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Effect of Maximal Exercise on Blood Biochemistry in Middle-Distance Runners

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ORIJINAL ARTICLE

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Abstract

In this study, it was aimed to examine the reflection level and effect of maximal exercise on blood biochemistry in middle distance running. Eighteen male athletes, who were ranked at the national team level and in national competitions, were included in the research. Venous blood was taken into straight tubes with vacutainer just before the subjects included in the study started running. Blood samples were taken just before, 1, 6 and 24 hours after the run and with the same method. Athletes' blood glucose, urea, uric acid, cholesterol triglyceride, HDL, LDL, Fe, TDBK, Iron saturation (Fe Sat), total protein, albumin, AST, ALT, LDH, CPK, GGT, ALP, Ca and P values ILL AB It was studied with ILL AB test kits on the 1800 device, and transferrin (TDBK /1.25) and Fe Sat were calculated as [(TDBK/Fe) x 100] according to the VLDL Frieldwald formula. The evaluation of the findings is the changes in the biochemical parameters of the athletes participating in this study. Blood glucose, creatinine, cholesterol, HDL, LDL, TDBK, transferrin, total protein, albumin, LDH, GGT, ALP, Ca and P values in 1 hour, urea, uric acid, triglyceride, VLDL, AST, ALT, CPK values in 6 hours. It was determined that it increased depending on both concentration in the hour and decreased to the level before the exercise after 24 hours, and this change was statistically significant except for the TG, VLDL and Fesat values. Fe and Fesat, on the other hand, reached their highest values at the end of 24 hours.

Keywords: Middle-Distance Runners, Blood Biochemistry, Exercise

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Orta Mesafe Koşucularında Maksimal Egzersizin Kan Biyokimyasina Etkisi

Öz

Bu araştırmada orta Mesafe koşularında maksimal egzersizin kan biyokimyasına yansıma düzeyi ve etkisini incelemek amaçlanmıştır. Araştırmaya milli takım seviyesinde ve ulusal müsabakalarda dereceye girmiş 18 erkek atlet dahil edilmiştir. Çalışmaya alınan deneklerin koşuya başlamadan hemen önce venöz Kan vacutainerli düz tüplere alınmıştır. Koşudan hemen önce, 1, 6 ve 24 saat sonra ve aynı yöntemle kanlar alınmıştır. Sporcuların kan glikoz, üre, ürik asit, kolesterol trigliserid, HDL, LDL, Fe, TDBK, Demir saturasyon (Fe Sat), total protein, albumin, AST, ALT, LDH, CPK, GGT, ALP, Ca ve P değerleri ILL AB 1800 cihazında ILL AB test kitleri ile çalışılmış, VLDL Frieldwald formülüne göre, transferin (TDBK /1.25), Fe Sat ise [(TDBK/Fe) x 100] olarak hesaplanmıştır. Bulguların değerlendirilmesi ise bu çalışmaya katılan sporcuların biyokimyasal parametrelerdeki değişiklikler. Kan glikoz, kreatinin, kolesterol, HDL, LDL, TDBK, transferin, total protein, albümin, LDH, GGT, ALP, Ca ve P değerlerinin 1saatte, üre, ürik asit, trigliserid, VLDL, AST, ALT, CPK değerlerinin ise 6. saatte hem konsantrasyonda bağlı olarak yükseldiği, 24 saat sonra ise egzersizden önceki düzeyine düştüğü, bu değişimin TG, VLDL ve Fesat değerleri hariç istatistiksel olarak anlamlı olduğu saptanmıştır. Fe ve Fesat ise 24 saat sonunda en yüksek değerine ulaşmıştır.

