25 - ANALYSIS OF LACTATE RECOVERY CURVE AFTER TABATA PROTOCOL ON CYCLING

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ABSTRACT

The aim of the study was to verify the return curve of lactate to baseline levels after a session of the Tabata protocol with a stationary bike roller. Therefore Ten male cyclists (30.95 ±6.46 years, 80.07 ±9.04 kg; 177.1 ±6.84 cm) were submitted to eight maximum intensity of 20s series, 10s active recovery there between. Venous blood collected the day before the test, pretest, posttest, after 1h, 12h, 24h, 48h, and 72h characterized the study design. There was a significant difference ($p<0.05$) in the post-test collections and after 1h, returning to baseline levels in post collection 12h. The peak of the curve was the post-test. The Tabata protocol causes changes in blood lactate concentrations, and normalcy turns between 1h and 12h after exercise.

1. INTRODUCTION

Blood lactate has been used by coaches to the prediction of exercise performance, helping to determine the exercise intensity (OLIVEIRA et al., 2006; BILLAT, 1996). However, one must pay attention to the results, since the nutritional status and exercise the athlete must be controlled (BILLAT, 1996).

Its formation comes from the breakdown process of the glucose molecule into two pyruvates in the cytosol of the cell, without the presence of oxygen, for the transfer of energy present in the molecules of adenosine triphosphate (KENNEY; WILMORE; COSTILL, 2013). In situations of rest or during practice exercise with moderate intensity, lactate can be formed by the energy metabolism of red blood cells and the limitations of the enzyme activity in muscle fibers. Given this, there is its accumulation, because the rate of production and removal are equal (KENNEY; WILMORE; COSTILL, 2013; SOUZA; PRADA, 2009).

While in strenuous activities, there is the breakdown of linearity, i.e., the lactate production exceeds the rate of elimination, known as anaerobic threshold (KENNEY; WILMORE; COSTILL, 2013). In that case, fatigue and hydrogen ions increase, the pH and calcium released by the sarcoplasmic reticulum reduce, and may lead the individual to exercise interruption (BARCELOS JR; DOIMO, 2007; SOUZA; PRADA, 2009). This accumulation can result from the imbalance between the supply and use of oxygen in muscle work (BARCELOS JR; DOIMO, 2007). The higher the spew of lactate and other substances, the faster the muscle returns to its ground state, which will fit to carry out the activities with maximum performance (BARONI et al., 2010).

During exercises whose intensity permeating between 50-75% of VO2max lactate practically does not vary and their average concentration remains at 3.5 to 4 mmol / L (COELHO et al., 2015). Accordingly, Dobgenski (2007) points out that well-conditioned individuals or athletes, lactate becomes more evident when its levels exceed 70% of VO2max, and sedentary or unconditioned between 50 and 60% of VO2max.

It appeared in the middle of the 30 and 40, to intensify the race training, interval training emerged and became the subject of discussion even today. The literature has not reached a consensus regarding the best combination of exercise intensity and recovery time for the better cardiorespiratory response (LUCAS; DENADAI; GRECO, 2009). The lactate removal rate is related to oxygen consumption. Efforts that last five minutes, lactate levels do not reach stability. Thus, glycolysis is constant, and several rest intervals suggest that it could avoid the lactate balance at a higher value (GRECO, 2010).

Within the sports training, there are many questions and doubts regarding the ideal time for the implementation of a new training session. The control some variables, such as the load, duration and pause between stimuli allow the coach to adjust the plan based on the overload principle (SILVA; MACEDO, 2011). Moreover, they can contribute to that there is a balance between the load applied during the training and the athlete's recovery time (SHALLOW; GREVE; POLITO, 2013), thus avoiding the loss of performance, injuries, overtraining or overreaching (VAISBERG; MELLO, 2010).

In literature, lactate is a reference to prescribing the training intensity. As few studies were found in Portuguese with research object the lactate curve after training, and considering the variables mentioned, this study aimed to verify the return curve of lactate to baseline levels after a session of the Tabata protocol bike with a stationary roller.

2. METHODS

2.1 PARTICIPANTS

Participated in the descriptive exploratory nature of the experimental study, ten amateur cyclists, male, from Chapecó, SC (30.95 ±6.46 years, 80.07 ±9,04 kg; 1.77 ±0.07 m; 8,53 ± 3.10% fat). The athletes had at least three years of experience in the sport and competed regularly at regional and state levels of evidence. 1h40min trained on average daily at a frequency of four times per week. After being aware of the study's objectives and its possible benefits and risks, they signed a free and informed consent to participate in this study. The research protocol obtained its license by the Research Ethics Committee of the UNOESC (UNOESC / HUST, CAAE 42824514.1.0000.5367, No. 1020653, 25.03.2015).

