100 - ACUTE EFFECT OF TWO TYPES OF RECOVERY IN THE SWIMMERS BLOOD LACTATE FOLLOWING MAXIMUM EFFORT

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1.INTRODUCTION

Lactic acid is the reaction product of anaerobic glucose, which, to dissociate, releasing hydrogen ions (H +) causing tissue acidosis and turning into lactate. This reaction occurs when conducting intensive effort for about 1 to 2 minutes. Such acidosis interferes with the production of ATP (adenosine triphosphate) and muscle contraction (TORTORA & GRABOWSKI, 2008; WILMORE et al., 2010).

The accumulation of lactate in the blood depends on the balance between production and removal of this (GATTI et al., 2004). It is known that lactate production continued until 5 minutes after the termination of the stress, as evidenced by Toubeski et al. (2008b). Already Cicielski et al. (2008), states that the level of blood lactate continues to rise until the third minute after cessation of activity. Therefore, when analyzing the amount of times that the swimmer swims a trial in a competition, it is necessary a mechanism for efficient lactate removal (VESCOSCI et al., 2011).

Although there is a tendency to adopt active recovery for lactate removal, because it provides an increase in blood flow and thus oxygenation of muscle tissue, there is still no consensus on the best way to accomplish such removal, with active recovery, passive, or the use of two. Platonov (2005) states that the rate of lactate elimination with passive recovery is 0.02 to 0.03 g / l / min, as with active recovery, held 30-50% of VO2 max is 0.08 0.09 g / l / min. However Toubekis et al. (2008a) states that passive recovery has the same removal rate and benefits that active recovery at 60% of the maximum effort, for the duration of 5 minutes. Being passive recovery more indicated when the rest interval is less than 2 minutes (TOUBESKI et al., 2008a).

Dealing exclusively of active recovery, there is no unanimity regarding the intensity and duration of execution. Greenwood et al. (2008) proposed a 10-minute free-style swimming speeds of the anaerobic threshold, on average 86% of maximum effort as optimal recovery and subsequent improvement in performance. Already Ferreira et al. (2011) states that implementation of the activity to 85% of anaerobic threshold for 30 minutes is able to remove about 70% of the lactate produced. However Toubeski et al. (2008b) argues that five minutes of active recovery (approximately 300m)at 60% of maximum effort followed by 10 minutes of passive recovery, is enough to reduce blood lactate and positively affect performance. For Maglicsho (1999), recovery is expected to last 10 to 20 minutes relaxed in swimming at athletic intensity defined as this intuitively choose the most appropriate swimming speed.

By defining the type, duration and intensity of recovery must also analyze the effort. For Lucas et al. (2009), the passive recovery between short repetitions should be prioritized, with less than 60 seconds, in order to achieve greater intensity during the repetitions. However, between sets of high intensity active recovery is more suitable, because of accelerating the removal of lactate (LUCAS et al. 2009).

When analyzing the blood lactate as an evaluator of recovery, it is of paramount importance to consider the many variables involved, such as athlete's biological age, gender, the factors surrounding the tests, stress levels, individual conditioning, the temperature of water, and others (BARROSO et al. 2011).

In this regard, Silva et al. (2007) in his study with children and adolescents 9-17 years concluded that the accumulation of lactate after exercise was greater in adolescents 15-17 years than in younger ages, may well assert that the production of lactate is dependent on the biological maturation. Regarding fitness, Toubekis et al. (2006) argues that well-developed aerobic capacity is closely related to the removal of lactate. Rather, Cicieslki et al. (2008) states that high aerobic capacity is not decisive in the elimination rate of lactate.

Respecting the variables mentioned, this study aims to identify the acute effect of active recovery and passive recovery on blood lactate swimmers after maximum effort, thus comparatively analyze the response of this lactate.

2.METHODS

2.1.SUBJECTS

Fifteen swimmers high performance (8 men and 7 women, 17.4 ± 1.59 years, 1.72 ± 0.8 meters, 64.45 ± 6.75 kg) participated as volunteers in this study. All had experience in high performance sport for at least two years and competed in at least four regional or national competitions per year. All were informed of the procedures of the experiment, as well as their implications, and signed an informed consent to participate in the study. The experimental procedures in this study were approved by the Ethics Research Center University of Brasilia - CEP / UniCEUB under number CAAE: 01845312.5.0000.0023.