Anahtar Kelimeler: Orta Mesafe Koşuları, Kan Biyokimyası, Egzersiz

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Introduction

Biochemical parameters are affected by the type and intensity of exercise. The aim of performance training in middle-distance running is to increase the body's capacity against maximal effort loads. When the loads are more intense, the body struggles to reinstate itself by inducing the synthesis of new tissues and enzymes (Smith and Robert, 1994). As a result, an extreme fatigue syndrome may develop for the athletes, but there no definitive physical findings associated with this clinical condition (Budjett, 1990). Since each individual may react differently to load, objectively evaluating the fatigue level can be effective in regulating an athlete's training program and diet. Such loads alone constitute a metabolic stress (Coyle, 2000). Apart from a decrease in plasma volume, the use of metabolic fuels causes an increase in cell membrane permeability and the release of enzymes (Ward, 1993). Although it has been reported that biochemical parameters can be used to prevent or detect fatigue syndrome in its early stages, this issue is still controversial (Gastman 1997; Child et al., 2000; Gray et al., 1993; Coyle, 2000). In moderate endurance athletes, long-term training at high intensity has been shown to decrease serum iron (Fe), very low-density Lipoprotein (VLDL), low-density Lipoprotein (LDL), cholesterol, glucose, and albumin levels (Lehmann et al., 1993). Most of the studies on this subject have been done on elite athletes and for some selected parameters (Smith and Robert, 1994; Lehmann et al., 1997; Rama et al., 1994). This study was planned to examine the effects of maximal exercise on many parameters in the blood and their attainment of pre-exercise level in middle-distance runners who are highly trained.

Method

Eighteen male athletes with average age (21 ± 2) and average performance age (8.2 ± 2,5), who were trained at the national team level and at the top level in national competitions, were included in the study. The characteristics of the subjects included in the study are shown in Table I. Venous blood was drawn into vacutainer straight tubes just before starting the run. Athletes ran the 2000 meters in an average of 5.45 ± 1:02 minutes. Blood samples were taken just before the run, 1 hour later, 6 hours later, and 24 hours later, using the same method. Athletes' blood glucose, urea, uric acid, cholesterol triglyceride, HDL, LDL, Fe, TDBK, iron saturation (Fe Sat), total protein, albumin, AST, ALT, LDH, CPK, GGT, ALP, Ca, and P values were studied on ILL AB 1800 device with ILL AB test kits according to VLDL Frieldwald formula, transferrin was taken as (TDBK/1.25) while Fe Sat was taken as [(TDBK/Fe) x 100]. The statistical analysis was done on SPSS software (Version 8.0) using the Friedman test. A value of $P<0.05$ was considered significant.

Table 1

Characteristics of the Subjects Participating in the Study

Characteristics	Age	Height	Weight	BMI	Performance Age	2000 m	Pulse Before the Run	Pulse After the Run
AVG	21	1,77	67,3	23,13	8,2	5,45	70	186
Std Davilation	2	0,08	4,54	0,7	2,5	1.02	13,04	6,56

Findings

The changes in the biochemical parameters of the athletes participating in the study are summarized in Table II. It was determined that blood, glucose, creatinine, cholesterol, HDL, LDL, TDKB, transferrin, total protein, albumin, LDH, GGT, ALP, Ca, and P values after 1 hour; urea, uric acid, triglyceride, VLDL, AST, ALT, CPK values after 6 six hours increased due to hemoconcentration, and after 24 hours returned to pre-exercise levels, this change was determined to be statistically significant expect for TG, VLDL and Fe Sat values. And Fe and Fe Sat values reached their height after 24 hours (Table 2).

Table 2

Changes in Study Parameters Before and After Exercise

Parameter/ Time	Glucose (mg/dl)	Urea (mg/dl)	Creatinine (mg/dl)	Uric Acid (mg/dl)	Cholesterol (mg/dl)	Triglyceride (mg/dl)	HDL (mg/dl)	LDL (mg/dl)
Right before exercise	110± 0,4	14,6±3,0	1,3 ± 0,1	6,4± 1,5	149,1± 3,6	135,2± 0,8	43,7±5,3	77,4±18,0
1 hour after exercise	147,7±30,9	14,9± ,9	1,8 ± 0,2	6,8± 1,1	159± 25,8	159,4± 83	45,6±5,6	82,4±19,1
6 hours after exercise	105,3±17,6	19 ± 7,5	1,4± 0,2	7,3± 1,4	144,3±25,3	170,2± 9	41,6±4,8	69,3± 2,2
24 hours after exercise	74 ± 8,4	14,2±2,5	1,3 ± 0,1	6,2± 0,9	149, ± 26,3	153,2 ±47	42,1±4,3	76,1± 3,5
p	0,000	0,008	0,000	0,022	0,000	0,158	0,000	0,014

