Original Article

Evaluation of Urinary GGT in Elite Male Karate Athletes Pre & Post Exercise

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ABSTRACT

Background and Aims: **Post exercise proteinuria and increased urinary Gamma-Glutamyl transferase (GGT) levels can be indicative of exercise-induced renal damage. The aim of this investigation was to study the effect of one session of intensive training on renal tubular injury markers and compare their values to those 6 hours after training, for evaluating tubular damage after intensive training.**

Materials and Methods: **In this cross-sectional study with pre- and post- test design, 10 elite volunteer male athletes were selected and participated in one training session (2 hours). Urine samples were collected before training, one hour after training, and 6 hours after training. Urinary protein, creatinine, and GGT values were measured through laboratory methods and then Pr/Cr and GGT/Cr ratios were computed.**

Results: **There were significant differences between values of protein, urine Pr/Cr ratio, GGT and creatinine in the three sampling phases ($P<0.05$). However, no significant differences were observed between values for GGT/Cr ratio. There were significant differences between the mean values of creatinine, protein, GGT, and Pr/Cr ratio within pre-exercise and 1 hour post-exercise values and Pr/Cr ratio values in pre-exercise and 6 hours post-exercise ($P<0.05$).**

Conclusions: **It seems that a session of karate training does not result in permanent renal damage and for evaluation of tubular function, it is better to get the urine sample for urinary marker at least 6 hours after exercise.**

Keywords: **Gamma Glutamyltransferase, Kidney Function Test, Karate**

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Introduction

In the last few years, martial arts have been faced with an abundance of enthusiasts (1). In this field, "Kara-te" ("empty-hand" in Japanese) has an especial importance amongst the others. Karate players defend and attack without using a weapon (2). Even though the exercise is proven useful for the human body, it seems that since it is a heavy sport, it may be harmful to the kidneys (3), cardiovascular (4), and muscular systems functions (5). The exercise may result in proteinuria by reducing the renal circulation and the glomerular filtration rates (6).

Actually, exercise results in protein exertion to urine, especially protein that available in blood plasma. This state is called "exercise proteinuria" which occurs during vigorous exercise or ultimately after that, and it depends on the intensity and duration of training. High intensity/short duration training can increase glomerular and tubular proteinuria, while moderate intensity/long duration training increases proteinuria, especially due to the decrement of tubular protein reabsorption (7).

A membranous enzyme, known as Gamma-Glutamyltransferase (GGT), is an important cellular antioxidant, and plays a key role in glutathione homeostasis via extracellular glutathione breakdown (8). This enzyme is primarily located on the luminal surface of cellular membranes of proximal tubule epithelial cells, thus its highest activity can be found in kidneys (9).

Increasing the enzymes excretion to urine can be due to renal damage and the type of urinary enzymes can determine the primary site of renal damages, because every part of nephron has a specific enzyme subtype (10). Several studies have been done investigating the effects of exercise on urinary protein and creatinine, but the number of studies on urinary GGT in athletes is low (11). As far as the author has investigated, no studies have been done on karate athletes.

The aim of this study was to assess the effect of one secession of intensive exercise on GGT changes pre & post exercise, as a marker of renal tubular injury.

Materials and Methods

In this cross-sectional study, the subjects were the karate athletes of Arak team, one of the sport clubs of the main league of Iran (Autumn 2010). Research methods were approved by Medical University of Arak's Ethics Committee (NO:89-84-2). The exclusion criteria were the presence of any history of serious/chronic diseases, any history of renal diseases, and history of drug-induced nephrotoxicity. Ten karate athletes were selected ranging in age from 18 to 26 years. The test was done in one day by giving a training program with the following schedule: general and karate-specific warm-up for 30 minutes, main stage workout (i.e. Yuri Tsuki, Mawashi Gery, tsuki, and Mawashi Gery) for 2 minutes each, in 2 sets and 2 minutes rest; Meet's Tsuki and Mawashi Gery for 30 seconds each, in 3 sets and 1 minute rest; rapid Tsuki , Mawashi Gery and Kusacherica Tsuki every movement each 10 seconds for each movement, in 3 sets and 1 minute rest, and 15 minutes of recovery. The total duration of the training was 120 minutes and totally included three sampling times, first, before the training started; 1 hour post-training, and 6 hours post-training the karate athletes gave clean-catch urine samples in sterile containers. Urinary GGT levels were measured by GTSL method, urinary creatinine levels were measured using the JAFFE reaction, and no adjustments were done for daily creatinine variations.

