Dynamics of biochemical indicators in the mesocycle of training in highly qualified weightlifters

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Abstract

Objective of the study was to study the dynamics of changes in biochemical parameters in the blood of weightlifters and to identify the magnitude and direction of individual changes in biochemical markers within the mesocycle of the training process before and after participation in international competitions.

Methods and structure of the study. Biochemical control was carried out at the final stage of preparation for the Asian Championships against the backdrop of peak training loads and immediately after participation in competitions. Weightlifters (8 women) (n=8), who were members of the national team of the Republic of Kazakhstan, took part in the study. Control was carried out 4 and 2 weeks before participation in the championship and immediately after it.

Results and conclusions. During training, weightlifters successfully coped with high training loads with a pronounced focus on activating the creatine phosphate mechanism for energy supply to muscle work. The majority of subjects were characterized by low values of metabolic biomarkers, such as CPK and AST, which indicates a high level of adaptive potential in athletes during the entire training period. Low levels of CPK and muscle tissue damage index had a positive impact on the effectiveness of the training process of weightlifters and made it possible to achieve high rates of growth in sports and technical indicators. As a result, the women's team performed successfully at the Asian Championships and won 2 gold, 1 silver and 2 bronze medals.

Keywords: *highly qualified weightlifters, creatinine, creatine phosphate mechanism of energy supply, creatine phosphokinase indicators, aspartate aminotransferase indicators, muscle tissue destruction index, mesocycle of the training process, training load.*

Introduction. In elite sports, an important problem is the systematic search for effective means and methods of sports training, as well as the development of new technologies and models of the training process. To improve the quality of management of the training process, means of objective monitoring of biochemical processes are often used, in particular those associated with measuring the concentration of creatinine, aspartate aminotransferase (AST), creatine phosphokinase (CPK) activity in the athlete's blood [1, 2, 5, 7, 12, 13].

Objective of the study was to identify the dynamics of changes in biochemical parameters in the blood of weightlifters and to identify the magnitude and direction of individual changes in biochemical markers within the mesocycle of the training process before and after participation in international competitions.

Methods and structure of the study. The study involved highly qualified female weightlifters who were members of the national team of the Republic of Kazakhstan during the preparation for the Asian Weightlifting Championships. The athletes' own weight and level of sportsmanship in absolute values (points) were determined using the coefficients of the Sinclair table.

Laboratory examination of athletes to determine biochemical markers in the blood was carried out during the training camp, after intense physical activity, a night's rest (sleep), and the next morning, on an empty stomach. Blood was drawn from the ulnar vein.

Laboratory studies were performed on an automatic biochemical express analyzer.

Laboratory analysis determined the values of creatinine, unit of measurement μmol/l and μmol/l/kg, creatine phosphokinase (CPK), aspartate aminotransferase (AST), unit of measurement U/L, Unity/Litre, units/liter, (u/l). The muscle tissue damage index (CPK /AST) was determined. The mathematical and statistical analysis program SPSS was used to process the data. During the analysis, the following statistical indicators were determined: group average-M, standard deviation-S. The significance of differences was determined by Student's t-test for dependent samples. The subjects trained according to traditional programs [8]. The training process took place in the conditions of a training camp for the Asian Championship. Blood sampling was carried out at the peak of athletic fitness, 4 and 2 weeks before the main start, and the third measurement was carried out immediately after the completion of the competition.

Results of the study and discussion. Analysis of the obtained empirical data on the value of one's own weight and personal result in the sum of double events in glasses, as well as biochemical parameters showed that the group average values of creatinine concentration were M = 99.9 μmol/l; S=10.83. The values of creatinine per kg of weight were M=1.26 μmol/l/kg, S=0.34. The average group value of creatinine is higher than the reference values [7], which may indicate the high efficiency and focus of the training load on developing the power of the creatine phosphate mechanism for providing energy for muscle contraction. Calculations of the partial correlation coefficient between creatinine per kg of weight and the level of sportsmanship in absolute values, excluding the influence of one's own body weight, have a significant relationship - $r = 0.73$ ($p < 0.05$).

CPK activity indicators in this group of subjects were M = 270.3 units/l; S=164.1. In almost all subjects, CPK activity did not exceed physiological norms, and the group average value was no more than 1.5 times higher than the reference values [7]. Empirical data suggests that the athletes managed to maintain a high level of adaptive potential, which was the key to successful performance at the Asian Championships. It is important to note that in most subjects the muscle tissue damage index (CPK /AST) was no more than 10, which indicates the absence of critical damage to muscle fibers [7]. Great importance in the biochemical monitoring of athletes is given to the study of the activity of intracellular transaminases - AST (diagnosis of heart conditions) [1, 7]. The group average values of the activity of these enzymes in the subjects were within the normal range [7].

The values of the obtained biochemical parameters reflecting the concentration level of creatinine, creatine phosphokinase (CPK), aspartate aminotransferase (AST) in the blood of the subjects (absolute values) at the beginning and end of the training mesocycle, as well as the magnitude and direction of the group average changes are presented in the table. The group average creatinine value is higher than the reference values [7]. There is a significant increase in creatinine levels against the background of peak loads for two weeks by 11.34 μmol/l ($p < 0.05$). At the same time, during the systematic reduction of the training load two weeks before the start of the championship and during the period of participation in competitions, the group average creatinine values sharply decreased by 22.2 μmol/l ($p < 0.001$). The empirical data obtained can indicate the high sensitivity of the creatine phosphate mechanism for providing the energy of muscle contraction to the action of training loads of varying magnitude and direction. These facts are important to consider when constructing various sports training cycles in weightlifting.