Table 3

Changes in Study Parameters Before and After Exercise (Continuation)

Parameter/ Time	VLDL (mg/dl)	Fe (µg/dl)	TDBK (µg/dl)	Fe Sat (%)	Transferrin	Total Protein (g/dl)	Albumin (g/dl)	AST(U/L)

Right before exercise	27,8 ±14,3	83,2±37,8	424,5±38,8	21,2±8,8	337,6±30	8,0 ±0,3	5,6± 0,2	22,1±5,5
1 hour after exercise	32,0 ±16,6	86,1±40,2	445,2±36,8	21,3±6,9	353,5±28,5	8,5±0,3	5,9± 0,2	25,5±5,7
6 hours after exercise	35,2±15,7	65,7±22,9	412,6 ± 36	16,8±5,05	327,4±27,7	7,0 ±0,4	4,9± 0,2	31,5±19,5
24 hours after exercise	31,4±9,2	95,2±28,8	436,0±34,1	23,6±6,8	347,2±26,2	7,3±0,2	5,1± 0,2	24,1±8,6
p	0,134	0,011	0,000	0,143	0,000	0,000	0,000	0,001

Table 4

Changes in Study Parameters Before and After Exercise (Continuation)

Parameter/ Time	ALT (U/L)	LDH (U/L)	CPK (U/L)	GGT (U/L)	ALP (U/L)	Ca (mg/dl)	P (mg/dl)	ALT (U/L)
Right before exercise	12,7 ± 4,4	296 ± 71	294±200	16.1 ± 3.	108,3±38,4	9,4±0,2	3,6±0,6	12,7 ± 4,4
1 hour after exercise	14,5 ± 4,3	340 ± 82	341±245	17,7±3,1	114,2±37,5	9,6±0,3	5,1±1,1	14,5 ± 4,3
6 hours after exercise	16,1 ± 15,8	327±122	365±282	11,9±3,7	102,2±33,8	9,1±0,3	5,0±0,6	16,1 ± 15,8
24 hours after exercise	14,5 ± 5,1	298±58	328±287	15,3±2,7	103,8±36,1	8,8±0,1	4,1±0,6	14,5 ± 5,1
p	0,024	0,015	0,001	0,000	0,000	0,000	0,000	0,024

Discussion

Although glucose and triglyceride concentrations are expected to decrease due to the decrease in blood insulin level and increase in lipoprotein lipase activity during acute and chronic exercise, it is known that this depends on the intensity of the exercise, the TG concentration decreases in the first 12 hours and 24 hours and reaches the basal value in 72 hours (Kory, 1993). Although the blood glucose, TG and VLDL levels of our athletes did not comply with this, they reached their basal values at the end of 24 hours.

Serum enzyme activity varies depending on the intensity and duration of exercise, as well as the training level, age, and gender of the person (Kory, 1993). Creatine Kinase (CK) is a marker of muscle contraction, but it is known to show individual variations (Lehmann, Wieland, Gastmann, 1997; Kory, 1993). In our study, serum LDH, ALP and GGT activities increased 1 hour after exercise, and AST and ALT activities increased at the 6th hour in accordance with CK.

Renal blood flow is reduced during exercise due to blood being sent to the muscles. Acute exercise leads to increased serum creatinine, urea, uric acid, calcium, phosphorus concentrations

(Kory, 1993). In our study, the levels of these parameters increased in the 1st and 6th hours, due to the hemoconcentration, and decreased to their basal values at the end of the 24th hour. Exercise is also known to cause proteinuria, especially albuminuria (Kory, 1993). In our athletes, too, blood albumin and total protein concentrations at the end of 24 hours were slightly above the basal values.

The serum Fe response is thought to depend on the training status of the athlete and the loading during exercise. If training is repeated at frequent intervals, fatigue will increase, and recovery period and homeostasis may not occur adequately in the periods between exercise. Chronic fatigue, "overtraining", will occur (Smith & Robert, 1994). Transferrin concentration increases in Fe deficiency and in acute exercise-induced hemoconcentration and decreases in Fe overload. It has been reported that transfer in endurance sports increases 24 hours after exercise and decreases to its former level within 7 days. Conversely, it has been reported that excessively intense exercise has no effect on transferrin levels or increases slightly (Gray, Telford, Weidemann, 1993). However, chronic endurance training increases transferrin. In a study conducted with middle-distance runners, it was found to be higher when compared to the control group (Smith & Robert, 1994). In our study, serum transferrin TDBC level decreased to its basal value at the end of 24 hours, while Fe and Fe Sat increased, this finding also reflects the training level of our athletes.

