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EXCRETION OF CREATININE, URIC ACID AND MICROPROTEINS BY GENERAL BODY MASSAGE APPLIED AFTER EXERCISE

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Abstract:
Sports massage science has become an area of interest among many athletes' instructors, trainers and also sports physiologists. This study was conducted to analyze the effects of massage on uric acid, creatinine and microprotein parameters. The study included 42 participants, 21 in the study group (Ex) and 21 in the control group (C). The first urine samples (urine) were taken within 2-3 hours after the submaximal exercise. After urinary excretions of the subjects were completely finished, the massage protocol was applied to the subjects at the same time of the day. Submaximal exercise was applied to both groups. Following the exercise, massage was applied to the study group. Massage was not applied to the control group. Analyzes were performed by taking urine samples from the subject group twice before and after massage. A statistically significant difference was found in the level of uric acid and creatinine before and after massage which was applied after submaximal exercise ($p < 0.01$). No statistically significant difference was found in the microprotein level before (6.47 ± 0.97) and after (7.04 ± 1.45) massage which was applied after submaximal exercise ($p > 0.05$). In accordance with the data obtained, although it was determined that massage had effects on the measured parameters; it was not clear in what ways these effects were. It is estimated that the change in uric acid levels may be due to antioxidant properties and massage may cause this change by affecting the antioxidant defense

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system. It is suggested to take the level of creatinine, uric acid and microprotein into account for performance improvement and regulation and balancing the resting period of the athletes.

Keywords: submaximal exercise, massage, microprotein, creatinine, uric acid

1. Introduction

Sports massage science has become an area of interest among many athletes' instructors, trainers, and also the sports physiologists (Moraska, 2005). This therapy which is applied for muscle-soft tissue pain and exhaustion after intensive training is a widespread and popular method (Best et al., 2008). Many studies show that massage has a positive impact on pain, anxiety and psycho-physiological relaxation (Weerapong et al., 2005; Lindgren et al., 2010; Arroyo-Morales et al., 2011; Kunikata et al., 2012; Dreyer et al., 2015). Sports massage can be used especially for recovery at the cellular level after exercise and for enhancing parasympathetic activity (Resnick, 2016). It is stated that massage is not only psychologically effective, but also reduces pain that occurs physiologically after exercise and prepares muscles for a larger capacity (Kanbir, 2005; Dreyer et al., 2015).

It has been suggested that important metabolic processes in the organism proceed more appropriately thanks to the acceleration of blood and fluid flow by the help of massage. One of the factors blocking the limits of human performance is that the substances to be removed from the body cannot be removed from the body sufficiently in the required period. At what rate massage, which is known as one of the factors that helps to eliminate these elements, (Wood, 1981; Robert et al., 1993) will contribute to removing the substances in question including creatinine, uric acid and microprotein from the body with the existing protocols is important in terms of protecting and sustaining the athletes' performance (Robert et al., 1993).

Uric acid is the main product of purine catabolism in humans and its daily synthesis is approximately 400 mg. It is received approximately 300 mg dietetically. Purines perform many important functions in the cell, the most relevant one being the formation of the monomeric precursors of nucleic acids DNA and RNA (Maiuolo et al., 2015). Seventy-five percent of uric acid is excreted with urine. Xanthine oxidase is the enzyme that synthesizes uric acid from xanthine and it is very important for the organism. This enzyme also causes tissue damage since it leads to the formation of superoxide radical (O2). This radical leads to the formation of hydrogen peroxide by the effect of superoxide dismutase. Hydrogen peroxide is protected from the organism tissue damage by becoming inactive through the effect of catalase or peroxidase (Bhagavan, 1992). There is a complex antioxidant defense system to reduce the free radical damage. Anti-oxidants suppress free radicals by forming less reactive compounds (Child et al., 1998).