As a result of the study, it was found that during the mesocycle the dynamics of changes in the group average biochemical parameters of creatine phosphokinase were statistically unreliable. The range of CPK values among the subjects ranged from 132 to 544 U/L against the background of maximum loads. These facts indicate an adequate individual reaction of the body of female athletes to the impact of maximum high training loads.

Such data may be evidence that in a large volume of muscle mass there was no negative effect on the recovery processes associated with inhibition of the synthesis of "nucleic acids and proteins" [6], and this, as a consequence, could have a positive effect on the rate of increase in myofibril mass, which will directly influence the overall effectiveness of the training process according to such a criterion as the increase in sports and technical indicators of athletes [9].

The results of the data obtained can be considered as the boundary values of CPK, at which athletes will achieve the highest rates of growth in sports results in preparation for competitions.

An analysis of the scientific literature revealed that, for example, among highly qualified athletes (men, women) in orienteering, the CPK values averaged 475.74 units. at a norm of 473-483 units. [eleven]. In comparison with the results of our studies, it is clear that weightlifters have significantly lower CPK values according to the results of all three measurements.

Dynamics of changes in biochemical parameters in weightlifters during the period of maximum load before the Asian Championships and immediately after the competition (n=8)

Statistical indicators	1st dimension	dimension 2nd	3rd dimension
	Creatinine μmol/l per kg body weight		
M	1,14	1,26	0,99
S	0,38	0,34	0,32
Difference		0,12	-0,27
t		3,23	4,31
	Creatinine μmol/l		
M	88,5	99,9	77,7
S	10,67	10,83	9,06
Difference		11,34	-22,2
t		3,4	5,7
	Creatine phosphokinase (CPK) units/l		
M	227,75	270,3	243,1
S	66,81	164,1	120,65
Difference		42,5	-27,13
t		0,95	1,4
	Aspartate aminotransferase (AST) units/l		
M	20,81	23,4	21,49
S	8,05	8,0	5,29
Difference		2,55	-1,87
t		3,44	1,29
	Muscle tissue destruction index (CPK /AST) (MTDI)		
M	11,72	11,95	11,95
S	4,02	7,6	6,5
Difference		0,23	0
t		0,12	0

Note: t value = 2.37; p<0.05; t = 3.50; p<0.01; t = 5.41; p<0.001

It is important to note that in most subjects the muscle tissue damage index (CPK/AST) was no higher than 10, which indicates the absence of critical damage to muscle fibers [7]. The dynamics of MTDI indicators was in the range of 11.72-11.95. A slight increase in enzyme activity may be associated with the absence of metabolic stress and signs of overtraining [7].

An important result of the study is that at the experimental level it was shown that it is possible to influence the quantitative indicators of biomarkers within one mesocycle through individual correction of the training load and, thereby, control intracellular processes in muscle fibers, achieving the best balance between destruction and synthesis "nucleic acids and proteins" [6]. And this can be one of the significant factors that determines the rate of increase in sports results, determining the overall effectiveness of the entire system of training athletes and successful performance in important competitions.

The results of the study indicate that during training, weightlifters successfully coped with high training loads with a pronounced focus on activating the creatine phosphate mechanism for energy supply to muscle work.

The majority of subjects were characterized by low values of metabolic biomarkers, such as CPK and AST, which indicates a high level of adaptive potential in athletes during the entire training period. Low levels of CPK and muscle tissue damage index had a positive impact on the effectiveness of the training process of weightlifters, which made it possible to achieve high rates of growth in sports and technical indicators. As a result, the women's team successfully performed at the Asian Championships and won 2 gold, 1 silver and 2 bronze medals. One participant was recognized as the best athlete of the championship, and another athlete became the winner of the Asian Championship in the overall classification (according to the Sinclair system). This athlete attempted to set a new world record in this exercise in the clean and jerk.

The greatest importance for diagnosing muscle tissue damage is given to changes in the enzyme creatine phosphokinase in the blood. Practice shows that CPK values of more than 500 U/L may indicate underrecovery of the athlete; more than 1000 U/L indicate serious disorders in the body, significant damage to myocytes, which can cause a decrease in the athlete's performance and increase the risk of injury [10]. The

trainer can use the obtained laboratory information to rationally structure the training process, establish optimal recovery periods, as well as to assess the compliance of physical activity with the functional state of the body, timely identification of signs of overtraining and overstrain of the musculoskeletal system.

To achieve a high training effect in weightlifting, training loads should be performed short in time and with high intensity. To achieve large volumes of high-intensity training work, you should increase the number of workouts to two or three during the day. To avoid the accumulation of excess lactate concentrations, it is necessary to include periods of passive rest for 15-20 minutes between exercises [12]. This time is enough to reduce lactate by 50-60% [10]. Knowledge of the laws of functioning and adaptation of the human body to training loads of various types makes it possible to increase the effectiveness of training athletes at all stages of the development of sports and technical skills [11].

Conclusions. Biochemical control of creatinine and creatine phosphokinase indicators is an informative indicator of the athletes' body's response to the training load, and can be used to manage the educational and training process in weightlifting.

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