2.2.EXPERIMENTAL PROCEDURE

Each subject performed a simulation of competitive event in 200 meters freestyle (crawl), with 15 minutes of recovery, in two different experimental conditions, separated by at least 1 week. Water temperature 27-29 ° C. In the first experimental condition (PAS), the athletes were submitted after completion of the maximum effort, 15 minutes of passive recovery, in which were placed in the supine position protected from the sun, covered by a towel.

In the second experimental condition (ATV), agreeing with Toubekis et al. (2008a) argues that the recovery protocols usually consist of an active and passive part, for the blood collection, subjects had 5 minutes of passive recovery in the supine position, protected from the sun, covered by a towel, followed by 10 minutes of active recovery, held 60-65% of the maximum capacity of each athlete.

In both procedures were, prior to the simulation of competitive event, a warm period that consisted of 1600 meters, determined by the coach, composed of free swimming 600 meters, 200 meters leg, 200 meters arms, 4 x 50 meters education, 4 x 50 meters progressive from 1st to 4th and 200m swimming easy. After the warmup period, the athletes remaining 10 minutes in rest in the supine position before the start of the test, as proposed by Greenwood et al. (2008).

2.3.BLOOD COLLECTION AND ANALYSIS

Were collected three blood samples in each experimental procedure for analysis of lactate concentration. The samples were 1-2 drops of blood collected from the distal phalanx and analyzed immediately in lactimeter Accutrend ® Plus (Roche Products Chemicals and Pharmaceuticals SA). The samples were obtained immediately before exercise (Pre-PAS / Pre-ATV), 5 minutes (PAS-5min / ATV-5min) and 15 minutes (PAS-15min / ATV-15min) after the maximum effort.

2.4.STATISTICAL ANALYSIS

In the statistical treatment of the data, was used the descriptive analysis (mean and standard deviation). To compare the concentration of lactate in the two types of recovery, analysis of variance was used (ANOVA), "post-hoc" Tukey to identify where significant differences (SPSS version 18.0 for Windows, SPSS, Inc., Chicago, IL, USA) . In all analyzes, was adopted $p < 0.05$.

3.RESULTS

The results of the lactate concentration in all samples are presented in Table 1.

LACTATE CONCENTRATION (MMOL/L)			
	PAS	**ATV**	**p**
PRE	3.46 ± 0.59*	3.73 ± 0.88*	0.998
5 MIN	12.05 ± 2.29	11.49 ± 2.30	0.960
15 MIN	10.25 ± 1.78	7.4 ± 2.20 **	0.001

Table 1 Mean (SD) and significance of lactate concentration during the experimental procedures.
* Significant difference between collections PRE and other collections (p <0,05).
** Significant difference between ATV 15min and the other samples (p <0,05).

In the collection prior to exercise (PASPréand ATVPré) no significant difference between the two types of recovery, however significant differences with the other collections post competitive simulation ($p < 0.05$). There was no difference between the two types of recovery for 5 min. However, at 15 min, there was significant difference between PAS and ATV ($p < 0.05$) as ATV showed lower values. There was no difference between 15 minutes and 5 minutes in PAS, however, between the 15th and the 5th minute of ATV, there was a significant difference ($p < 0.05$). Figure 1 shows the kinetics of lactate production and removal during the procedures.

Figure 2 and 3 explains the absolute difference (Δ) between collections Pre, 5min and 15min. The "Δ" represents the amount of lactate produced between collecting Pre and 5 minutes after the maximum effort, beyond the amount removed between 5 and 15 minutes, in both types of recovery. In PAS between the collection Pre (3.46 mmol / L) and 5 min (12.05 mmol / l) production was 8.59 mmol / l lactate. In ATV between Pre (3.73 mmol / l) and 5 min (11.49 mmol / l), there was a production of 7.76 mmol / l lactate, with no significant difference between PASPré and ATVPré. In PAS, between 5 minutes (12.05 mmol / l) and 15 minutes (11.49 mmol / l), was the removal of of 1.8 mmol / l (14.94%). Already in ATV, between 5 minutes (11.49 mmol / l) and 15 minutes (7.4 mmol / l), was the removal of 4.09 mmol / l (35.6%) blood lactate. There was significant difference PAS15min and ATV15min ($p < 0.05$).