In order to minimize errors due to changes in urine flow, GGT levels were given as ratios toward urinary creatinine levels and urinary protein levels were determined according to Bradford method using bovine serum albumin as the standard. Variance analysis using general linear model-repeated measures test was conducted to assess the significance of differences among the three measurements. In addition, dependent *t*-test was run to determine the difference between the two sample pairs using commercially available statistics software (SPSS 18). *P*-value<0.05 was considered statistically significant.

Results

Demographic characteristics of the male karate athletes and their urinary findings are shown in Table 1 2 and 3, respectively. Pre-training GGT [u/l] levels increased to a higher amount after 1 hour post-training, and decreased after 6 hours post-training to an amount similar to the initial. The only statistically significant increase in GGT levels was that of the 1 hour post-training (*P*<0.05). GGT/Cr (u/g creatinine) levels increased both 1 and 6 hours after post-training compared to the pre-training, but they were not considered significantly different (*P*>0.05). Creatinine levels increased to a higher value after 1 hour post-training, which was the only significant increase of creatinine levels from pre-training to post-training (*P*<0.05). It also decreased after the 6-hour post-training in comparison with the pre-training values. Proteinuria level was considered higher 1 hour post-training and similar to the pre-training and the 6 hours post-training. The only significant difference was the increase of proteinuria level 1 hour post-training compared to pre-training (*P*<0.05). It was shown that urine protein/Creatinine ratio 1 hour post-training and 6 hours post-training and 1 & 6 houres post training sample increased (*P*<0.05).

Table 1- Demographic characteristics of male karate athletes

Values Variable	Minimum	Maximum	Mean±standard deviation
Age(Years)	18	26	20.82±2.52
Weight(Kg)	52.5	90	73.25 ±11.85
Height(Cm)	168	190	180.30±7.10
BMI(Kg/m^2)	18.38	25.74	22.40±2.39
Sports history(years)	6	16	11.00±3.30

Table 2- Comparing urinary factors of male karate athletes in the tree times of sampling with repeated measures Test (*=*P*<0.05)

Time Variable	Before training	1 hour after training	6 hours after training	*P*-value
Protein(mg/ml)	1.68±0.27	38.30±14.77	6.00±6.27	0.000
Creatinine(mg/dl)	42.70±15.60	62.70±10.72	36.60±25.94	0.001
GGT(U/l)	75.50±27. 35	210.30±80.40	68.40±34.10	0.000
Protein/creatinin	0.05±0.03	0.61±0.22	0.24±0.24	0. 000
***GGT(u/g creatinine)**	1.84±0.46	3.35±1.12	4.76±3.27	0.399

*Gamma Glutamyl Transferase

Table 3- The difference and significant levels between the means related to sample pairs, W: Wilcoxon Test, The others: Dependent *t*-Test (*=*P*<0.05)

Variable \ Time	Before training-1hour after training		1hour after training-6 hour after training		Before training-6 hour after training	
	Test	***P*-Value**	Test	***P*-Value**	**Test**	***P*-Value**
Protein(mg/ml)	Dependent *t* test	0.000*	Dependent *t* test	0.000*	Dependent *t* test	0.064
Creatinine (mg/dl)	Dependent *t* test	0.001*	Dependent *t* test	0.005*	Dependent *t* test	0.365
GGT*(U/l)	Dependent *t* test	0.001*	Dependent *t* test	0.000*	Dependent *t* test	0.245
Protein/creatinine	Dependent *t* test	0.000*	Dependent *t* test	0.003*	Dependent *t* test	0.031*

*Gamma Glutamyl Transferase

Discussion

The results of this analysis show that one session of intensive karate training increases the urinary level of renal damage markers in male karate athletes. However, these exercise-induced changes decrease to initial values after 6 hours post-training. The findings show significant differences between the average protein values sampled at three different times. However, the average protein values increased from 1.68±0.27 before training to 38.30±14.77, 1 hour post training, and decreased to 6.00±6.27, 6 hours after the training session which reveals no significant differences compared to the initial values (*P*>0.05) (Tables 2 and 3).

Ayca *et al.* (2008) observed no significant differences between pre, post, and 24 hours after training urinary protein values of gymnasts which is in contrast to the findings of our research (12). Another study by Ayca *et al.* (2006) reported significant differences in the levels of urinary protein changes after one training session in male volleyball athletes but had no follow-up period (11).

