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Original article

Monitoring the skeletal ,muscle damage marker levels of elite mountain bikers during official mountain marathon

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Abstract. *Study Objectives:* The purpose of the present study was to monitor the levels of skeletal muscle damage of elite mountain bikers during the official mountain marathon. *Methods:* The study group consisted of 12 male elite mountain bikers. The implementation of the study was performed during the official 6th International Manavgat Mountain Biking competition on 01.04.2018 in the Manavgat District of Antalya. The blood samples of the athletes were taken before the competition, immediately after the competition, 24 hours, 48 hours, and 72 hours after the competition, The descriptive statistics were given as mean, standard deviation, and minimum and maximum values. The normality test of the data was checked with the Shapiro-Wilk Test. The Friedman Test was preferred among non-parametric tests for repeated measurements in the analysis of the data that did not have normal distribution. The Dunn' Post-Hoc Test was used to determine the source of the differences between measurement times. *Results;* According to the results, it was determined that there were statistically significant difference between skeletal muscle damage markers according to measurement times. *Conclusion:* As a result, it may be speculated that the competition setting is a marker of skeletal muscle damage in elite mountain bikers. Among the bio-motoric characteristics, endurance is important in elite mountain bikers, as a characteristic of their branches, long-term exercise cause that they use heart beat at a maximum level; and therefore, it can be argued that this prepares the ground for skeletal muscle damage marker.

Key words: Mountain Bicycle, Competition Setting, Skeletal Muscle Damage

Introduction

Today, the post-exercise muscle damage marker attracts the attention of many scientists, and many studies are being conducted on this. As a result of these studies, several pharmacological agents are recommended to avoid muscle damage. The post-exercise muscle damage marker also attracts the attention of those who receive physical therapy due to various diseases, those who do sports due to cardiovascular diseases, in other words, those who do sports for health purposes, and trainers who prepare exercise programs. Studies in the literature, it was seen that a muscle damage marker occurs in the structure of the muscle because of the type and nature of the exercise, and the myocardial muscle causes similar wear and tear to infarction (1-3).

In the literature, many studies have been conducted and techniques have been determined for the detection of skeletal muscle damage. The first method is imaging techniques (Magnetic Resonance Imaging (MRI), Micrography, Electron Microscope, Ultrasonography), and structural changes in the histological appearance of myofibrils can be used

as indicators of muscle damage, but these methods are both expensive and difficult to apply to the area. At the same time, the biopsy technique is used as the second method for the detection of muscle damage. However, differences arising from biopsy techniques may affect the results. The third method is based on the determination of serum-specific enzyme activities in serum levels (4).

The damage to the muscle after exercise is also called "Adaptive Microtrauma" in the sports sciences field and is investigated a lot in exercise physiology studies (5). Although skeletal muscle damage marker is related to the intensity and volume of exercise, it is more pronounced after an unusual exercise. It was determined that even a single exercise protocol plays protective roles against muscle damage that would occur after exercise in the same severity or after a heavier exercise. Considering the effective renewal process and the protection of exercise after muscle damage marker caused by exercise, it may be considered that muscle damage is inevitable in terms of adaptation to training (6).

Contraction, in which muscle damage is observed more severely, is the eccentric contractions. The damage mechanism after unconventional eccentric muscle contraction is triggered by mechanical and chemical factors. Eccentric muscle contractions are those with negative character (i.e. climbing stairs, running down a hill, etc.) where muscle size grows. The first signs of damage immediately after eccentric exercises are reduction in strength and loss of function. The pain peaks at the 24-48th hours after exercise. Concrete muscle damage findings in humans were determined as a result of the biopsy on the soleus muscle on the 2nd and 7th days after exercise (7). In this context, the purpose of the present study was to monitor the skeletal muscle damage marker levels of elite mountain bikers during official mountain marathons.

Material and Method

Participants

A total of 12 licensed male mountain bikers were included in the study; however, since the Creatine Kinase (CK) level was over 1000 U/L (hyper-responder) in one individual, the relevant data were not included in the study and were accepted as lost data, and the study was continued with 11 mountain bikers (8).

Competition Protocol

The implementation of the study was performed during the official 6th International Manavgat Mountain Biking competition on 01.04.2018 in the Manavgat District of Antalya. The competition track consisted of 90 km, which was completed by the athletes between 3.30 and 4.00 hours. Two of the competitors who were included in the study showed high performance at the marathon and ranked among the first 3.

Body Weight and Height Measurement

A SECA-brand electronic scale with a sensitivity of 0.5 kg was used to weigh the participants with barefoot when there were only shorts and t-shirts on them. The heights were measured with a SECA-brand height scale with a sensitivity of 0.1 m.