2.2 ANTHROPOMETRIC MEASUREMENT

The day before the Tabata Protocol session, the athletes underwent anthropometric assessment. Body mass by a digital scale 2096PP / 2 model, max. 200kg, min. 1kg, error 50g (Toledo of Brazil, Brazil) and height with a wooden clinical stadiometer (Cardiomed, Brazil). To calculate body density a clinical adipometer (Cardiomed, Brazil) and the calculation was made using the equation of Jackson and Pollock (1978), accurate for athletes. The folds were measured: subscapularis, triceps, chest, axillary, iliac above, abdomen and thigh. Body composition was estimated by the Siri equation (1961). All measurements were carried out for only an experienced assessor for two times, in the case of the error percentage was greater than 5%, a new

measure proceeded.

2.3 EXPERIMENTAL PROCEDURE

Was carried out in the laboratories of Anthropometry and Exercise Physiology, of Unoesc, Chapecó, SC, in controlled temperature at 22 ° C, a session of the Tabata Protocol training roll Elite Qubo Power Fluid (Spain), with a road bike model, adapted to the measures of cyclists. The test consisted of a slight warming-up of three minutes on the bicycle, followed by eight shots of 20 seconds each, a maximum intensity, with ten active seconds between each shot, totaling four minutes of the test. The subjects were instructed not to practice strenuous exercise in the past 72 hours and ingest any liquids from the pre-test blood collection to post-test.

The average cadence produced in the protocol was 80.1 (± 7.05 rpm), and a maximum of 112.20 (± 9.11 RPM) registered with a performance meter model Edge 520 (Garmin, USA). However, speed data has not been due to problems with the sensor during the test. In the end, the athlete's protocol session reported the level of fatigue that was between levels 17 and 20 on the scale of perceived exertion (BORG, NOBLE, 1974).

2.4 COLLECTION AND ANALYSIS BLOOD

Venous blood was collected at the antecubital fossa of cyclists and placed in vacuum tubes with 3 ml of blood and a fluoride drop. Then, plasma separation occurred with the clinical centrifuge Angfixo 80-2B model (Daiki, Japan) for 15 minutes at 3500rpm. For the analysis of samples, we used the enzyme lactate kit (Life Biotech, Brazil), according to manufacturer's instructions. The process of spectrophotometry was through semi-automatic biochemical analyzer Bioplus model BIO-200 and maria bath bivolt digital, BM02 model (Kacil, Brazil).

Eight blood samples were collected at different times, as follows: the day before the experimental procedure as a way to control (2.86 ± 0,64 mg/dL), pre-test, immediately after completion of the test, 1h, 12h, 24h, 48h and 72h after the test.

2.5 STATISTICAL ANALYSIS

For the data analysis, there was a difference of pretest collects the following collections and used the T-student test compared to analyze the difference between the averages. The level of significance was $p<0.05$, and the results follow the presentation as a mean and standard deviation. An athlete is absent in one of the blood collections and given this, was added the average value of two standard deviations in this one collection. Independent variables of the study was post-test blood groups, after 1h, 12h, 24h, 48h and 72h, and as a dependent variable the pretest collection.

3. RESULTS

The values obtained in the present blood collection in Figure 1 represent the lactate recovery curve. Based on the pre-test blood collection (2.86 ±0.64mg/dL), there was a significant difference ($p<0.05$) in the samples after the test (26.48 ± 4.2mg/dL) and after 1 h (6.85 ± 3.22mg/dL), have returned to baseline levels after 12 hours (2.42 ± 0.58mg/dL), showing no significant differences in the samples after 24 hours (3.09 ± 1.23mg/dL), 48h (3.14 ± 0.63mg/dL) and 72 hours (3.43 ± 1.53mg/dL). The peak of the curve was found immediately after the test.

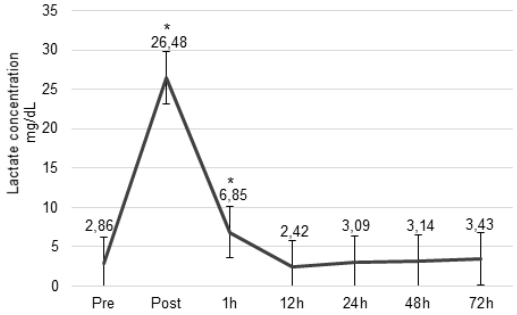

Figure 1. Graph representing the recovery curve of blood lactate. *$p<0.05$.

