EFFECT OF FRICTION TECHNIQUE MASSAGE FOR LEG AFTER MAXIMAL EXERCISE ON THE REMOVAL RATE OF BLOOD LACTATE

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ABSTRACT

Introduction: There are still controversies over the benefits of massage given at the break time between two successive matches. One cause of fatigue is lactic acid which accumulates both in muscle and blood. This study aims to determine the effect of friction massage techniques in the legs after maximal exercise on blood lactic acid removal rate to quicken eliminate fatigue. Methods: The laboratory research, using a randomized pretest posttest control group design, in 21 male students FIK UNY 2007, untrained, 21-23 years, were randomly divided into three groups: group front friction massage techniques (MFD: vastus, gastrocnemius), friction massage techniques back (MFB: the hamstring-gastrocnemius) and the rest (R). Treatments consisted of maximal exercise (pedaling a bicycle ergometer with pedal speed 50 RPM, initial load 50 watts, 10 watts every minute until the enhanced unable pedal again), stop, directly given friction massage techniques front, back and rest, each 5 minutes. Lactic acid concentration (mMol/L) was measured 4x, before students try to do the activity, immediately after the maximal exercise, after being massaged or rest 5 minutes, and 10 minutes after maximal exercise. Blood was taken from a fingertip by means of Lactate Pro. Results: There were significant differences (p < 0.05) between the velocity of blood lactate removal MFD group (0.914 ± 0.027) mMol/L/min and R (0.674 ± 0.022); MFB group (0.774 ± 0.041) and R; and groups MFD and MFB. Conclusion: In sequence, the highest speed lactate removal is with the front friction massage techniques, friction massage technique back, then rest. These results suggest that massage is done on the dominant active muscle will quickly eliminate fatigue because the rapid removal of lactate from muscle into the blood to other organs that can use lactate as an energy source.

Keywords: friction technique massage, blood lactate removal

INTRODUCTION

High-intensity physical activity can lead to elevated levels of lactic acid in muscles and blood (Fox, 1993). One important factor that causes fatigue is lactic acid buildup. Fatigue will be reduced when lactic acid is transported from muscle to other organs that can use it (Soekarman, 1987: 41). Effect of massage on recovery after high intensity exercise is debatable. Many studies on massage, the methods used are still weak, no control related to food control, and duration of massage is not appropriate (Robertson, Watt, Galloway, 2004: 173-176).

Massage is given after an exhausting exercise, significantly increases quadriceps muscle performance compared with passive rest (Rinder and Sutherland, 1995: 99-102). With massage, blood circulation and oxygen supply to body organs more smoothly so that fatigue can be quickly lost (Suharto, 1999: 141). Tanaka Research (2002) that the massage (effleurage technique, kneading and compression) at the lumbar region to help the subject reduce fatigue. Unlike Dolgener research and Morien (1993), blood lactate 20 minutes after an exhausting exercise, blood lactate levels with passive recovery and massage are not different, whereas subjects who used a bicycle better blood lactate removal (http://tkdtutor.com/ 11Training/LacticAcid.htm, 2006).

So far this is still controversy on the benefits of massage during a short break before the next game or after exercise. Expected to conduct research, empirical evidence that would be obtained with the use of massage techniques are appropriate and will accelerate the removal (removed) muscle lactate (local) into the bloodstream, so the pace of recovery as expected.

The results are expected to benefit the development of sports science in Indonesia, for sports coaches, personal trainers, sports teachers in general, and for people in the implementation of training programs in particular, as well as answer the controversy about the benefits of massage. The results of this study can also be used as reference in providing the proper forms to expedite the
recovery of blood lactate removal, especially in relation to the preparation and implementation of training programs.

Bompa (1994: 3) exercise is a systematic sports activity for a long period, increased gradually and individuals, aimed at forming human physiological and psychological functioning to meet the demands of his job. Getchell (1979: 32) explained that in working with high intensity and speed in a short time requires immediate energy, which can not be obtained quickly from the source aerobically. In these circumstances there is another process called anaerobic metabolism. Anaerobic means without oxygen, so anaerobic energy released when oxygen is not enough input. Anaerobic exercise requires a higher heart rate, and done in a short period (Kent, 1994: 457). Sharkey (1984: 10) writes in a table about exercise intensity, ie vigorous-intensity physical exercise using anaerobic metabolism, heart rate reached over 160.