During the 10 minutes for the active recovery, ATV, athletes swam 660.67 ± 38.45 meters.

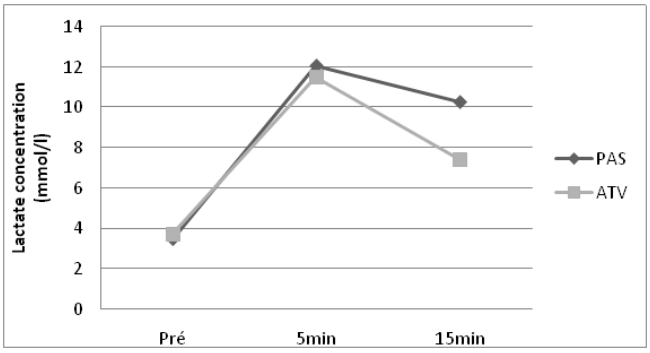

Figure 1 Graph representing the kinetics of production and removal of lactate in PAS and ATV.
* Significant difference between Pre and other samples (p<0.05).
**Significant difference between ATV 15 min and the other samples (p <0.05).

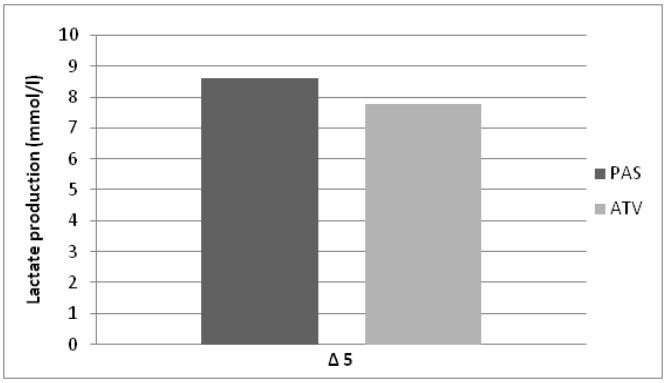

Figure 2 Graph representing the absolute difference between collections Pre and 5min.

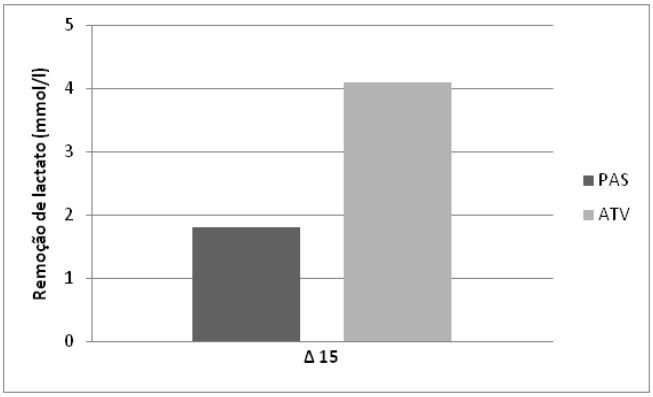

Figure 3 Graph representing the absolute difference between collections 5min and 15min.
* Significant difference between lactate removal in ATV and PAS ($p < 0.05$)

4.DISCUSSION

The results of this study showed a high lactate production in maximal swimming 200 meters in freestyle, with an average duration of 2 minutes. Importantly, the concentration of lactate found in the collection does not match PRE levels at rest lacto athletes surveyed. Such concentration in both PAS (3.46 ± 0.59) as in ATV (3.73 ± 0.88), aims only to indicate the production of lactate after maximal exercise and does not represent the rest, because there was a similar stimulus to the test during warmup, responsible for this increase.

The results also demonstrate that active recovery is more efficient in the removal of lactate than passive recovery, corroborating many previous studies in this direction (FERREIRAet al., 2011; GREENWOOD et al., 2008; TOUBEKIS et al., 2006 , TOUBEKIS et al., 2008b). Such efficiency is associated with exercise capacity to increase blood flow and therefore provide a greater supply of oxygen to the muscle tissue (MAGLISCHO, 1999; PLATONOV, 2005).