4. DISCUSSION

The results of this study showed the peak of lactate production soon after the Tabata Protocol (26.48 ± 4.2 mg/dL), reducing in the following collections and returning to baseline levels at 1 hour and 12 hours after the test.

In Silva et al. (2013) found the peak once the trial ends. While the study Fujitsuka et al. (1982), the peak occurred between 6 and 9 minutes from the end of the activity, being able to remain high until 2 hours after (DOBGENSKI, 2007).

In the study by Souza and Prada (2009) with five amateur cyclists, which analyzed one endurance test lasting 20h, lactate levels have changed primarily in the 1st and final lap. Gonelli (2007), in a continuous workout and interval lasting 40 minutes in football, compared the blood lactate concentrations between methods in the pretest moment, posttest 1, 3 and 5 minutes, where training protocol showed a significant increase in lactate levels.

Studies show that since the 1910s, have reported changes in lactate levels resulting from high-intensity exercise (BENETTI; SAINTS; CARVALHO, 2000). However, in the 60s, using intermittent exercises with short intervals found that blood lactate accumulation is small due to lower request glycolytic and higher replacement of adenosine triphosphate and creatine phosphate (LUCAS; DENADAI; GRECO, 2009). Divergently, Kenney, Wilmore, and Costill (2013), show that high-intensity exercise that lasts between one to two minutes lactate levels may increase to 1 mmol/kg at rest, surpassing even 25 mmol/kg after exercise.

The amount of muscle mass involved (FORTE et al., 2015), the temperature throughout the year (DOBGENSKI, 2007) and the type of exercise can influence results (Oliveira et al., 2009). As well as the intensity, the stimuli duration and the sport can stimulate the removal of lactate during active recovery (LUCAS; DENADAI; GRECO, 2009). Performance in high-performance sports get optimized with an appropriate structure, organization and control training, so it correlates directly with the Psycho-Morphological adaptation (GOMES, 2009).

The ratio of intensity, duration, and frequency of HIIT are unclear until today on a range of training plans and its variations. Enable and adjust the interval between them is a powerful instigator for physiological restoration (MACLNNIS; GIBALA, 2016). Furthermore, it has been seen in many instances as a strenuous activity, and may be unsafe for people with

cardiovascular diseases, moreover, has not established a protocol for these cases PEARSON; MACALUSO; HUSSAIN, 2015).

Many studies had emphasized the different application methods focused on muscle recovery after exercise, so that when successfully carried out may allow the athlete to advance implementation of a new stimulus. Such as cryotherapy, laser therapy, led therapy, hydrotherapy, manual therapy, active recovery, passive or electric and phototherapy.

The applied test improvement occurred immediately allowing a new training within 1 hour up to 12 hours. It is assumed that can be a result of the short-term stimulus; physical condition determined cyclists or used intensity may not have been enough to cause extensive damage.

As study limitation, the low number of subjects and the distance between the blood collection after 1h and 12h, preventing the accuracy of time that the values are no longer significant and returned to baseline levels considered.

5. CONCLUSION

Based on the study findings, Tabata protocol causes changes in blood lactate concentrations, providing a recovery curve in a 72h period. It found the peak of the curve immediately after training and its return to baseline levels between 1 hour and 12 hours after activity, which assumes that on the applied intensity, the athlete was able to take a new training session within that period. At the same time, we suggest that further studies be carried out, determining VO2max of the subjects at baseline and applying research at different times of periodization training.

Keywords: Cycling. Interval training. Tabata Protocol.

1. REFERÊNCIAS

BARCELOS JÚNIOR, Sebastião Lopes de; DOIMO, Leonice Aparecida. Comportamento da frequência cardíaca, concentração de lactato sanguíneo e percepção subjetiva de esforço em mulheres praticantes de power jump. Coleção Pesquisa em Educação Física, v. 6, n. 1, p. 173-180, jul. 2007.

BARONI, Bruno Manfredini et al. Efeito da crioterapia de imersão sobre a remoção do lactato sanguíneo após exercício. Revista Brasileira de Cineantropometria e Desempenho Humano, v. 12, n. 3, p. 179-185. 2010.

BENETTI, Magnus; SANTOS, Targino dos; CARVALHO, Tales de. Cinética de lactato em diferentes intensidades de exercícios e concentrações de oxigênio. Revista Brasileira de Medicina do Esporte, v. 6, n. 2, p. 50-56, mar./abr. 2000.

BILLAT, L. Véronique. Use of Blood Lactate Measurements for Prediction of Exercise Performance and for Control of Training. Sports Medicine, v. 22, n. 3, p. 157-175, sep. 1996.