Lactic acid is a waste product (waste by product) as a result of chemical reactions in muscle contraction. The end product of anaerobic glycolysis is lactic acid. Lactic acid lowers the pH in the muscles and blood. Subsequently, a lower pH will inhibit the work of glycolytic enzymes and interfere with the chemical reaction inside muscle cells. This situation will result in increased muscle contraction muscle weakness and eventually fatigue failure (Fox, 1993: 126). Lactic acid levels of healthy persons at rest about 1.1 mMol/L, (Neiman, 1986), 1 to 1.88 mMol/L, (Fox, 1993) and 1-2 mmol/l (Janssen, 1993). Blood lactic acid levels in excess of 6 mmol/L may interfere with the working mechanism of muscle cells to the level of coordination of movement (Janssen, 1993: 51). Altitude tolerance of lactate concentration in muscle and blood during exercise is not known with certainty. However, research Aminuddin and Sunarko Setyawan (2003:149) found that the tolerance of lactic acid levels in humans is predicted to reach 20 mMol/L of blood, can even reach above 30mMol/L in high-intensity dynamic exercises.

Massage is a massage in the effort of recovery (recovery) are artificial or assistance, which aims to accelerate the return earned homeoostasis conditions, that is the best physiological condition for the cell body (Santosa Giriwijoyo and Muchtamadji, 2006: 270). According to Gupta (1996:106-110), one of the factors that affect fatigue after exercise is an excessive buildup of lactic acid within the muscle. Massage significant resources to speed up recovery, namely increasing local circulation, increase cellular permeability (thereby facilitate the lactic acid out of muscle cells), and has a calming effect on central and peripheral nerves. Some studies show evidence of the influence of massage, among other capabilities in skeletal muscle relaxation, increasing blood and lymph circulation, reduce anxiety, and immunological effects, especially on individual health (Diane, Steven, Samuel, Jacqueline, 2000: 83). According Basoeki (1991: 38) gives the effect of mechanical massage on the body, the cause of heat required for the implementation of the motion and pressure on blood vessels may accelerate blood circulation, besides it also increases the permeability of cell walls.

MATERIALS AND METHODS

Types of laboratory research, using a randomized pretest posttest control group design (Zainudin, 2000: 52), at 21 FIK UNY 2007 male students, 21-23 years, not athletes, healthy, height 165-170 cm, weight 55-60 kg, initial heart rate 60-80 beats/minute, initial blood lactate levels of 1-2 mMol/L, capable of physical activity with the maximal load test story to a bicycle ergometer, and willing to undertake the research. Randomly divided into 3 groups, each group of seven persons, namely the front friction massage techniques (MFD: vastus, gastrocnemius), the group behind friction massage techniques (MFB: hamstring-gastrocnemius) and the rest group (R: rest passive.) Treatment of exercise until maximal (pedaling a bicycle ergometer with pedal speed 50 RPM, initial load 50 watts, 10 watts every minute until the enhanced unable pedal again), stop, directly given friction massage techniques front, back and rest, every 5 minutes. Will be calculated velocity of blood lactate removal in the three groups. Lactate was measured 4x, before students do the activity, immediately after exercise, after being massaged or rest 5 minutes, and 10 minutes after exercise. Blood was taken from a fingertip by means of Lactate Pro. Analysis of data using descriptive statistical tests, test-normality, homogeneity-test, ANOVA and LSD (Least Significant Different) with 5% significance level, using SPSS.

RESULTS

Descriptive data in age, height, weight, and pulse initial group of students try one (front friction massage techniques: MFD), group 2 (rear friction massage techniques: MFB) and the third group of controls (rest: R) (Table 1).

