Dependence of the state of metabolism on the time of cessation of sports activities of former athletes

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Abstract
Objective of the study was to study the main indicators of metabolism in the blood plasma of former athletes, depending on the time of completion of sports activities.

Methods and structure of the study. The study involved 24 former male athletes, with various sports specializations, qualifications from III adult category to Candidates for Master of Sports, aged 19-29 years. Depending on the time of completion of an active sports career, former athletes were divided into two groups: those who completed sports for a period of up to two years and more than two years. The control group consisted of untrained men of the same age. Indicators of protein, carbohydrate, lipid, purine metabolism and oxidative balance were studied in blood plasma.

Results and conclusions. The initial post-sport period is characterized by the predominance of catabolic processes (manifested in the form of a significant increase in the concentration of urea, medium molecular weight peptides, uric acid), carbohydrate metabolism disorders (a significant increase in glucose levels), lipid metabolism (a significant increase in total cholesterol, triacylglycerols) and oxidative balance in the form of accumulation TBA-active products against the background of a trend towards a decrease in total antioxidant activity. In the late post-sport period, there were no significant differences from the examined control group in terms of the studied indicators.

The initial post-sport period is characterized by an unfavorable change in the indicators of all types of metabolism, followed by a reverse trend in the late post-sport period. A comprehensive study of key metabolic indicators is a reliable criterion for diagnosing the development of a state of detraining. Metabolic changes accompanying the development of the state of detraining are recommended to be taken into account in the interpretation of biochemical analyzes during the rehabilitation of former athletes.

Keywords: *detraining, metabolism.*

Introduction. Sport implies an increased, in comparison with the usual, motor mode, which leads to the body's adaptation to constant intense physical activity, which turns into an attribute of an athlete's life [7-10]. The end of a sports career, especially a forced one, inevitably leads to a significant decrease in motor activity, which can be interpreted as relative physical inactivity. It has been shown that an abrupt cessation of the training process leads to adverse metabolic changes, including lipid metabolism [3], which are aggravated by the consequences of injuries and psychological discomfort. According to [6], 74.6% of the surveyed sports veterans would seek medical help in resolving the issue of adaptation to reduced physical activity. The study of metabolic rearrangements in people who have completed their sports career seems to be a rather urgent task both in terms of diagnosing the impact of developing relative physical inactivity on the health status of former athletes and preventing adverse consequences.

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to Candidate for Master of Sports, aged 19-29 years. Depending on the time of completion of an active sports career, former athletes were divided into two groups: those who completed sports for up to two years (Group 1; n=12) and over two years (Group 2; n=12). The control group (n=15) consisted of conditionally healthy untrained male students of the same age, who go in for physical culture within the program of the university.

Blood for the study was taken from the cubital vein and centrifuged. Indicators of protein, carbohydrate, lipid, purine metabolism and oxidative balance were studied in blood plasma. The concentration of total protein (TP), creatinine, urea, glucose, triacylglycerols (TG), uric acid (UA) was determined by standard sets of reagents, total cholesterol (TC) - by the Zlatkis-Zak method [4], TBA of active products (TBAap) - spectrophotometrically, at 535 nm. The level of medium molecular weight peptides (MP) was studied according to the method [1] on a Shimadzu UV mini-1240 spectrophotometer (Japan). The MP value was expressed in units equal to extinction (E) multiplied by 1000. The study of total antioxidant activity (TAA) was carried out on an Emilite 1105 chemiluminometer (Russia) according to the method [5] and expressed in conventional units (c.u.).

Statistical processing was performed by the Statistica 10.0 package. Arithmetic mean (M) and 95% confidence interval (95% CI) were calculated. The normality of distribution was checked using the Shapiro-Wilk test, the significance of the difference was determined by Student's t-test and considered significant at $p<0.05$.

Results of the study and their discussion. Data on the state of metabolism are presented in the table.

The concentration of total protein in the subjects of the 1st group, when compared with the data of the control group, was higher by 6.5% (p=0.091), which can be explained by the intensification of protein metabolism associated with adaptive changes during the transition to a lower level of motor activity. At the same time, the higher values of creatinine in former athletes of the 1st group by 10.8% (p=0.092) can be explained by a large amount of muscle mass compared to untrained people in the control group. However, there is reason to believe that the cessation of sports leads to a decrease in the efficiency of the phosphate energy supply system, which is confirmed by a lower creatinine level in former athletes of the 2nd group.