COELHO, Daniel Barbosa et al. Limiar anaeróbico de 4,0mM é capaz de estimar a máxima fase estável de lactato de jogadores de futebol em testes de campo. Revista Brasileira de Ciência e Movimento, v. 23, n. 2, p. 32-39, jun. 2015.

DOBGENSKI, Vinícius. Efeito da suplementação de creatina na performance e em algumas variáveis bioquímicas e metabólicas em nadadores do sexo masculino. 2007. Dissertação (Mestrado em Educação Física) – Universidade Federal do Paraná, Curitiba, 2007.

FORTE, Lucas Dantas Maia et al. Limiar anaeróbio em exercícios resistidos: análise de aspectos metodológicos e hemodinâmicos. Revista Brasileira de Medicina do Esporte, v. 21, n. 6, p. 433-437, nov./dez. 2015.

FUJITSUKA, Noriaki et al. Peak blood lactate after short periods of maximal treadmill running. European Journal of Applied Physiology and Physiology Ocupacional, v. 48, n. 3, p. 289-296, 1982.

GOMES, Antonio Carlos. Treinamento desportivo: estruturação e periodização. 2. ed. Porto Alegre: Artmed, 2009.

GONELLI, Pamela Roberta Gomes. O efeito agudo do lactato sérico de sessões de treino contínuo e intervalado, em jogadores de futebol universitários. In: 5ª AMOSTRA ACADÊMICA UNIMEP, 5., 2007, Piracicaba. Anais... Piracicaba, 2007.

GRECO, Camila Coelho. Efeitos do desempenho aeróbio na máxima fase estável de lactato sanguíneo determinada em protocolo intermitente na natação. Revista Brasileira de Medicina do Esporte, v. 16, n. 2, p. 130-133, mar./abr/. 2010.

KENNEY, W. Larry; WILMORE, Jack H.; COSTILL, David L. Fisiologia do esporte e do exercício. 5. ed. Barueri: Manole, 2013.

LUCAS, Ricardo Dantas de; DENADAI, Benedito Sérgio; GRECO, Camila Coelho. Respostas fisiológicas durante o exercício contínuo e intermitente: implicações para a avaliação e a prescrição do treinamento aeróbio. Motriz, Rio Claro, v. 15, n. 4, p. 810-820, out./dez. 2009.

MACLNISS, Martin J.; GIBALA, Martin J. Physiological adaptations to interval training and the role of exercise intensity. The Journal of Physiology, out. 2016.

MCARDLE, William D.; KATCH, Frank I.; KATCH, Victor L. Fisiologia do exercício: nutrição, energia e desempenho humano. 7. ed. Rio de Janeiro: Guanabara Koogan, 2013.

OLIVEIRA, Anderson Souza-Castelo et al. Relações cineantropométricas e fisiológicas durante exercício incremental em esteira rolante. Revista Brasileira de Medicina do Esporte, v. 16, n. 4, p. 286-290, jul./ago. 2009.

OLIVEIRA, João Carlos de et al. Identificação do limiar de lactato e limiar glicêmico em exercícios resistidos. Revista Brasileira de Medicina do Esporte, v. 12, n. 6, p. 333-338, nov./dez. 2006.

PEARSON, Stephen John; MACALUSO, Andrea; HUSSAIN, Syed Robiul. High intensity interval training vs moderate intensity continuous training in the management of metabolic type disease. Anatomy & Physiology, v. 1, n. 5, p. 1-6, out. 2015.

RASO, Vagner; GREVE, Julia Maria D'Andrea; POLITO, Marcos Doederlein. Pollock: fisiologia clínica do exercício. Barueri, SP: Manole, 2013.

SILVA, Carla Cristiane da et al. Análise da cinética de remoção de lactato em atletas de canoagem slalom. Revista Brasileira de Ciência do Esporte, Florianópolis, v. 35, n. 2, p. 425-439, abr./jun. 2013.

SILVA, Fernando Oliveira Castanho da; MACEDO, Denise Vaz. Exercício físico, processo inflamatório e adaptação: uma visão geral. Revista Brasileira de Cineantropometria e desempenho Humano, v. 13, n. 4, p. 320-328, 2011.

SOUZA, Danúbio Baiano de; PRADA, Francisco José Andriotti. Variações metabólicas do lactato e glicemia em uma prova de 20 horas de ciclismo. Revista Diálogos, v. 11, n. 1, p. 80-84, 2009.

TABATA, Izumi et al. Effects of moderate-intensity endurance and high-intensity intermittent training on anaerobic capacity and VO2máx. Medicine & Science in Sports & Exercise, v. 28, n. 10, p. 1327-1330, oct.1996.