It is stated in some of the studies mentioning the existence of a relationship between uric acid and free radicals that high levels of uric acid have a role like an antioxidant in vivo situations and that uric acid protects erythrocytes against lipid peroxidation and from peroxidative damage which causes lysis (Ames et al., 1981). Therefore, uric acid is important for tissue, circulation and kidney. Creatinine is synthesized in kidneys, in the liver and in the pancreas. It reaches to the muscles and the brain through bloodstream. Muscle turns about 1-2% of the creatine into creatinine daily (Whelton et al., 1994). Measurement of urea and creatinine (CRE) is important in diagnosis and treatment of kidney diseases. Creatinine, which is removed from the body by kidneys, is a breakdown product of "creatine phosphate" which has a role as an energy store in muscles. Daily urinary volume is calculated by measuring its density in the blood and urine. Serum CRE level is a marker which is used in the diagnosis of kidney failure (Akoglu et al., 2015).

Athletes are intensively exposed to the demands of training and competition schedule which cover repetitions for most of the week and in exercise periods which are done on consecutive days. Each training and match cause high physical consequences in athletes such as muscle damage due to forcing or related traumas. Lots of intense training and competition may be the reason of the potential negative impact on the physical demands of the next training performance, the skeletal muscle, nerves, immune system and metabolic system, especially with minimal recovery time and may trigger overload injuries of some players. This situation, especially in congested fixture period, emerges in a short time period which requires competition and is forwarded repeatedly. Therefore, it is believed that the recovery capacity after competition and intense training is a significant predictor in the next training (Rey et al., 2012). Although massage is widely used by athletes, little scientific evidence exists to confirm the efficacy of massage for promoting physiological recovery after exercise and massage effects on performance (Hemmings et al., 2000). In recent years, the relationship between exercise and uric acid and creatinine levels of elite athletes in various fields have been analyzed and significant data have been obtained in this regard; yet the relationship between massage and these parameters has not been studied.

The aim of our study is to examine the effects of general body massage on the excretion of creatinine, uric acid and micro protein from the body considering its importance in terms of balancing the exercise and resting periods of athletes due to the fact that biochemical parameters change during exercise and resting period.

2. Material and Methods

2.1. Participants, equipment and measurements

The study involved 42 voluntary subjects (21 control: C, 21: Experimental: Ex) who were students studying at Physical Education and Sports Academy. All subjects were chosen among active athletes. All of the subjects were informed about the content and the risks of the study. Being healthy, not having a chronic or acute disease and not having limitation of motion due to disability caused by any reason were looked for as the criteria for the athletes to participate in the study.

The first urine samples (urine) were taken within 2-3 hours after submaximal exercise which was conducted by Monark 818E Pendulum bicycle ergo meter. Later, effleurage, friction, petrissage, deep friction and vibration were applied to the subjects respectively in a room at 20-27 °C temperature for 35 minutes at the same time of the day (at 15:00-17:00) as the massage protocol and urine samples were taken 15 minutes later. Passive resting was applied to C group as the same period of massage after exercise and urine samples were taken before and after this period.

All subjects drank water as much as they wanted before exercise and massage. Creatinine, uric acid and microprotein levels in urine were measured by using Olympus test kits (catalog # OSR 6178, OSR 6136 and OSR 6170) in Olympus AU 5200 auto analyzer.

The study was approved by Selçuk University Clinical Research Ethics Committee with decision number 2010/014.

2.2. Data analysis

The differences between the pre- and post- massage values and their associations were analyzed. Data were presented as mean ± standard deviation and the alpha level for significance was 0.001, 0.01, and < 0.05.

The direction of significant main effects between Ex and C group was analyzed using t-tests (paired and independent).

3. Results

The findings demonstrated a statistically significant difference between pre and post massage values at $p < 0.001$, $p < 0.01$, $p < 0.05$ level respectively.