Conclusion

For the realization of training-oriented activities, the oxygen and energy need of the tissues must be met. These requirements are met by the respiratory-circulatory systems, through the blood. The type of exercise applied is also effective in the changes in blood values after exercise. It was determined that almost all parameters of middle-distance runners got close to the pre-exercise level 24 hours after the application of maximal exercise. An increase in blood iron concentration is a finding that will increase their performance. We can say the athletes reach the blood biochemistry to train again after 24 hours.

Refereance

Akgün, N. (1994). *Egzersiz ve spor fizyolojisi*. Ege Üniversitesi.

Bauwens, M., Wierts, R., Van Royen, B., Bucerius, J., Backes, W., Mottaghy, F., & Brans, B. (2014). Molecular imaging of brown adipose tissue in health and disease. *European Journal of Nuclear Medicine And Molecular İmaging, 41*(4), 776-791.

Budgett, R. (1990). Overtraining syndrome. *British Journal of Sports Medicine, 24*(4), 231-236.

Child, R. B., Wilkinson, D. M., & Fallowfield, J. L. (2000). Effects of a training taper on tissue damage indices, serum antioxidant capacity and half-marathon running performance. *International Journal of Sports Medicine, 21*(05), 325-331.

Coyle, E. F. (2000). Physical activity as a metabolic stressor. *The American Journal of Clinical Nutrition, 72*(2), 512S-520S.

Gray, A. B., Telford, R. D., & Weidemann, M. J. (1993). The effect of intense interval exercise on iron status parameters in trained men. *Medicine And Science in Sports and Exercise, 25*(7), 778-782.

Gray, A. B., Telford, R. D., & Weidemann, M. J. (1993). The effect of intense interval exercise on iron status parameters in trained men. *Medicine And Science in Sports and Exercise, 25*(7), 778-782.

Kory M Ward. (1993). *Chemistry of exercise in clinical chemistry concepts and applications* Saunders Company.

Laker, M.F. (1998). *Clinical chemistry for medical students. Klink biyokimya*. Nobel & Güneş Tıp Kitabevi.

Lehmann, M., Wieland, H., & Gastmann, U. (1997). Influence of an unaccustomed increase in training volume vs intensity on performance, hematological and blood-chemical parameters in distance runners. *The Journal of Sports Medicine and Physical Fitness, 37*(2), 110-116.

Rama, R., Ibáñez, J., Riera, M., Prats, M. T., Pagés, T., & Palacios, L. (1994). Hematological, electrolyte, and biochemical alterations after a 100-km run. *Canadian Journal of Applied Physiology, 19*(4), 411-420.

Smith, D. J., & Roberts, D. (1994). Effects of high volume and/or intense exercise on selected blood chemistry parameters. *Clinical Biochemistry, 27*(6), 435-440.

Timmons, J. A., Baar, K., Davidsen, P. K., & Atherton, P. J. (2012). Is irisin a human exercise gene? *Nature*, 488.

Tsuchiya, Y., Ijichi, T., & Goto, K. (2016). Effect of sprint training on resting serum irisin concentration-sprint training once daily vs. twice every other day. *Metabolism, 65*(4), 492-495.

Vamvini, M. T., Aronis, K. N., Panagiotou, G., Huh, J. Y., Chamberland, J. P., Brinkoetter, M. T., ... & Mantzoros, C. S. (2013). Irisin mRNA and circulating levels in relation to other myokines in healthy and morbidly obese humans. *European Journal of Endocrinology, 169*(6), 829-834.

Wu, J., Boström, P., Sparks, L. M., Ye, L., Choi, J. H., Giang, A. H., ... & Spiegelman, B. M. (2012). Beige adipocytes are a distinct type of thermogenic fat cell in mouse and human. *Cell*, *150*(2), 366-376.