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Adrenaline recovery dynamics in standard Physical workouts in wrestlers

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Abstract. *Objective:* studyof the dynamics of changes in the concentration of adrenaline in the blood of wrestlers in the recovery period after physical exertion. *Methods.* A comparative analysis of the dynamics of changes in the amount of adrenaline in the blood and heart rate in highly qualified athletes and individuals not involved in sports was conducted before and after performing physical exercise in comparison with a control group of individuals not involved in sports. *Results.* The revealed changes in the amount of adrenaline in the blood and heart rate after physical exercise were statistically significant depending on the level of physical fitness. The comparative analysis of the dynamics of changes in the concentration of adrenaline in the blood of athletes and individuals not involved in sports during physical exercise revealed its dependence on the level of physical fitness of athletes.

Keywords: adrenaline, standard physical activity, athletes, wrestlers, heartbeat.

Динаміка відновлення адреналіну при стандартних фізичних навантаженнях у борців

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Резюме. *Мета роботи:* вивчення динаміки зміни концентрації адреналіну в крові в борців у відновлювальному періоді після фізичного навантаження. *Методи.* Проведено порівняльний аналіз динаміки зміни кількості адреналіну в крові й частоти серцевих скорочень у висококваліфікованих спортсменів та осіб, які не займаються спортом, до й після виконання фізичного навантаження порівняно з контрольною групою осіб, які не займаються спортом. *Результати.* Виявлені зміни кількості адреналіну в крові й частоти серцевих скорочень після фізичного навантаження були статистично значущими від рівня фізичної підготовленості. Проведений порівняльний аналіз у динаміці зміни концентрації адреналіну в крові в спортсменів та осіб, які не займаються спортом, у процесі виконання фізичного навантаження виявив залежність його від рівня фізичної підготовленості спортсменів.

Ключові слова: адреналін, стандартне фізичне навантаження, спортсмени, борці, серцебиття.

Introduction. Physiological or psychological stress usually causes changes in the concentration of hormones circulating in the bloodstream. Assuming that the athlete is in a state of homeostasis before the competition, changes in hormone concentrations will most likely reflect the level

of pre-competition arousal, which is a common emotional manifestation of stress in sports and can affect athletic performance [1; 2; 7; 11; 15]. Several studies have reported a relationship between hormonal changes and arousal levels [3; 6], as well as hormonal changes and behavior [9; 10; 13]. In addition, the athlete's mood before the start of physical exercise also has a significant effect on the endocrine response.

The number of studies aimed at studying changes in catecholamine levels in the pre-competition period is very small. In a study devoted to the analysis of the reaction of the body of elite tennis players before the start of the Davis Cup, a reliable increase (3–4 times) in the concentration of adrenaline and the absence of changes in the level of norepinephrine compared to the normal state during preparatory training were found [4; 5; 8; 12]. Kraemer W.J. in a controlled laboratory experiment convincingly showed that when preparing to perform test exercises with maximum intensity, the participants in the experiment experienced a preliminary increase in the concentration of adrenaline, the amplitude of which was higher than in the case of preparation for performing exercises with submaximal intensity [14]. Similar changes in the concentration of norepinephrine could not be detected, which indicates that the mechanism responsible for the preliminary increase in the level of catecholamines involves the activation of the adrenal glands, which secrete adrenaline in the largest quantities.

The aim of this work was to study the dynamics of changes in the concentration of adrenaline in the blood of athletes during the recovery period after physical exertion.

Materials and methods. The subjects involved in the study were divided into 2 groups: the first experimental group included 12 male masters of sports in wrestling aged 19–21, the second control group included 12 practically healthy students of the same age group who did not do sports. The compared groups had no statistically significant differences in age. To study the effect of physical activity on the dynamics of changes in the concentration of adrenaline in the blood of the subjects, a PWC170 bicycle ergometer test was used. The subject performs two loads of different power (M_1 and M_2) on a bicycle ergometer, each lasting 5 minutes, with a 3-minute rest between them at a pedal rotation rate of 60 rpm. At the end of each load (in the last minute), the heart rate is measured (respectively, HR_1 and HR_2). The performance indicator is calculated using the formula:

$$PWC\ 170 = M_1+(M_2-M_1)\ (170-HR_1)\ /\ (HR_2-HR_1)$$

To determine the concentration of adrenaline in the blood after performing physical activity, 2 ml of blood were taken from the ulnar vein of each athlete at 1, 5, 15 minutes of the recovery period. The content of adrenaline in the blood was determined using the IBL device (Hamburg) by the enzyme immunoassay method. In addition, to assess the state of the cardiovascular system in athletes, the heart rate was studied by the generally accepted method using the UMP-310 device [2].