Table 1: Height, weight and age averages of Ex and C groups together with their maximum pulse average values during exercise

N = 42	**X ± SD**	**Maximum**	**Minimum**
Age (Ex)	21.19 ± 2.18	25.00	18.00
Age (C)	20.38 ± 1.80	24.00	18.00
Pulse max (Ex)	171.75 ± 1.02	175	165
Pulse max (C)	170.48 ± 7.37	173.82	167.12
Height (Ex)	1.71 ± 4.06	178	163
Height (C)	1.72 ± 3.60	1.78	1.66
Weight (Ex)	55.21 ± 2.21	60.00	52.00
Weight (C)	56.14 ± 3.04	71.00	52.00

Table 1 demonstrates the height, weight and age averages of Ex and C groups together with their maximum pulse average values during exercise.

Table 2: Pre and post massage, creatinine, uric acid and microprotein values of experimental group

N = 21	**Pre Massage**	**Post Massage**		
	X ± SD	X±SD	t	p
Creatinine (mg/dl)	150.48 ± 27.49	155.63 ± 28.35	-1.45	**p < 0.01**
Uric Acid (mg/dl)	66.60 ± 10.08	71.87 ± 10.79	4.68	**p < 0.01**
Microprotein (mg/dl)	6.47 ± 0.97	7.04 ± 1.45	-0.46	p > 0.05

A statistically significant difference was found in the level of uric acid and creatinine pre and post massage which was applied after submaximal exercise (Table 2) ($p < 0.01$). No significant difference was found in the microprotein level before (6.47 ± 0.97) and after (7.04 ± 1.45) massage which was applied after submaximal exercise (Table 2) ($p > 0.05$).

However, the decrease in microprotein level after massage was found interesting when compared to submaximal exercise. Comparison of creatinine, uric acid and microprotein values of Ex and C groups before massage were not statically significant

Table 3: Comparison of creatinine, uric acid and microprotein values of experimental and control groups before massage

N = 21	**Ex Group**	**C Group**		
	X ± SD	X ± SD	t	p
Creatinine (mg/dl)	150.48 + 27.49	141.87 + 30.07	0.968	p > 0.05
Uric Acid (mg/dl)	66.60 + 10.08	68.51 + 9.91	-0.619	p > 0.05
Microprotein (mg/dl)	6.47 + 0.97	6.29 + 6.44	0.114	p > 0.05

Table 4: Comparison of creatinine, uric acid and microprotein values of experimental and control groups after massage

N = 21	Ex Group	C Group		
	X ± SD	X ± SD	t	p
Creatinine (mg/dl)	155.63 + 28.35	156.09 + 26.35	-0.055	p > 0.05
Uric Acid (mg/dl)	71.87 + 10.79	70.04 + 9.54	0.584	p > 0.05
Microprotein (mg/dl)	7.04 + 1.45	6.44 + 1.49	0.114	p > 0.05

No significant difference was found on each three parameters between massage or pre passive resting values of experimental and control groups.

4. Discussion and Conclusion

Researches show that intensively applied submaximal exercise affects physiological parameters significantly. It is stated that metabolic activity which increases during exercise causes significant changes in serum lipids (Jeppesen et al., 2013), in electrolytes (Demirtaş et al., 2015) and in some enzymes (MacNeil et al., 2014) and even that the exercise's effect on some biochemical parameters continues for 72 hours after the exercise (Günfer et al., 1998). For example, Child et al. (1998) analyzed total antioxidant capacity (TAC), uric acid concentration (UA), creatine kinase (CK) and beta-glucuronidase (beta-G) and malondialdehyde's plasma concentration (MDA) lipid peroxidation in venous blood taken from 17 volunteer athletes before and after the half marathon race and found that other parameters except CK increased at statistically significant $p<0.01$, $p<0.001$ level. Also, Benitez et al (1992) found a statistically significant difference between plasma uric acid levels before the race (330±40 μmol/l) and after the race (379±55 μmol/l) in the study they conducted on 11 male athletes ($p < 0.05$).

