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Evaluation of blood lactate in young men after wingate anaerobic power test

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Objective The aim of this study was to clarify the issues as to how long the recovery state lasted after a supramaximal exercise and when the new workload should begin.

Method Eleven students from İstanbul Technical University with mean age of 19.45±0.34 year , mean height of 171.45±2.02 cm and mean body weight 68.84±2.9 kg were examined to evaluate the amount of lactat in blood at 2, 5, 8 and 10 minutes after Wingate Anaerobic Power Test. Miniphotometer of Dr.Lange was used to determine the instant amount of lactate.

Results Blood lactate levels were 14.6 mmol/l, 14.25 mmol/l, 15.95 mmol/l and 13.16 mmol/l at the 2, 5, 8 and 10 minute respectively after Wingate Anaerobic Power Test. Peak power, mean power and fatigue index values were 529.32±38.70 W, 410.35±21.50 W and 45.27±3.74 % respectively. Blood lactate level increased to the 8th minute of the recovery process, and at the 10th minute it decreased compared to the 8th minute.

Conclusion After the supramaximal exercise lasting 30 seconds, the increase in the blood lactat level continued up to the 8th minute of the recovery period and at the 10th minute lactat dropped and eliminated. According to our study it can be said that the recovery period must be at least 10 minutes for next supramaximal exercise.

Key words Lactate, Wingate Test, recovery, anaerobic power.

Introduction

Anaerobic power or capacity is an expression used for the maximal exercise up to a maximum of two minutes and the energy used during the workload is provided in large measure without necessitating oxygen, since the stored phosphagenes and glycogen in the muscles would be enough up to two minutes. At the onset of the exercise, since ready energy materials are used, lactate is not formed. Later, lactate is formed, since the energy is obtained by breaking down the glycogen without oxygen. Lactate thus formed, is eliminated by the buffer systems of the organism. However, when lactate production is excessive, it accumulates in the muscles and the blood. Meanwhile, if the glycogen stores of the muscles and blood decrease, the exercises slow down and when the aerobic procedures undertaken are not sufficient, the exercise can not be maintained (1,2,3). Lactat is accumulated in the organism after all kinds of muscle exercise having maximal and supramaximal workload. It can even be observed within ten minutes workload (4). The measurements of lactate in the muscle and blood are being done to determine these processes. Lactate measurements during exercise yield information on the intensity of the workload and on its duration. The measurements carried out after the exercise yield information on the frequency of workload and on its scope, that is, on resting-recovery process (5). Babij found that, after an exercise of 10 minutes where maximal oxygen consumption rate was 50%, there was no [illegible] after the same exercise where oxygen consumption rate was 76%, lactate of the venous blood increased up to 5 minutes and then started to decline (6).

The primary objective of this study was to clarify the issues as to how long the recovery state lasted after a supramaximal exercise and when the new workload should begin.

Material and Method

The study was carried out on the cases (n=11) selected from the students of İstanbul Technical University whose mean age was 19.46±0.34 years, mean height 171.45±2.02 cm and mean body weight 68.84±2.90 kg and who attended the physical education's classes for the first time, and had no physical activity. Wingate Anaerobic Power Test (WAPT) was chosen as the supramaximal exercise (7), and a leg ergometric bicycle (Monark) with weight bearing device was used. Since it was a strenuous exercise, the subjects were given 1.5 kg of workload before the exercise, and warming up was applied at a 60 cycles per minute. Meanwhile, workloads of 3 to 5 seconds were applied every 20 seconds. After the warming up, at the end of the resting period for one minute, the essential supramaximal exercise of 30 seconds was applied. In the 2nd, 5th, 8th and 10th minutes of the recovery period after the exercise was over, blood lactate measurements were carried out immediately. Blood lactate measurements were carried out by Dr.Lange Operator Manual Miniphotometer 8 (1990 Model, Berlin-Germany) within the Range of 0-30 mmol/l (8).

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Blood collection procedure: Disinfect finger, then prick and wipe off first drop of blood. Aspirate 10 µl of blood into the capillary tube. Dispense the blood from capillary tube with the pipette into desired minicuvette. Rinse the blood samples with reagent in the minicuvette and mix them gently do not shake.

Lactate measurement: Lactate reagent must not be too cold. If the cuvette are cold warm them up with your hands, approximately 15 seconds. The lactate measurement can be done immediately after adding blood (8).

Data analysis was performed by using SPSS V5.01. Wilcoxon Matched-Pairs Signed-Ranks test was used in the data analysis.

Results

The age, height and body weight of the subjects and the mean values of the blood lactate levels measured during the recovery period after the supramaximal exercise are given in Table I.

As is seen in Table I. and in Figure 1., blood lactate increased numerically up to the 8th minute of the recovery process, and at the 10th minute it decreased compared to the 8th minute. At the end of the Wilcoxon Matched-Pairs Signed-Ranks test, it has been found that the increase in the blood lactate up to the 8th minute has not been significant and that the decrease at the 10th minute has been statistically significant (Z=-2.04, P=0.0409).