Muscle Damage Measurement

The blood samples of the athletes who were included in the study group were taken before the competition, immediately after the competition, 24 hours, 48 hours, and 72 hours after the competition, as 10 ml blood from the forearm vein by a specialist nurse, and were kept at biochemistry tubes containing sodium fluoride. The blood samples were left to rest for 30 minutes, centrifuged in cooled centrifuge device for 5 min at 4000 rpm, and the serums obtained were divided into 3 Eppendorf Tubes for analysis of biochemistry profiles. The samples were stored at -80^{o}C until analyses.

All parameters (Creatine Kinase (CK), Creatine Kinase -Miyokardiyal Band (CK-MB), Lactate Dehydrogenase (LDH), Myoglobin (MYB), Blood Lactate (LA)) were analyzed at the Medical Biochemistry laboratory of Suleyman Demirel University Faculty of Medicine. CK, CK-MB, LDH, LA enzymes were analyzed with the Spectrophotometric Method (Beckmann Coulter AU 5800) in biochemistry autoanalyzer, and the Electrochemiluminescence Method (ECLIA) Method was used in MYB Hormone Autoanalyzer

(Roche Cobas, 660). Approval was obtained for the study from the Ethics Board of Suleyman Demirel University, Faculty of Medicine.

Statistical Analysis

The descriptive statistics were given as mean, standard deviation, minimum, and maximum values. The normality test of the data was checked with the Shapiro-Wilk Test ($p < 0,05$). The Friedman Test was preferred among non-parametric tests for repeated measurements in the analysis of the data that did not have normal distribution. The Dunn' Post-Hoc Test was used to determine the source of the differences between measurement times. The significance level was taken as $p < 0.05$.

Results

The demographical characteristics of the elite mountain bikers who participated in the study are given in Table 1. In this respect, mean height value was 1.72 ± .07 m, mean body weight was 64.90 ± 6.84 kg, mean age was 22.36 ± 2.57 years, and mean sports age was 7.27 ± 2.37 years.

Table 1. Demographic characteristics of the athletes

Variables	N	Minimum	Maximum	$\bar{X}$ ± SD
Height (cm)	11	1.60	1.84	1.72 ± .07
Body weight (kg)		56.00	78.00	64.90 ± 6.84
Age (years)		19.00	28.00	22.36 ± 2.57
Sports Age (years)		4.00	11.00	7.27 ± 2.37

The differences in the measurement times of CK, CK-MB, LDH, MYB, LA levels of the elite mountain bikers who participated in the study are given in Table 2. In this respect, it was determined that although there were differences between the CK levels 24 hours after the competition and the values before the competition and 72 hours after the competition ($p < 0.05$), there were no differences among other times ($p > 0.05$). Significant differences were detected among CK-MB levels immediately after the competition and the values 72 hours after the competition ($p < 0.05$); however, there was no difference among other times ($p > 0.05$). Although there was a significant difference among the values measured immediately after the competition and the values at the 24th, 48th, and 72nd hours after the competition ($p < 0.05$), it was determined that there was no difference among other times ($p > 0.05$). Although it was determined that there was a difference between the MYB levels immediately after the competition and at the 24th and 72nd hours after the competition ($p < 0.05$), it was found that there was no difference among other times ($p > 0.05$). There was a significant difference between the LA values measured immediately after the competition and the values at the 24th and 72nd hours after the competition ($p < 0.05$); however, it was determined that there was no difference among other times ($p > 0.05$).

Table 2. Descriptive statistics of the biochemical parameters of the athletes by measurement times

Measurement Times	CK $\bar{X}$ ± SD	CK-MB $\bar{X}$ ± SD	LDH $\bar{X}$ ± SD	MYB $\bar{X}$ ± SD	LA $\bar{X}$ ± SD
Before competition	160,12 ± 90,72^{b}	9,62 ± 4,05^{b}	183,85 ± 28,00^{ab}	24,23 ± 5,57^{b}	33,99 ± 11,26^{ab}
Immediately after competition	214,28 ± 92,47^{ab}	17,08 ± 5,56^{a}	292,50 ± 76,33^{a}	145,69 ± 154,06^{a}	63,40 ± 21,93^{a}
24 hours after competition	326,69 ± 215,72^{a}	13,51 ± 10,60^{ab}	182,80 ± 32,99^{b}	27,07 ± 8,09^{b}	24,96 ± 5,66^{b}
48 hours after competition	221,36 ± 102,33^{ab}	11,87 ± 7,85^{ab}	183,26 ± 28,14^{b}	32,70 ± 14,15^{ab}	38,10 ± 34,71^{ab}
72 hours after competition	156,57 ± 62,16^{b}	9,37 ± 8,78^{b}	168,60 ± 14,05^{b}	25,27 ± 8,24^{b}	20,81 ± 4,88^{b}
N (11)	< 190 (U/L)	< 24 (U/L)	< 248 (U/L)	28-72 (ng-ml)	4,5-19,8 (mg-dl)
X^2	19,127	16,727	19.127	20,143	22,327
p	0,001**	0,002**	0,001**	0,001**	0,001**

**p < 0,01; ab: Different letters represent the differences between the groups.

Discussion and Conclusion

Based on the results of the differences in skeletal muscle damage marker CK level measurements, it was found that there were differences between the CK levels 24 hours after the competition, and the values before the competition and 72 hours after the competition ($p < 0.05$); and there were no differences among the measurements made at other times ($p > 0.05$). As a result of the study, it was determined that the competition effected on CK levels. It is considered that the reason why CK levels returned to normal 72 hours after the competition was the recovery of the competitors.