In terms of total protein levels, there was no significant difference. In a study which was conducted with 9 selected marathon runners (Bergholm et al., 1999), it was stated that uric acid levels of athletes changed significantly pre-post training. It is thought that the differences in the number of the subjects, the protocols of exercise conducted and the exercise time are effective on the differences in increasing or decreasing biochemical parameters before and after exercise in the findings present in the literature. Yet, massage therapy applied after exercise is one of the most frequently used interventions to regulate the biochemical parameters, to balance homeostasis and to increase the level of healing and recovering level of athletes. However, there is little evidence to support the effectiveness of massage for performance gain and the data on its effectiveness in this regard vary (Poppendieck et al., 2016). It is known that the exercise consisting of eccentric muscle contractions increases the passive muscle stiffness by reducing the range of motion (Pournot et al., 2016). Sports massage seems to be an effective way to resolve this problem which occurs in the muscle. Especially, in professional branches of sports like football, the fact that teams have trained masseurs shows the importance of massage in performance sports.

When the literature is analyzed, it is seen that although there is not an equivalent research to compare with the presented study, the studies on the effectiveness of massage on recovery after exercise focuses on studies such as heart rate variability, relief and oxygen consumption (Bennett et al., 2016; Resnick, 2016), eliminating stiffness occurring in the muscle with local vibration (Pournot et al., 2016), the levels of effectiveness of massage time (Poppendieck et al., 2016) and the effect of massages on pain or suffering (Skillgate et al., 2015, Crawford et al., 2016). The positive effects of massage have been identified in the studies analyzed. For example, Bennett et al. (2016) measured salivary cortisol level, blood pressure, the heart rate and stress perception before and after massage to determine the positive effects of massage on 36 students and the results showed that massage had significant physiological effects ($p < 0.001$).

In the same direction, Robertson et al. (2004) observed a significant decrease (30.2±4.1-34.2±3.3) in fatigue index on professional men athletes in the massaged group (31). In their study which they conducted with 10 healthy athletes, Zainuddin et al. (2005) studied the effects of massage applied after eccentric exercise on muscle function and delayed onset muscle pain (DOMS). In the study that the researchers conducted fortnightly, the application showed significant effects on plasma creatine kinase (CK) activities and CK increase was less, massage decreased DOMS and edema approximately 30% in the highest level of fatigue and DOMS increase was determined less in significant quantities in the massaged group.

Bakar et al (2015) studied the effects of massage on removing blood lactate from the body and muscle damage in the period following submaximal exercise on 18 healthy males. 18 male students who were randomly selected and exercised were either applied massage or were considered as a control group. In both groups, graded exercise test on a treadmill was conducted to determine the individual anaerobic threshold. After seven days, all subjects had run for 30 minutes equal to the running speed they were exposed to during the measurement of individual anaerobic threshold and in the same treadmill ergometer. The control group was not exposed to any application after exercise, the experimental group received massage application. As a result, a decrease was seen in lactic acid (LA) and lactate dehydrogenase (LDH) levels which increased immediately in the after-exercise process at the end of massage application. It was determined in the subjects who received massage application that there was a rapid and significant decrease 2 hours after the submaximal exercise. In the study; plasma creatine kinase (CK) and myoglobin levels were also compared and myoglobin showed a significant difference 2 hours after submaximal exercise and CK 24 hours after submaximal exercise. Researchers found that massage applied after submaximal exercise caused a more rapid decrease in LA, LDH, CK and myoglobin muscle enzymes. However, they stated that massage can contribute to improvements and recovery in muscle damage and structural damages of muscle cells.

As a consequence, the positive effects of massage identified in the literature are consistent with the presented study. In addition, although a study which used similar materials and methods is not found, it is concluded in accordance with the data obtained that massage can be important in terms of the evaluation of the athlete performance and providing exercise-resting balance by contributing to removing biochemical parameters in question including creatinine, uric acid and microprotein from the body. However, it is necessary to state that massage can affect the antioxidant defense system due to the fact that the differences in uric acid levels may be caused by the antioxidant properties and that to fully enlighten the effects of these parameters on massage their relationship with antioxidants need to be analyzed.

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