For statistical data processing, the IBM SPSS 25.0 computer program was used. Descriptive statistics of the study results are presented as arithmetic means (M) and standard deviations (SD). For intergroup comparisons of data, the Mann-Whitney criterion was used. To compare indicators over time, the Wilcoxon criterion for dependent samples was used. Differences were considered statistically significant at $p < 0.05$.

Results of the study. By the end of our study, it became clear how the amount of adrenaline changed under the influence of physical activity (Table 1).

In athletes, the concentration of adrenaline in the blood was 0.24±0.02 mg/ml at rest and 0.47±0.02 mg/ml in people not involved in

TABLE 1 – **Comparison of the dynamics of heart rate and blood adrenaline levels in the study groups, M±SD**

Research period	Indicator	Main group	Control group	P-value
State of rest	Heart rate, beats/min	65.0±2.2	76.1±3.6	0.001
	Adrenaline, mg/ml	0.24±0.02	0.47±0.02	<0.001
1 min after loading	Heart rate, beats/min	142.2±6.6*	154.6±9.6*	0.003
	Adrenaline, mg/ml	3.0±0.14*	3.2±0.19*	0.014
5 min after loading	Heart rate, beats/min	106.0±9.9*	122.2±3.2*	<0.001
	Adrenaline, mg/ml	1.95±0.13*	2.9±0.16*	<0.001
15 min after loading	Heart rate, beats/min	62.4±2.1	79.3±3.2	<0.001
	Adrenaline, mg/ml	0.22±0.03	0.52±0,0.4*	<0.001

* – statistical significance of differences relative to the resting state at the level of p<0.05.

sports (p=0.001). In top-class athletes, the heart rate was 65.0±2.2 beats/min, and in the control group, the heart rate was 76.1±3.6 beats/min (p=0.008). After the standard load, the heart rate increased to 142.2±6.6 beats/min in athletes, and to 154.1±9.6 beats/min in the control group (p<0.001). The amount of adrenaline in athletes after 1 minute was much higher than in the entry state 3.0±0.14 mg/ml and in the control group – 3.2±0.19 mg/ml, respectively (p=0.014).

In the 5th minute of the recovery period, in top-class athletes there was a decrease to 1.95±0.13 mg/ml (by 33%), in the control group – to 2.9±0.16 (by 15%) (p<0.001). The number of heartbeats decreased and amounted to 106.0±9.9 beats/min versus 122.2±3.2 beats/min in the control group. At the 15th minute, the heart rate of the athletes was statistically significantly lower than in the control group – 62.4±2.1 versus 79.3±3.2 beats/min (p<0.001). By the 15th minute of recovery, the adrenaline content and heart rate level in high-class athletes corresponded to the level of athletes at rest. In people not involved in sports, the heart rate did not differ significantly from the initial level, and the adrenaline content was 0.08 mg/ml higher than the initial indicators, i.e. it was not fully restored (p=0.026).

Discussion. As shown, at rest, the amount of adrenaline and heart rate in athletes were lower than in people who do not do sports. This may be associated with physiological restructuring in the regulation of adrenaline secretion as a result of increased heart function under the influence of physical activity [1; 4]. After performing physical activity, the reason for the increase in the amount of adrenaline in the blood of athletes is associated with the maximum mobilization of the body's energy capabilities, compared with non-athletes. At the 5th minute of the recovery period, the amount of adrenaline in students was statistically significantly higher than in athletes. The reason for this is the slow mobilization of the forces of an unadapted organism after physical activity in the recovery period [5; 6; 8]. At the 15th minute of the recovery process, the reason for the decrease in the amount of adrenaline is associated with its industrial use.

Conclusion. The conducted comparative analysis of the dynamics of changes in the concentration of adrenaline in the blood of athletes and individuals not involved in sports during physical activity revealed its dependence on the level of physical fitness of athletes. Adrenaline is important in mobilizing the body's energy capabilities during long-term physical activity and sports training. However, it is necessary to take into account that with the wrong approaches to the use of motor activity, it can also have a negative effect. Motor activity subjects the mechanisms of maintaining the normal functioning of the body to a serious test. In this regard, athletes sometimes find themselves in an ambiguous situation due to the professionalization of sports, the emergence of new technical elements and even new sports that require great effort. All this turns sports into an extreme factor that requires the mobilization of functional reserves and compensatory-adaptive mechanisms controlled by the nervous, endocrine and immune systems.

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