Research Paper

Volume : 2 | Issue : 7 | July 2013 • ISSN No 2277 - 8179

Effect of Increasing Maximal Aerobic Exercise to Some Metabolic Factors in Elite Male and Female Field Hockey Players

Physical Education

KEYWORDS : Maximal Exercise, Growth Hormone, Gamma glutamyltransferase

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ABSTRACT

Objective: It has been aimed to evaluate the response of metabolic factors in elite female and male athletes to increasing maximal aerobic exercise and to evaluate pre-exercise and post-exercise serum levels.

Material and Method: 27 young (average age: 19) professional field hockey players (13 female, 14 male) were included in this study. Shutle Run test has been applied to the subjects. The subjects have run the distance between two lines, which was 20 meters, with accelerating (8 km/s) speed. In the running tests, which were performed with signal tone, the test was finished when the subject has missed two signals. The blood samples, which were taken before the exercise, right after the exercise and after 1 hour from the exercise, were kept in 80°C until analysis. In the analysis, serum levels have been measured by using Growth Hormone (GH), Insulin-like Growth Factor-1 (IGF-1), Protein Bound Insulin-like Growth Factor (IGFbp), Gamma glutamyltransferase (GGT) and insulin (INS) original kits. The data have been statistically evaluated separately for male and female athletes.

Findings: Immediately after the exercise, GH, IGF-1, IGFbp, GGT and INS serum levels have increased. While this increase was substantial in GH and INS, it was smaller in IGF-1, IGFbp and GGT. After 1 hour from the exercise, GH, INS, IGF-1, IGFbp and GGT serum levels have decreased. GGT's response to increasing maximal aerobic exercise is higher in females comparing to males. IGFbp responses are not statistically meaningful in both genders ($p<0.05$).

Result: GH, IGF-1, IGFbp, GGT and INS's response to increasing maximal aerobic exercise in elite athletes and post-exercise serum levels are found to be beneficial in terms of health and body position.

INTRODUCTION

GH is a hypophysial hormone, which is excreted more couple of hours after meal, during exercise and after falling asleep, and which ensures body development and growth.[1] Insulin-like growth factors are peptides that promote growth. IGF-1 generally synthesized and released for circulation in the liver, however, it is locally synthesized in tendons and ligaments.[2] GGT is an enzyme, which separates gamma glutamyl part from glutathione, which is an important antioxidant, and helps re-synthesize of glutathione within the cell.[3]

Exercise stimulates GH release. GH levels start to increase within the first 10 – 20 minutes after the beginning of the exercise. It reaches top level at the end of the exercise or right before the end of the exercise and this increase continues after the exercise.[4] IGF-1 increase in serum, which is observed with exercise, is independent from GH. [5] Because the increase in IGF-1 level actualize before the increase in serum GH level.[6]

The decrease in insulin level in circulation and the GH level, which increases with exercise, are important for regulating availability of fatty acids after exercise. GH increases the availability of fatty acids and oxygen intake as a source. In parallel with this, exercise capacity increases. [7] In long exercises, the availability of fatty acids instead of glycogen in further stages of exercise is important in terms of performance.[8] IGF-1 is a significant element, which plays key roles in cellular growth and development.[9, 10, 11] Changes in serum GGT level are associated with mortality risk, cardiovascular diseases, type 2 diabetes, seizure or hypertension.[12, 13]

Both GH and IGF-1 serum levels increase during highly intense exercises. While weightlifting exercises do not make any changes in IGF-1 serum level, endurance type exercises cause significant increases in IGF-1 level.[14, 15, 16] In gentle exercises, GH and IGF-1 levels do not change. [17] GH and IGF-1 response to exercise may change in accordance with age, gender, body composition, physical fitness and exercise density.[7, 18]

In the study, which we have conducted in accordance with these results, we aimed to analyze the response of metabolic factors in elite female and male athletes to increasing maximal aerobic exercise and evaluate the clinical effects of this response and effects on body composition.

MATERIAL and METHOD

Subjects

13 professional young female grass hockey players and 14 professional young male grass hockey players attended the study after their written attendance forms and health reports had been taken. Ethical Committee approval of the study is released.

Exercise protocol

The subjects were applied shutle run test.[19] The subjects ran between two lines taking apart from each other with a distance of 20 meters; the test was started with a slow running of (8km/h). The run started with the first signal sound. Then, the same distance was run again and the second run started. Running speed was adjusted with the signals increasing 0,5 km/h per minute. When two signals were missed consecutively, the test was finished. The subjects were instructed not to eat anything three hours before the exercise and not to do sport starting from two days before the exercise; and these conditions were taken under control in this way.

Collection of samples

Blood samples were taken from each subject before exercise, immediately after exercise and one hour after the exercise. The serums were kept at -80 ^{0}C until the analysis. GH, INS, GGT, IGF-1 and IGFbp values were measured by means of auto analyzer using original kits (Roche Hitachi Modular DP Systems (Manheim Germany).

Statistical analysis

All values have been transferred to SPSS 15.0 pack program. One-way ANOVA test has been used in repetitive measurements, since the distribution of values match with normal distribution. T test has been applied for independent samples in comparing the female and male values. If the results were $P<0.05$, they were considered meaningful.

FINDINGS

Profiles of the subjects are shown in Table 1.