Some authors also claim that, during exercise, there is the diffusive transport of lactate present in the muscle fibers active (working) for the rest, in the same muscle group. This transport mechanism is due to a difference in lactate concentration and quantity of fibers surrounding and favors the oxidation or conversion of glucose to lactic acid (MAGLISCHO, 1999).

However, there is no consensus among researchers regarding the intensity and amount (volume) of this active recovery. In this study, active 10-minute recovery at 60% intensity was removed from 4.09 mmol / l (35.6%) lactate, reaching 7.4 mmol / l blood concentration, while in passive recovery was removed only 1.8 mmol / l (14.94%).

Already Toubekis et al. (2008a) states that there was no difference between active recovery performed at 60% intensity and passive recovery for 5 minutes. This finding is due, most likely, the lactate peak is present between 3 and 5 minutes after the end of the maximum effort.

However in a study with 11 high performance swimmers, Toubekis et al. (2008b) concluded that there was no difference between 5 minutes and 10 minutes of active recovery at 60%, because both removed the same amount of lactate, being more than passive recovery.

Regarding the intensity, the findings of this study indicate the intensity of 60% as sufficient for removal of lactate, corroborating Toubekis et al. (2008b). Such intensity becomes effective in the eyes of researchers to be below the lactate threshold, preventing any buildup and using oxidative metabolism for energy production, and contribute to the maintenance of proper swimming technique.

Already Greenwood et al. (2008) argues as optimal intensity of removal of lactic acid the velocity corresponding to the anaerobic threshold (lactate). In their study, concluded that the removal was more efficient at lactate threshold, 86% of the intensity of swimming athletes surveyed, other than speed or passive recovery. However, the authors believe that this study perform recovery at lactate threshold intensity is a risk, since this threshold is set by the point at which the rate of production exceeds the rate of elimination or removal of this substance (WILMORE et al. 2010) .

Maglischo (1999) states that it is not necessary to determine an intensity recovery, since the athletes themselves determine the speed most comfortable. In this sense, it can be understood that the intensity is not the most important component of active recovery, but the volume to be executed. Because of the number and sequence of any evidence that an athlete in a competition means that after the active recovery lactate levels should approach quantities at rest, approximately 2 mmol / l (VESCOVI et al. 2011) For Maglischo (1999), the lactate level at rest is 1.5 mmol / l.

The results of this study indicate that after 10 minutes (660.67 ± 38.45 meters swam) the blood lactate was 7.4 ± 2.20 mmol / l, amount still far from ideal, suggesting that a greater volume of active recovery is required.

In his study of cyclists, Ferreira et al. (2011) concluded that the 85% intensity of the lactate threshold, after 30 minutes of recovery, a difference of 67.38% over the first collection, recovering active and passive recovery 37.24% passing 12.5 mmol / l to 4.06 mmol / l and 13.76 mmol / l to 8.61 mmol / l, respectively. Therefore, it was more favorable a larger amount of recovery for the present study.

Becoming more specific, Vescovi et al. (2011) proposed models of active recovery to achieve the amount of lactate from home. For the 200-meter freestyle (crawl), used in this studyhe proposes a range from 1300 to 1500 meters men and 800-1000 meters to women.

5.CONCLUSION

Based on the results of this study it is concluded that active recovery is more efficient than the passive recovery in the removal of lactate as has been shown in the literature. Active recovery was 35.6% the removal of of lactate produced, while in the passive recovery, only 14.96%. This study demonstrated that 10 minutes of active recovery at an intensity of 60% is able to remove the blood lactate more efficiently, but this volume was still not enough to remove the optimal amount of lactic acid, causing the substance to resting levels. This requirement is due to the number of races in which the swimmer participates in the same competition.

The elimination mechanisms and active greater efficiency of recovery are disclosed in the literature, including in this

study. However, it is necessary to deepen the research on the relationship of the volume and intensity during this recovery, creating models that will help coaches and athletes, facilitating the maintenance of better fitness and delaying fatigue during competition.

