.

The determination of LT is the most common method for aerobic capacity evaluation through [La] response to exercise (18). The IT has been associated with the gold standard among protocols of aerobic capacity diagnosis termed MLSS (21). On the other hand, the intensity obtained from LMT can predict MLSS, and its protocol has been shown to be valid (2). However, the exercises in these tests are always cyclic. To try to shift this paradigm and to consider the specificity principle, a specific kick was used to evaluate [La]. LT was found in both test, therefore, the specific tests appear to represent a promising possibility for evaluation in TKD.

We were not able to find any studies on LT measured by means of specific movements in competitive TKD athletes in the literature. Because of the absence of studies we cannot compare directly our results but, in the same line with the present work, one study used a sport specific movement to determine the lactate minimum intensity successfully for Judo (1). In spite of literature scarcity about LT in TKD, there are a few studies that help to clarify the physiology of TKD during competitions or simulations. One work verified the changes in HR and [La] during simulated TKD competition in three weight-governed division. The mean HR response was 160 beats·min^{-1} (86% HRmax) and [La] during competition was 3.35 mmol·L^{-1}. Although LT was not measured, the authors (7) concluded that the [La] found was close to it, probably due to fixed value of LT to 4 mmol·L^{-1} as proposed by others (12). Nevertheless, the LT determined by fixed [La] was established on running (12). Differences on the type of exercise may change the situations for the TKD movements and so prevents such generalization.

Our HR data were similar between the IT and LMT tests (i.e., HR at LT and HR max), showing a good agreement between protocols, which appears to agree with the 80% of the age-predicted maximal HR for recreational TKD students while performing two different beginner's forms (only arm and both arm and leg techniques) (17). Other authors have reported HR in the 64.7 to 81.4% of HR max (6), but during the specific trainings for experienced TKD practitioners. Although our data were not collected in similar situations like simulated competition (7), arm/leg techniques (17), fitness boxing trials (15) or specific training (6), the HR at LT was approximately 83% and 89% of the maximal HR in IT and LMT protocols, respectively. On the other hand, during international competitions, [La] responses increased to 7.5 ± 1.6 mmol·L^{-1} in the first round and to 11.9 ± 2.1 mmol·L^{-1} in the third. Heart rate increased to 175 ± 15 beats·min^{-1} (89 ± 8% HR max) in the first round, and to 187 ± 8 beats·min^{-1} (96 ± 5% HR max) in the third round (5). These data show that international level TKD requires near-maximal cardiovascular responses and high [La]. Thus, training should include exercise bouts that sufficiently stimulate both aerobic and anaerobic metabolism and the protocols employed in the present study are propitious once LT provides enough information about energetic metabolism and intensity to a specific training. Also, whereas, the recovery of PC depends on aerobic metabolism and that it can be maximized by an optimal evaluation and prescription of specific training, our original work over specific LT in TKD tests becomes promising.

In relation to the intensity obtained from IT and LMT we found the same values with either kicks at LT (Figure 2) and in maximum kicks. This result demonstrates that both protocols are effective in identifying LT. Such evidence is important to assess and to prescribe training for athletes, given that they should be prepared for 6 to 7 fights in a single day (23). Unfortunately, we have not found any

study that has evaluated the LT in a specific movement for TKD to compare our data with. But, by analogy, our results of LT relative to maximum intensity were 60% and 70% for IT and LMT, respectively. This percentage is proximal to the percentage registered for LT in running protocols (3).

CONCLUSIONS

We conclude that it is possible to identify the LT in both incremental test and lactate minimum test specific to the TKD, through kick bandal chagi, and there is no difference in the LT intensity between the two proposed protocols. Therefore, we corroborate our initial hypothesis that it is possible to estimate the LT in specific tests for TKD.

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Address for correspondence: Gustavo Ribeiro da Mota, PhD, Department of Sport Sciences, Federal University of Triângulo Mineiro, Uberaba, MG, Brazil, 38025-180. Phone + 55 (34) 3318-5931; Email. grmotta@gmail.com

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