The indicator of medium molecular weight peptides in former athletes of the 1st group was significantly higher by 30.0% (p=0.008). At the same time, in former athletes of the 2nd group, the concentration of medium molecular weight peptides was lower compared to the 1st group by 14.6% (p=0.084), but higher than in the control group by 11.1% (p>0.1). Such a

Plasma Metabolism Rates in Detrained Individuals (M; 95% CI)

Researched indicator	Control group (n=15)	Former athletes	
		1st group (n=12)	2nd group (n=12)
Total protein, g/l	**69,3**	**73,8**	**72,4**
	(66,4 - 72,2)	(69,7 - 77,9)	(68,5 - 76,3)
Creatinine, µM/l	**60,3**	**66,8**	**62,6**
	(55,9 - 64,7)	(61,4 - 72,7)	(57,1 - 68,1)
Medium molecular weight peptides, E×1000	**237**	**308**	**263**
	(206 - 268)	(273 - 343)*	(230 - 296)
Urea, mm/l	**4,80**	**5,84**	**5,13**
	(4,45 - 5,15)	(5,33 - 6,35)*	(4,70 - 5,56)
Glucose, mM/l	**4,65**	**5,15**	**4,89**
	(4,43 - 4,87)	(4,88 - 5,42)*	(4,58 - 5,20)
Uric acid, µM/l	**262**	**325**	**296**
	(235 - 289)	(290 - 360)*	(263 - 329)
Triacylglycerols, mM/l	**0,94**	**1,19**	**0,96**
	(0,86 - 1,02)	(1,07 - 1,31)*	(0,86 - 1,06)
Total cholesterol, mm/l	**4,12**	**5,52**	**4,46**
	(3,85 - 4,39)	(5,05 - 5,99)*	(4,07 - 4,85)
TBA active products, µM/l	**5,38**	**7,46**	**5,65**
	(4,87 - 5,89)	(6,87 - 8,05)*	(5,14 - 6,16)
Total antioxidant activity, c.u.	**0,073**	**0,072**	**0,073**
	(0,069-0,077)	(0,068 - 0,076)	(0,069-0,077)

Note: * - the difference with the control is statistically significant (p<0.05).

distribution of this indicator indicates a certain staging in the development of the state of detraining, namely, an increase in catabolic processes at the initial stage of cessation of regular training, followed by adaptation to a changed level of physical activity. This position is confirmed by the study of indicators of urea and UA.

An increase in the concentration of urea in the development of the state of detraining can be associated with the consequences of a stress reaction, as well as with a decrease in the muscle mass of a former athlete, with a subsequent increase in the content of protein degradation products in the blood, including urea. In addition, the dietary habits of ex-athletes should also be taken into account, usually including the consumption of foods high in protein. The content of uric acid also agrees well with this. An increase in uric acid can also be associated with an intensification of the catabolism of unclaimed adenine associated with a decrease in ATP production.

Higher glucose values during the development of detraining, in our opinion, are associated with a stress response to relative physical inactivity, which leads to the activation of the sympathoadrenal system and the synthesis of hormones with contra-insular action. This leads both to inhibition of insulin production and to a decrease in the utilization of glucose by muscle tissue, since only a functioning muscle is able to consume glucose with a minimum amount of insulin in the blood.

A decrease in the role of lipid metabolism in the energy supply of muscle activity was established, confirmed by higher, by 26.6% (p=0.003), TG values in the initial post-sport period.

In detrained individuals, higher values of total cholesterol were noted. At the same time, if in the initial post-sport period, these differences, compared with the control group, were significant and amounted to 34.0% (p 0.001), then in the late post-sport period, the differences were not statistically significant, which, in our opinion, indicates ending adaptive restructuring to the changed level of physical activity.

The revealed increase in the concentration of TBAap by 38.6% (p 0.001) in the initial post-sport period indicates the intensification of free radical oxidation reactions, leading to the destruction of cell membranes, which explains atrophic processes and a decrease in muscle mass. In addition, the processes associated with the destruction of membranes lead to the disruption of membrane-dependent processes with the potentiation of atherogenesis, which is consistent with the results of the study of the total cholesterol index. The study of the total antioxidant activity in blood plasma did not reveal significant differences

in this indicator in former athletes compared to the control group. However, studies conducted at the cellular level indicate a significant decrease in TAA in the erythrocytes of former athletes [2], therefore, in general, we can talk about a decrease in the effectiveness of the antioxidant defense system in detrained individuals.

Conclusions. The initial post-sport period is characterized by an unfavorable change in the indicators of all types of metabolism, followed by a reverse trend in the late post-sport period.

A comprehensive study of key metabolic indicators is a reliable criterion for diagnosing the development of a state of detraining.

Metabolic changes accompanying the development of the state of detraining are recommended to be taken into account in the interpretation of biochemical analyzes during the rehabilitation of former athletes.

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