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ACUTE EFFECT OF TWO TYPES OF RECOVERY IN THE SWIMMERS BLOOD LACTATE FOLLOWING MAXIMUM EFFORT

ABSTRACT

Objectives: To identify the acute effect of passive recovery and active recovery on blood lactate after maximal exercise, as well as demonstrating the lactate kinetics in these two types of recovery. Methods: The sample consisted of 15 swimmers with a mean age 15-20 years who participated in two experimental procedures. In the first, after conducting a simulation proof of competitive 200 meter freestyle, performed passive recovery of 15 minutes in the supine position. In the second procedure, after the same simulation competitive athletes performed five minutes of passive recovery, supine, necessitated by the blood collection, and 10 minutes of active recovery at 60% - 65% intensity, according to the ability of each athlete. During passive recovery, athletes remained protected from the sun, in a covered place. 3 collections were made about 1 - 2 drops of blood in each procedure occurring before simulation competitive 5 minutes after and 15 minutes after, the two procedures. Results: In the collection held prior to competitive simulation, there was no significant difference ($p < 0.05$) between the two procedures. However, significant differences ($p < 0.05$) in blood lactate concentration after the two types of recovery and the recovery active responsible for removing 36.6% of the lactate produced, while the passive recovery, only 14.96% . Conclusion: The active recovery is more efficient than the passive recovery, the removal of lactate produced after a maximum effort. This study showed that 10 minutes of recovery actively held at 60 - 65% intensity, is capable of removing lactate more efficiently. However, this recovery period was not sufficient to remove the required amount, causing its concentration to resting levels. This requirement is given by the amount of evidence in a professional swimmer participates in the same competition.

KEYWORDS: Recovery, lactate, swimming.

EFFET AIGU DE DEUX TYPES DE SANG RECOUVREMENT DES NAGEURS LACTATE APRÈS L'EFFORT MAXIMUM

RÉSUMÉ

Objectifs: identifier l'effet aigu de la récupération passive et récupération active sur lactate dans le sang après l'effort maximal, ainsi que la démonstration de la cinétique de lactate dans ces deux types de récupération . Méthodes : L'échantillon se composait de 15 nageurs ayant un âge moyen de 15-20 ans qui ont participé à deux procédures expérimentales . Dans la première, après avoir mené une preuve de simulation de la concurrence 200 mètres nage libre , effectué récupération passive de 15 minutes dans la position couchée . Dans la seconde procédure , après la même simulation athlètes de haut niveau effectuées cinq minutes de récupération passive , en position couchée , rendues nécessaires par la collecte de sang , et à 10 minutes de récupération active à 60 % - l'intensité de 65% , selon la capacité de chaque athlète. Lors de la récupération passive , les athlètes

sont restés protégés du soleil , dans un endroit couvert . 3 collections ont été faites au sujet de 1-2 gouttes de sang dans chaque procédure survenant avant simulation compétitifs 5 minutes après et 15 minutes après , les deux procédures . Résultats : Dans la collection tenue avant simulation concurrentiel , il n'y avait pas de différence significative (p < 0,05) entre les deux procédures . Toutefois, des différences significatives (p < 0,05) de la concentration de lactate dans le sang après les deux types de recouvrement et le recouvrement actif responsable de l'enlèvement de 36,6 % du lactate produit , tandis que la reprise passive , seulement 14,96% . Conclusion : La récupération active est plus efficace que la récupération passive , l'élimination du lactate produit après un effort maximum. Cette étude a montré que 10 minutes de récupération active au lieu de 60 - intensité de 65% , est capable d'éliminer le lactate de manière plus efficace . Toutefois, cette période de récupération n'était pas suffisante pour éliminer la quantité requise , ce qui provoque sa concentration à des niveaux de repos . Cette exigence est donnée par la quantité de preuves dans un nageur professionnel participe à la même compétition.