Descriptive data of blood lactate levels early, soon after the maximum activity, immediately after dimasase 5 minutes, 10 minutes after the maximum activity, the velocity of lactate removal first five minutes, and transfer speed of 5 minutes the second lactate (Table 2).
Table 1. Descriptive data in age, height, weight, pulse rate of the students tried the three groups.

<table>
<thead>
<tr>
<th>Groups</th>
<th>Age (years)</th>
<th>Height (Cm)</th>
<th>Weight (kg)</th>
<th>Pulse (dpm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MFD</td>
<td>21.14±0.38</td>
<td>167.57±2.51</td>
<td>57.86±1.77</td>
<td>69.29±3.68</td>
</tr>
<tr>
<td>MFB</td>
<td>21.14±0.38</td>
<td>168.00±2.24</td>
<td>57.57±1.51</td>
<td>69.71±3.25</td>
</tr>
<tr>
<td>R</td>
<td>21.14±0.38</td>
<td>168.00±1.00</td>
<td>57.14±1.07</td>
<td>71.14±2.67</td>
</tr>
</tbody>
</table>

Table 2. Descriptive data of blood lactate levels early, soon after the maximum activity, immediately after dimasase 5 minutes, 10 minutes after the maximum activity (mMol/L), lactate removal rate first five minutes, and transfer speed of 5 minutes the second lactate (mMol/L/min), the three groups.

<table>
<thead>
<tr>
<th>Groups</th>
<th>Early lactate</th>
<th>Post exc. Lactate</th>
<th>Pos mass. Lactate 5' (5'-I)</th>
<th>Post Rest lactate 10' (5'-II)</th>
<th>Speed of Lactate removal 5'-I</th>
<th>Speed of Lactate removal 5'-II</th>
</tr>
</thead>
<tbody>
<tr>
<td>MFD</td>
<td>1.843±0.151</td>
<td>9.600±0.231</td>
<td>11.029±0.355</td>
<td>6.457±0.305</td>
<td>0.285±0.039</td>
<td>0.914±0.027</td>
</tr>
<tr>
<td>MFB</td>
<td>1.843±0.097</td>
<td>9.614±0.291</td>
<td>10.714±0.426</td>
<td>6.843±0.237</td>
<td>0.220±0.030</td>
<td>0.774±0.041</td>
</tr>
<tr>
<td>R</td>
<td>1.857±0.127</td>
<td>9.657±0.190</td>
<td>10.486±0.212</td>
<td>7.114±0.212</td>
<td>0.165±0.097</td>
<td>0.674±0.022</td>
</tr>
</tbody>
</table>

Distribution normality test on the variables age, height, weight, and pulse rate early in the third group, all the normal distribution (p > 0.05). Also on the variable initial blood lactate levels, immediately after the maximum activity, after the five-minute massage, 10 minutes after recovery, and speed of transfer of lactate in all three groups, all normally distributed (p > 0.05). Test of homogeneity of the variables of age, height, weight, resting heart and blood lactate levels early in the third group, all homogeneous (p > 0.05). Different test (ANOVA) to variable levels of blood lactate gave results that there were significant differences (p = 0.000) between the three groups of lactate removal rate, both on the first five minutes, five minutes of the second, and the total (Table 3).

Table 3. Anova test variable speed lactate removal in the first five minutes, five minutes a second, and total the three groups

<table>
<thead>
<tr>
<th>Variables</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed of Lactate removal 5'-I</td>
<td>74.169</td>
<td>0.000</td>
</tr>
<tr>
<td>Speed of Lactate removal 5'-II</td>
<td>103.374</td>
<td>0.000</td>
</tr>
<tr>
<td>Speed of Lactate removal Total</td>
<td>43.021</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Anova test results above was followed by Least Significant Difference test (LSD) with pairwise comparisons to indicate significance of blood lactate removal rate differences between groups 1, 2 and 3 both in the first five minutes or five minutes after maximal physical activity. This gives the results of LSD test p < 0.05 indicate differences in blood lactate removal rate between groups 1, 2 and 3 both in the first five minutes or five minutes after physical activity a maximum of two very significant (Table 4). Univariate test for the total removal of the mean velocity of blood lactate groups 1, 2 and 3 give the results as in figure 1.