Table 1. Physical features of the subjects

Variables	Female	Male
Age (years)	18,76±1,09	19,5±1,22
Height (cm)	166,30±4,98	176±5,53
Weight (kg)	57,07±5,37	68,78±6,29
Sports age (years)	7,48±1,81	7,21±1,36

In this study, GH levels in female and male athletes have increased after exercise ($p<0.05$). In male athletes, the values after an hour from the exercise are lower than the values before exercise ($p<0.05$). Insulin values increased both in female and male athletes after exercise and after an hour from the exercise, they fell down to the level measured before the exercise ($p<0.05$). While IGF-1 and GGT values increase at post-exercise values in female athletes, the values taken after an hour from the exercise are lower than the post-exercise values ($p<0.05$). In male athletes, there were no statistically meaningful differences between exercise and IGF-1 and GGT values ($p>0.05$). In IGF-BP values, no meaningful differences have been observed in both female and male subjects with exercise ($p>0.05$) (table 2).

Table 2. Changes in some enzymes of field hockey players observed with exercise

Variables	Female	Male
Before Exercise GH (U/L)	5,77±2,10	6±1,6
İmmediately after GH (U/L)	19,04±3,06*	18,25±3*
An hour after exercise GH (U/L)	8,22±2,47*≠	3,59±0,67*≠
Before Exercise INS (U/L)	6,48±1,43	2,31±0,18#
İmmediately after exercise INS (U/L)	16,74±1,59*	5,09±0,65*#
An hour after exercise INS (U/L)	5,33±0,72*≠	2*≠#
Before Exercise GGT (g/dl)	12,84±2,39	12,92±1,56
İmmediately after exercise GGT (g/dl)	13±2,81*	13,21±1,72
An hour after exercise GGT (g/dl)	12,23±2,52 *≠	11,71±1,39
Before Exercise IGF-1 (U/L)	344,15±29,59	396±38,69
İmmediately after exercise IGF-1 (U/L)	370,30±37,45*	445,28±56,2
An hour after exercise IGF-1 (U/L)	339,30±32,49*≠	416,35±38
Before Exercise IGFbp (U/L)	5,53±0,24	5,85±0,55
İmmediately after exercise IGFbp (U/L)	5,64±0,3	6,38±0,77
An hour after exercise IGFbp (U/L)	5,55±0,3	5,98±0,45

When *p<0,05 is compared with the values before the exercise, when ≠ p<0,05 is compared with the values after the exercise, when # p<0,05 Female and Male values are compared

DISCUSSION

GH level increases in parallel with the increase in exercise density.[20] With increasing maximal aerobic exercise that we have performed on elite athletes, GH serum levels showed a significant increase both in female and male athletes. While the increase in IGF-1 was statistically meaningful in female athletes, it was not meaningful in male athletes. While there are no changes in serum GH and IGF-1 levels with gentle exercises, GH level increases with partial infarction gentle exercise and with the exercises that are performed with large muscle groups.[21, 22] This gives rise to the thought that this is resulted from insufficient oxygen intake during progressing exercise. GH and IGF-1, which increase with exercise, also increase erythropoiesis.[23] Contraction capacity of the heart increases through the anabolic effect of GH on myocardium.[24] IGF-1 may decrease during aerobic exercises.[25] Stress causes increases in GGT.[26] In our study, an increase in GGT serum levels, which is thought to be associated with insufficient oxygen intake, is observed with increasing maximal aerobic exercise. While this increase is statistically meaningful in female athletes, there is a slight increase in male athletes. These results support the other studies, which state that GGT level is a more important indicator in female athletes.[27] Along with increasing maximal aerobic exercise, the amount of oxygen intake decreases and energy requirement increases. Along with the significant increase in GH level, oxygen intake increases and fatty acids are used as energy source instead of glucose. Thus, the increase in GH level also increases the exercise performance. As fatty acids are used as source, it contributes to the changes in body composition.

In our study, the increase in IGF-1 and IGFbp levels in increasing maximal aerobic exercise was limited. While this increase was statistically meaningful only in serum IGF-1 analysis applied on female athletes, IGFbp results in both genders and IGF-1 results in male athletes were not statistically meaningful. It is thought that since the increasing maximal exercise performed by elite athletes was aerobic, the increase in IGF-1 and IGFbp was limited.

In our study, after an hour from increasing maximal aerobic exercise, GH, IGF-1, IGFbp, GGT and INS levels, which have increased during exercise, have decreased. While this decrease was statistically meaningful in GH, IGF-1, GGT and INS levels in female athletes, only the decrease in GH and INS serum levels was found to be statistically meaningful in male athletes. These results makes us think that metabolic factors (GH, IGF-1, IGFbp, GGT, INS) in female athletes respond to increasing maximal aerobic exercise more. The post-exercise decrease in GGT levels shows that it was below the pre-exercise level and oxidative stress has decreased more comparing to pre-exercise in both male and female athletes.

It is stated that increasing GGT level is associated with coronary diseases.[28, 29, 30, 31, 32] IGF-1 is more beneficial than other conventional nutrition biomarkers that are used in nutrition, health and body composition evaluations.[33] IGF-1 can also increase tendon collagen synthesis in tendon tissue. [2] GH is important for body development and regeneration.[34] GH level is lower in obese individuals.[35]

Evaluation studies with chronic diseases and cancer types have been performed with IGF-1 and GH.[36, 37, 38, 39, 40] This situation increases the importance of responses given by metabolic factors to diseases and body compositions. In the study that we have conducted, it increases the importance of responses given by metabolic factors to increasing maximal aerobic exercise. The response of GH, IGF-1, IGFbp, GGT and INS serum levels to increasing maximal aerobic exercise in elite athletes is clinically positive.

ACKNOWLEDGEMENTS

We acknowledge the support of the biochemistry laboratory of medicine faculty of Gaziantep University.

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