Urinary protein values increase after one training session. The amount of this increase depends more on the intensity of the exercise than the duration (13). Generally, due to the size and electrical charge of protein molecules, they are filtered through glomerular capillary membrane, from which about 90 percent is absorbed via renal tubular cells. In general, proteinuria is due to increased filtration, reduced protein re-absorption, or both. Various studies have shown that both mechanisms take part in this phenomenon; however, the increased glomerular capillary permeability mechanism is more dangerous than protein re-absorption. Generally, the anionic property in glomerular membrane confronts the crossing of the protein molecules with negative charge. During exercise, the albumin permeability of the membrane increases due to reduction in the negative charge of the glomerular membrane. Previously, it was believed that severe renal vasoconstriction due to exercise causes proteinuria, but recent studies have shown that renal prostaglandins can be a cause for exercise-induced proteinuria, based on using prostaglandins inhibitor drugs before training which dramatically decreases the value of exercise-induced proteinuria without any changes in renal hemodynamics (14).

The results of this research also revealed that average creatinine levels increase one-hour post exercise compared to pre-exercise and then decrease 6 hours post exercise with statistically significant differences. Although insignificant differences were observed between the average data pre- and 6 hours post-exercise which mean that creatinine level returns to its initial level 6 hours post-exercise ($P<0.05$).

Although several studies show an increase of urinary creatinine level post-exercise (10), many researchers have reported insignificant increase of urine creatinine (11, 12). The differences observed between the results of these studies may be due to the intensity, the duration of training, or the age of volunteers. Creatinine is a substance formed by metabolism of creatin in muscles, filtered through kidneys. The urinary creatinine levels can be a renal filtration marker. The more the renal filtration, the higher urinary creatinine levels (15).

Based on the above facts, it is concluded that protein/creatinine ratio has less changes than the independent values of protein and creatinine (16, 17). This study revealed significant differences in protein/ creatinine ratio between all three sampling times. The results are similar to those of Scarpa *et al.* (18) but in contrast to those of Ayca *et al.* (11) and Ayca *et al.* (12).

Though the average values of GGT increased from 75.50±27.35 pre exercise to 210.30±80.40, 1 hour post exercise but decreased again to 68.40±34.10, 6 hours post exercise ($P<0.05$), that difference was not significantly different from pre-exercise value. The average values of GGT/ Creatinine ratio, in all three times of sampling showed no significant differences either.

Ayca *et al.* (2006) (11) found no significant differences between the GGT values pre- and post exercise in female and male volleyball players but it was significant for spikers. Due to performing more explosive and jumping movements, it seems that one exercise session causes renal tubules injury in spikers more than other volleyball players do. The findings of studies by Ayca *et al.* (2008) (12) and Scarpa *et al.* (2007) (18) showed significant changes in this enzyme values post exercise.

The highest activity of GGT is found in proximal tubule epithelial cells, so this enzyme can be a marker for some tubular injuries (19). The amount of excretion of some renal enzymes, such as leucine aminopeptidase, alkaline phosphatase, and GGT increased in renal injury. It seems that the increase in GGT excretion can be due to injury of proximal renal tubules (20). According to existing evidence, increased urinary GGT level may be due to two mechanisms: The first mechanism is either complete or partial ischemia of kidneys that prevents oxygenation to tubular epithelium and leads to reduction in cellular energy values and discharge of ATP reserves that trigger biochemical events responsible for deactivating, fatal damages, and finally cell death (21). The second one may be due to myoglobinoria of rhabdomyolysis. In this case, the myoglobin entering kidneys (which is toxic to kidneys) causes renal cells damage and release of GGT (22).

Our study faced some limitations in the number of volunteers and the sampling periods. It was better that more subjects attended the study and sampling took place several times post exercise.

Conclusions

Although absolute values of Creatinine, protein, GGT, and protein/Creatinine ratio increase after one training session, the GGT/Creatinine ratio changes are not significant. Finally, each of the above mentioned values decrease to its initial value 6 hours later. Therefore, it seems that one session of karate training cannot lead to permanent renal damage and the increased urinary marker return to normal range up to 6 hours. The urinary markers such as GGT should be measured at list 6 hour after exertion to be used as a valid tubular damage marker.

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