Table 4. Differences in blood lactate removal rate between groups 1, 2 and 3, at 5 minutes of the first and second five minutes after maximal physical activity

<table>
<thead>
<tr>
<th>Variables</th>
<th>(I) Groups</th>
<th>(J) Groups</th>
<th>Difference (I-J)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed of Lactate removal 5'-I</td>
<td>MFFront</td>
<td>MFRear</td>
<td>0.061</td>
<td>0.003</td>
</tr>
<tr>
<td>mMol/L/minutes</td>
<td>Rest</td>
<td>Rest</td>
<td>0.114</td>
<td>0.000</td>
</tr>
<tr>
<td>Speed of Lactate removal 5'-II</td>
<td>MFRear</td>
<td>MFRear</td>
<td>0.051</td>
<td>0.009</td>
</tr>
<tr>
<td>mMol/L/minutes</td>
<td>MFRear</td>
<td>Rest</td>
<td>0.140</td>
<td>0.000</td>
</tr>
<tr>
<td>Speed of Lactate removal 5'-II</td>
<td>MFRear</td>
<td>Rest</td>
<td>0.238</td>
<td>0.000</td>
</tr>
<tr>
<td>mMol/L/minutes</td>
<td>MFRear</td>
<td>Rest</td>
<td>0.098</td>
<td>0.000</td>
</tr>
</tbody>
</table>
Effect of Friction Technique Massage for Leg after Maximal Exercise (Yudik Prasetyo, Elyana STP Asnar)

Figure 1. Total average speed of a group of blood lactate removal (MFD), 2 (MFB) and 3 (R), the three differed significantly with $p = 0.000$ (table 3)

Univariant test results in a row to give the sense that velocity is the highest blood lactate removal by friction massage techniques next five minutes, friction massage techniques back five minutes, then rest 5 minutes.

**DISCUSSION**

Lactic acid accumulation parameters as indicators of fatigue is strengthened by the opinion Westerblad, which explains in his research that muscle fatigue is caused by intracellular acidosis due to accumulation of lactic acid (Youth Pledge, 2006). Initial lactate concentration is a defined criterion in the selection of the sample. This is because blood lactate levels above the normal average concentrations there is an indicator of fatigue, even in the achievement of anaerobic tend to take place more quickly (Janssen, 1993).

High-intensity physical activity can lead to elevated levels of lactic acid in muscles and blood (Fox, 1993). Accumulation of lactic acid in muscles during short high intensity exercise (Myers J and Ashley E, 1997: 789). If the workload is increased, there will be a shift in the use aerobic energy system from the system into the anaerobic system and an increase in blood lactic acid levels.

Based on the test of normality with the Kolmogorov-Smirnov test between groups showed no significant difference ($p > 0.05$) between maximal lactate concentration of group 1, 2, and 3. This situation illustrates that the maximum capacity that people have tried in every group having equal value. From the mean value of initial blood lactate levels, lactate immediately after the maximum activity, lactate after 5 minutes of massage, lactate after 10 minutes recovery in Table 2, there were elevated levels of blood lactate after maximal physical activity. This condition indicates that physical activity performed has increased metabolic response to meet the energy needs required.

Exercise at high levels can increase blood lactate concentration that can cause adverse effects to the body. Blood lactate levels exceeding 6 mMol/L may interfere with the working mechanism of muscle cells to the level of coordination of movement (Janssen, 1993: 51). High blood lactate levels would be very detrimental to an individual's performance, because the accumulation of lactic acid causes muscle fatigue and decreased strength.

Based on research results, obtained average concentrations of blood lactate immediately after maximal activity is 9.60 to 9.65 mMol/L. This suggests that people try to include untrained group, because blood lactate levels has not yet reached the maximum value. Maximal blood lactate levels one can achieve the value of 15.2 mMol/L (Gleeson, 1989: 377-393), can even reach a value of 20 mMol/L and above 30 mMol/L in high-intensity dynamic exercise (Aminuddin, Sunarko Setyawan, 2003: 149).