VAISBERG, Mauro; MELLO, Marco Túlio de. Exercícios na saúde e na doença. 1. ed. Barueri, SP: Manole, 2010.

ANALYSIS OF LACTATE RECOVERY CURVE AFTER TABATA PROTOCOL ON CYCLING
ABSTRACT

The aim of the study was to verify the return curve of lactate to baseline levels after a session of the Tabata protocol with a stationary bike roller. Therefore Ten male cyclists (30.95 ±6.46 years, 80.07 ±9.04 kg; 177.1 ±6.84 cm) were submitted to eight maximum intensity of 20s series, 10s active recovery there between. Venous blood collected the day before the test, pretest, posttest, after 1h, 12h, 24h, 48h, and 72h characterized the study design. There was a significant difference ($p<0.05$) in the post-test collections and after 1h, returning to baseline levels in post collection 12h. The peak of the curve was the post-test. The Tabata protocol causes changes in blood lactate concentrations, and normalcy turns between 1h and 12h after exercise.

Keywords: Cycling. Interval training. Tabata Protocol.

ANALYSE DE LACTATE RÉCUPÉRATION CURVE APRÈS TABATA PROTOCOLE SUR LE CYCLISME
RÉSUMÉ

Le but de l'étude était de vérifier la courbe des taux de lactate aux niveaux de base après une session du protocole Tabata avec a vélo aux rouleau stationnaire. Par conséquent dix cyclistes masculins (30,95 ±6,46 années, 80.07 ±9.04 kg; 177,1 ±6,84 cm) ont été soumis à huit séries de 20s sur intensité maximale, avec 10s entre celles-ci de récupération active. Le sang veineux a été recueilli le jour avant le test, sur le prétest, post-test, après 1h, 12h, 24h, 48h et 72h. Il y avait une différence significative ($p<0,05$) dans les collections post-test et après 1h, et aucune différence significative par rapport à la douzième heure. Le pic de la courbe était le post-test. Il est conclu que le protocole Tabata provoque des changements dans les concentrations de lactate dans le sang, et le retour à des niveaux de base conclus entre le premier et le 12éme heure après l'exercice.

Mots-clés: Cyclisme. L'entraînement par intervalles. Protocole Tabata.

ANÁLISIS DE CURVA DEL LACTATO DE RECUPERACIÓN DESPUÉS DEL PROTOCOLO TABATA EN CICLISMO
RESUMEN

El objetivo del estudio fue verificar la curva de recuperación del lactato a los niveles basales después de una sesión del protocolo Tabata con rollo estacionario en bicicleta. Para tanto, diez ciclistas varones (30,95 ±6,46 años, 80,07 ±9,04 kg; 177,1 ±6,84 cm) fueron sometidos a ocho series de 20s en intensidad máxima, con 10s de recuperación activa entre ellas. Se recogió sangre venosa el día antes de la prueba, en el pre-test, post-test, después de 1h, 12h, 24h, 48h y 72h. Hubo diferencia significativa ($p<0,05$) en el post-test y después de 1h realizado el protocolo. Se encontró valores basales a 12 horas después de la colecta. El pico de la curva ocurrió en el post-test. Se concluye que el protocolo Tabata produce cambios en las concentraciones de lactato sanguíneo, y que los niveles basales son atingidos entre 1h y 12h después del entrenamiento.

Palabras clave: Ciclismo. Entrenamiento de intervalo. Protocolo Tabata.

ANÁLISE DA CURVA DE RECUPERAÇÃO DO LACTATO APÓS PROTOCOLO TABATA EM CICLISMO
RESUMO

O objetivo do estudo foi verificar a curva de retorno do lactato aos níveis basais após uma sessão do protocolo Tabata em bicicleta com rolo estacionário. Para tanto, dez ciclistas do sexo masculino (30,95 ±6,46 anos; 80,07 ±9,04 Kg; 177,1 ±6,84 cm) foram submetidos à oito séries de intensidade máxima de 20s, com 10s de recuperação ativa entre elas. O sangue venoso foi coletado no dia anterior ao teste, pré-teste, pós-teste, após 1h, 12h, 24h, 48h e 72h. Constatou-se diferença significativa ($p<0,05$) nas coletas pós-teste e após 1h, e sem diferença significativa a partir da décima segunda hora. O pico da curva ocorreu no pós-teste. Conclui-se que o protocolo Tabata provoca alterações nas concentrações de lactato sanguíneo, e que retorno aos níveis basais atingido entre 1h e12h após o exercício.

Palavras-chave: Ciclismo. Treinamento Intervalado. Protocolo Tabata.