Discussion

Stanley found that, in the exercises of 6 minutes where the workload increased stepwise, lactate production was eliminated in an exercise performed by a workload of 600 kgm/min and 60 cycles of per minute, and that, in a workload of 1200 kgm/min, lactate production was 309.4 µmolkg^{-1} and its

Table I. The mean values of blood lactate measurement after WAPT at 2, 5, 8 and 10th minute.

	Age (Year)	Height (cm)	BW. (kg)	2Lak mmol/l	5Lak mmol/l	8Lak mmol/l	10Lak mmol/l	Mean Power	Peak Power	FI (%)
1	21	160	54.0	17.20	19.84	18.67	15.80	311.17	349.27	40.00
2	19	159	63.0	14.01	15.42	14.60	13.14	358.09	488.96	42.42
3	19	172	72.0	13.87	13.69	24.04	16.80	509.44	635.04	50.67
4	20	170	71.4	15.78	13.09	17.81	15.36	403.74	495.40	44.17
5	20	174	76.5	12.60	12.64	14.50	10.54	450.57	638.74	55.63
6	20	175	76.5	13.84	13.47	13.49	13.46	396.59	440.82	22.45
7	20	177	76.0	15.13	14.60	14.94	15.20	434.22	572.01	55.47
8	18	171	48.5	11.26	12.57	10.15	11.34	283.28	330.81	33.62
9	20	181	75.6	14.23	14.88	14.94	14.17	504.87	658.34	50.68
10	17	176	73.5	11.51	11.61	11.81	12.09	441.54	726.06	67.26
11	20	171	70.2	15.18	14.96	20.47	6.83	420.34	487.08	35.59
X	19.46	171.45	68.84	14.06	14.25	15.95	13.16	410.35	529.32	45.27
SEM	0.34	2.02	2.90	0.54	0.66	1.20	0.86	21.50	38.70	3.74

(BW= Body weight, FI=Fatigue index)).

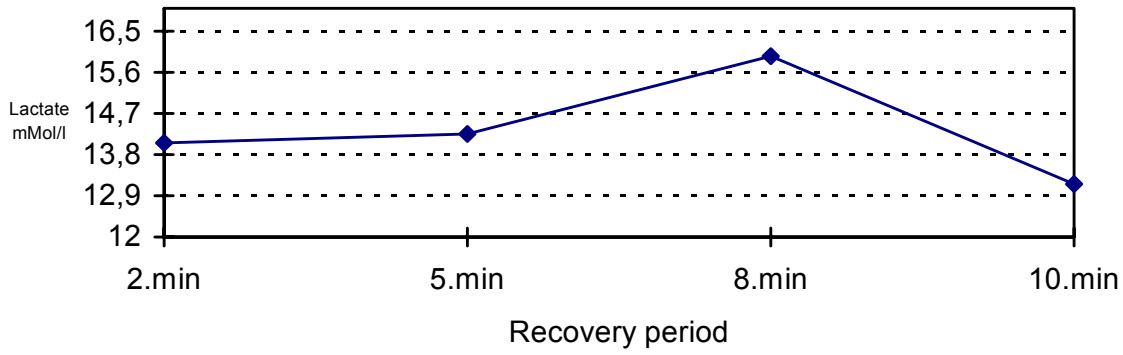

Figure 1. The mean values of blood lactate measurements at 2, 5, 8 and 10th minutes of recovery process.

elimination occurred in 169.7 µmol kg^{-1}min^{-1} (9). Banister et.al. observed that in workloads increasing stepwise until the subject became exhausted, lactate of venous blood became increased in workloads of

250-275 watt level, and that this increase lasted until the third minute of the rest (8mmol/l) (10). Forrest reported that the lactate of the athletes running for semi-marathon whose training levels were different, reached the normal values after 1 to one and a half hours (11). Astrand reported that the blood lactate after a maximal exercise of 3 minutes reached the maximal value in subsequent 6 minutes (17.4 mmol/l) and returned to its normal value after approximately one hour (3). Itoh subjected 9 well-trained athletes to maximal exercise of 15, 30 and 45 seconds on the bicycle ergometer and measured venous blood lactate at 2.5, 5, 7.5, 10 and 12.5 minutes after the exercise and found peak values of 8.1±1.7, 11.2± 2.4 and 14.7±2.1 mmol/l levels respectively. 6 long-distance male runners and 6 male sprinters are subjected to a exhaustive running exercise one minute a treadmill (12). Then, the peak blood lactate concentrations measured at the recovery period are found to be 16.7±1.0 mmol/l, 12.3±0.5 mmol/l for sprinters and long-distance runners, respectively (13). Eight sprinters, 8 long-distance runners and 7 untrained adult male are subjected to running a distance of 400 m. Then, the peak blood lactate concentrations measured by enzymatic technique are found to be 19.06±1.48 mmol/l, 14.97±1.49 mmol/l and 13.59±3.01 mmol/l for sprinters, long-distance runners and untrained males respectively (14). Six elite 400m male runners are subjected to 300 m sprinting. Then, the peak arterial blood lactate value are measured as 18.8±1.8 mmol/l during the recovery period (15). The total arterial blood lactate concentrations of elite male athletes of 400 and 800 m are measured by using the samples taken from their fingers during the recovery period. The peak values are recorded at the 5^{th} minute as 17.97±2.28 and 15.56±2.08 mmol/l for 400 m athletes and 800 m athletes respectively. The running period are measured to be 53.94 seconds and 1.26.14 seconds for 400 m athletes and 800 m athletes, respectively. Although both running periods are longer than our test period, the measured lactate peak values are approximately equal. This result is considered to arise because of untrained subjects (16).