Speeds removal of lactic acid depends on the smooth circulation of blood. With the smooth circulation of blood, lactic acid more quickly moves (Fox, 1988: 50). According to Gupta et al (1996:106-110), one of the factors that affect fatigue after exercise is an excessive buildup of lactic acid in muscles. Massage that is of significant importance to accelerate recovery after exercise, which has three effects of massage is to
increase local circulation, increase cellular permeability (thereby facilitate lactic acid out of the muscle cell), and has a calming effect on central and peripheral nerves. Friction massage technique is to scour the fingertips or the heel of the hand with a movement like a spiral. Aims to help drive the pile from combustion (lactic acid) found in muscle, local blood flow, stimulate peripheral nerve tissue and improve the ability of motion (contractility) (Bambang P, 2001, Matuankotta, 2003).

Mean blood lactate levels after recovery friction massage techniques ahead five minutes, friction massage techniques back five minutes, and the rest five minutes to show improvement compared with the average at the time of maximal immediately after physical activity. The increase was due to lactate diffuses into the blood, thus increasing blood lactate levels (Guyton, 1995: 620). Elevated levels of lactate and lactic transfer speed is on the front friction massage techniques five minutes, this was due to the friction massage techniques to help accelerate the removal of lactate from muscle into the blood by increasing cellular permeability (ease of lactic acid out of muscle cells), in addition increase the venous pump mechanism and the pump lymph (lymph nodes) are artificially to accelerate recovery by accelerating the circulation. With an active muscle pump system, also occurred in the acceleration of blood circulation in active muscles. Acceleration circulation helps accelerate the recovery (in sports activities), since there acceleration of all the substances supply network needs as well as the acceleration of waste removal/lactic acid (Santosa Giriwijoyo and Muchtamadji MA, 2006: 273).

With the smooth circulation of the group using the front friction massage techniques, it will also increase aerobic metabolism and ATP demand is higher than the other recovery groups. This condition allows the use of lactate as an energy source more quickly than group 2 and 3, and will accelerate the cleanup lactate.

At maximum activity cycling, the most active muscles are vastus (quadriceps), which in the most active muscle will occur the highest accumulation of lactate, so that the improvement/removal of the largest blood lactate through the front friction massage techniques derived from vastus muscle.

Recovery is a condition that is very important for the athlete in achieving high performance. The ability for recovery is absolutely necessary to deal with a series of matches or a solid race and continuity which carried high, making a good recovery ability, athletes can be better prepared physically and psychologically to face the next work load (Fatkur Rohman K, 2003: 4). The results of this study showed that massage actually done correctly, can accelerate the removal of lactate from muscle into the blood stream so quickly will reduce or eliminate fatigue.

Restoration of blood lactate levels are also associated with the intensity of physical activity undertaken. This deals with the transport of lactate from active muscle to a muscle that is less active, while being transported to other organs that can use it (Soekarman, 1987: 41). Therefore, fatigue should be restored in order to return to normal conditions. Recovery may occur spontaneously (rest), but can also be accelerated by artificial (massage).

Lactate into the blood would be used: (1) for the aerobic oxidation in muscle cells in the body ie muscle cells are less active, such as arm muscles during cycling, as well as muscles that have a lot of mitochondria and capillary blood vessels (which contains a lot of muscle fibers "Slow twitch"). Lactate will be converted into pyruvic acid which then enter the Kreb cycle for oxidized aerobically, (2) to be resynthesized into glucose through enzymatic process called gluconeogenesis mainly in liver cells (Steven, 1983: 56, Powers SK, 2007). Lactic acid accumulates in muscle and blood after an exhausting work will be removed by means of: (a) converted into liver glycogen, (2) into blood glucose, and (3) is oxidized by aerobic systems form ATP, CO2 and H2O (Ilhamjaya Patellongi, et al, 2000: 70).

CONCLUSION
Sequentially, the highest speed lactate removal is with the front friction massage techniques, friction massage technique back, then rest. These results suggest that massage is performed on the dominant active muscles, would quickly eliminate fatigue, because the rapid removal of lactate from the muscle.

REFERENCES
Massage Therapy During Academic Stress. American Psychosomatic Society.