Studies in the literature, it was reported that CK amounts reach the highest level 1-5 days after exercise. In a study conducted by Vincent (1997), the elevation in CK levels after leg resistance exercise reached the highest levels in days 3 and 4 (9). In the study of Schneider et al. (1995), it was found that the serum CK amount was twice higher in marathoners than before the marathon, and returned to normal 4 days after the marathon (10). In another study conducted by Clarkson et al. (1992), it was determined that serum CK values increased as a result of long-term exercise, and peaked after 24th and 48th hours (5). In a similar study, the same results were reported by Noakes (1987) (11). In the study conducted by Howaton (2009) that included repeated sprints, the time effects of muscle damage was examined, and it was reported that the differences in CK values were significant in subjects after 48 hours. Although the differences were not as high as exercise protocols with high density, no significant differences were detected in subsequent measurements 72 hours after the exercises (12).

According to the results regarding the differences in the measurement times of muscle damage marker MYB levels, it was determined that there were differences among the MYB levels immediately after the competition and the MYB levels at 24th and 72nd hours after the competition ($p < 0.05$), and there were no differences among other times ($p > 0.05$). Baker et al. (2005) conducted exercise protocol that included concentric-eccentric contractions held at bicycle ergometer and found that the MYB level was 53 ± 22.1 before the exercises, and was 54.5 ± 25.4 immediately after the exercises (13).

According to the results of differences in skeletal muscle damage marker CK-MB level measurements, although there was a significant difference among the values after the competition and other values ($p > 0.05$); however, there was no significant difference among other values ($p > 0.05$). In a study conducted by Hazar (2004), it was determined that trainings that involved maximal force and continuity in force did not cause significant damage to myocardial values, and reported that the elevation in CK-MB was not of cardiac origin, but was caused by skeletal muscle damage. The results of the present study of ours are similar to the literature data (14).

According to the results of the differences in the levels of skeletal muscle damage marker LA measurements, it was found that there was a significant difference among LA values immediately after the competition and at 24th, 48th, and 72nd hours after the competition ($p < 0.05$); however, there were no differences among the values before the competition and all the values after the competition ($p > 0.05$). Cetinkaya (2014) conducted a study on footballers, and determined that the LA level before the strain and the training program was 42.56 ± 1.77 mg/dl; 97.32 ± 6.95 mg/dl immediately after the strain, 16.60 ± 0.81 mg/dl 48 hours after the strain; and after the training program was applied, 25.89 ± 1.50 mg/dl before the strain, 93.83 ± 6.89 mg/dl immediately after the strain, and 21.91 ± 3.04 mg/dl 48 hours after the strain (15).

Nose et al. (1991) conducted a study and reported that the blood lactate level increased at a significant level after exercises applied at 95% VO_{2max} level (16). Bouhlel et al. recorded the mean blood lactate level as 12.81 ± 1 mmol/l after 20-meter shuttle run test in their study conducted with 8 elite taekwondo athletes with a mean age of 20 ± 1 years, and it was measured as $10,2 \pm 1,2$ mmol/l after the competition (17). The studies in the literature support the present study with similar results. A different point is that the elevated LA level 48 hours after the competition may be due to the characteristic of the branch regeneration training.

According to the results of the differences in skeletal muscle damage marker LDH level measurements, although it was found that there were significant differences among the values immediately after the competition and the values at 24th, 48th, and

72nd hours after the competition ($p > 0.05$), there were no differences among other times ($p > 0.05$). endil (2008) conducted a study and reported that the LDH level of the subjects who participated in the study was 146.7 ± 19.43 u/l before exercise, 167.8 ± 19.52 u/l after exercise, 189.7 ± 17.69 u/l at the 24th hour after exercise, 201.4 ± 12.68 u/l at the 48th hour after exercise, and 191.8 ± 8.17 u/l at the 72nd hour after exercise (18).

As a result of the present study, it can be speculated that the competition setting is a marker of skeletal muscle damage because of exercise in elite mountain bikers. Among the bio-motoric characteristics, endurance is important in elite mountain bikers. As a characteristic of the branches of elite mountain bikers, long-term exercises cause that they use heart beat at a maximum level; and therefore, it can be argued that this prepares the ground for skeletal muscle damage marker.

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Conflicts of interest: The authors declare that there is no conflict of interest about this manuscript.

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