Mero applied a maximal exercise of 15 seconds to six untrained 11.9±0.3 age children and observed peak lactate value at the 5^{th} minute (8.5±1.5 mmol/l) after the exercise (17). Mclellan et al. observed that the hypoxia showed no effects on WAPT performance of male subjects (27.9±3.4 age). They also determined that 8.4±2.9 mmol/l blood lactate at hypoxia and 9.2±3.1 mmol/l at normoxia (18). Meshil et al. determined blood lactate level reaching up to 10.4±2.5 mmol/l for male subjects (26.1±5.9 year of age) 3 minute after WAPT application (19). Perez et al. determined 13.2±3.0 mmol/l blood lactate level for 10 male subjects (25.7 year of age) 3 minute after WAPT application (20). Medbo and Tabata observed 10.2±0.5 mmol/l blood lactate level for 16 male subjects (25.0±1.0 mean age) 4.7±0.5 minute s after WAPT applications (21). Astrand et.al. observed 12.4±1.0 mmol/l blood lactate level for male subjects 5 minutes after WAPT applications (22). Scott et al. applied 90 g/kg body weight WAPT to 4 male subjects (24.3±2.8 mean age) and observed 14.0±3.7 mmol/l blood lactate value 5 minutes after the test (23). Baltzopoulos et al. applied WAPT to 8 male subjects (20.8±1.8 mean age) and determined the peak values of blood lactate (10.0±1.9 mmol/l) 5 minutes after the test (24). Bedu et al. applied WAPT to boys of 7-15 year of age and observed the heights values of blood lactate levels 2-4 minutes after the test (25). Frose and Houston observed peak values of blood lactate (13.5±2.4 mmol/l) for 12 male subjects (22.4±2.4 mean age) 5 minutes after WAPT (26). Gökbel and Dölek applied WAPT to 36 healthy boy students (13-17 year of age) and observed the peak levels of the test as 8.6±2.6 and 8.6±2.4 successively (27).

According to the studies given above it is well shown that the blood lactate level generally reaches the peak values (approximately 8-13 mmol/l) 3 and 5 minutes after the WAPT applications and lactate values measured after exercise depend upon, exercise time, exercise intensity and training condition of the subjects. In our study we found the peak values of blood lactate as 15.95±1.20 mmol/l 8 minutes after WAPT and decreasing values were found 10 minutes after the test.

The ages of our subjects and their condition levels were different from the materials used in other resembling investigations. Frose and Houston (26) whose subjects were approximately at the same age with our subjects found out resembling blood lactate levels (13.5±2.4 mmol/l and 15.95±1.20 mmol/l) after WAPT. Scott et al. (23) found 14.0±3.7 mmol/l peak blood lactate level which was the nearest value to our determination, however they used 90 g/kg for WAPT instead of regular 75 g/kg.

In WAPT that uses supramaximal load, the administration can not be successful if the subjects were not motivated. This results in low lactate accumulation in the blood and accelerated lactate elimination. In this study in order to obtain a supramaximal loading, we motivated the students continuously and reached up to fatigue index (FI) of 45.27±3.24 %. Gökbel and Dölek (27) obtained a fatigue index of 30.9±9.0 % in their study. This low level possibly resulted in low blood lactate accumulation and rapid lactate elimination.

McLellan (18) obtained lower blood lactate levels in untrained subjects than our determinations. However

it can be concluded that the subjects of McLellan (18) may be classified as trained ones according to their peak power.

It is necessary to control the fatigue index and power values with special reference to the age and training status of subjects during the administration of the WAPT and discussion of the results as well.

Conclusion

As seen in the studies carried out, lactate accumulates more depending on the intensity of the exercise and its duration, and its decrease to its normal value takes more time in the recovery period. After the supramaximal exercise lasting 30 seconds, the increase in the blood lactate level continued up to the 8th minute of the recovery period and at the 10th minute lactate dropped and eliminated. According to our study it can be said that the recovery period must be at least 10 minutes for next supramaximal exercise, after the supramaximal exercise of 30 seconds.

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