EFECTO AGUDO DE DOS TIPOS DE RECUPERACIÓN EN LO LACTATO EM LA SANGRE EN NADADORES DESPÚES DE ESFUERZO MÁXIMO

RESUMEN

Objetivos: Determinar el efecto agudo de recuperación pasiva y recuperación activa de lactato em la sangre después del ejercicio máximo, así como la demostración de la cinética del lactato en estos dos tipos de recuperación. Métodos: La muestra estuvo conformada por 15 nadadores con una edad media de 15-20 años que participaron en dos procedimientos experimentales. En la primera, tras la realización de una prueba de simulación de la competencia 200 metros estilo libre, realizado recuperación pasiva de 15 minutos en la posición supina. En el segundo procedimiento, después de la misma simulación atletas competitivos cabo de cinco minutos de recuperación pasiva, en posición supina, que impone la recogida de sangre, ya 10 minutos de recuperación activa al 60% - 65% de intensidad, de acuerdo a la capacidad de cada atleta. Durante la recuperación pasiva, los atletas quedaron protegidos del sol, en un lugar cubierto. 3 colecciones se hicieron cerca de 1 - 2 gotas de sangre en cada procedimiento que ocurre antes de la simulación competitivos 5 minutos después y 15 minutos después, los dos procedimientos. Resultados: En la colección celebrada antes de la simulación competitiva, no hubo diferencia significativa (p <0,05) entre los dos procedimientos. Sin embargo, diferencias significativas (p <0,05) en la concentración de lactato en sangre después de los dos tipos de recuperación y la recuperación activa responsable de la eliminación del 36,6% del lactato producido, mientras que la recuperación pasiva, sólo el 14,96% . Conclusión: La recuperación activa es más eficiente que la recuperación pasiva, la eliminación de lactato producido después de un esfuerzo máximo. Este estudio demostró que 10 minutos de recuperación a cabo activamente en el 60 - 65% de intensidad, es capaz de eliminar el lactato de manera más eficiente. Sin embargo, este período de recuperación no fue suficiente para eliminar la cantidad requerida, causando su concentración a niveles de reposo. Este requisito viene dada por la cantidad de pruebas en un nadador profesional participa en la misma competición.

EFEITO AGÚDO DE DOIS TIPOS DE RECUPERAÇÃO NO LACTATO SANGUÍNEO DE NADADORES APÓS ESFORÇO MÁXIMO

RESUMO

Objetivos: identificar o efeito agudo da recuperação passiva e da recuperação ativa no lactato sanguíneo após o esforço máximo, além de demonstrar a cinética do lactato nestes dois tipos de recuperação. Metodologia: A amostra foi composta por 15 nadadores com idade média de 15 a 20 anos, que participaram de dois procedimentos experimentais. No primeiro, após a realização de uma simulação competitiva da prova de 200 metros nado livre, executaram recuperação passiva de 15 minutos, em decúbito dorsal. No segundo procedimento, após a mesma simulação competitiva, os atletas executaram 5 minutos de recuperação passiva, em decúbito dorsal, necessária em virtude da coleta sanguínea, e 10 minutos de recuperação ativa a 60% - 65% de intensidade, de acordo com a capacidade de cada atleta. Durante a recuperação passiva, os atletas permaneceram protegidos do sol, em local coberto. Foram realizadas 3 coletas de aproximadamente 1 – 2 gotas de sangue em cada procedimento, ocorrendo antes da simulação competitiva, 5 minutos após e 15 minutos após, nos dois procedimentos. Resultados: Na coleta realizada anteriormente à simulação competitiva, não houve diferença significativa (p<0,05) entre os dois procedimentos. Entretanto, houve diferença significativa (p<0,05) na concentração de lactato sanguíneo após os dois tipos de recuperação, sendo a recuperação ativa responsável pela remoção de 36,6% do lactato produzido, enquanto a recuperação passiva, somente 14,96%. Conclusão: A recuperação ativa é mais eficiente do que a recuperação passiva, na remoção do lactato sanguíneo produzido após um esforço máximo. Este estudo demonstrou que 10 minutos de recuperação ativa, realizada a 60 – 65% de intensidade, é capaz de remover o lactato sanguíneo com maior eficiência. Entretanto, a duração desta recuperação não foi suficiente para remover a quantidade necessária, levando sua concentração aos níveis de repouso. Esta exigência se dá pela quantidade de provas em que um nadador profissional participa em uma mesma competição.

PALAVRAS-CHAVE: Recuperação, lactato, natação.