Change of Blood Composition before and after Implementation of Special Physical Load

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Abstract: A comparative analysis of changes in the amount of adrenaline in the blood and heart rate in highly skilled athletes, and persons not involved in sports, before and after physical load has been carried out. Revealed amount of adrenaline in the blood and heart rate after physical load were directly dependent from the level of physical preparedness of the subjects.

Key words: Adrenaline, working capacity, athletes, palpitation, heart rate.

1. Introduction

Physiological and psychological stress, as a rule, causes changes in the concentration of hormones circulating in the blood. If we assume that an athlete is in the state of homeostasis before the start of a competition, the changes in hormone concentration most likely will reflect the level of precompetitive excitability, which is a common emotional manifestation of stress in sports and can affect athletic indices [1]. Several papers have reported on the relationship between hormonal changes and the excitability level [2, 3], as well as hormonal changes and behavior [3]. In addition, the athlete's mood before the start of exercise has also a noticeable effect on the endocrine response.

The number of researches who aimed at studying the changes in the level of catecholamines in precompetitive period is rather poor. In the work devoted to the analysis of the reaction of the body of highly skilled tennis players before the start of the Davis Cup, a significant increase (3-4 times) in the concentration of adrenaline and the absence of changes in the level of norepinephrine (NA) compared

with the usual state during preparatory training was found [4]. Kremer et al. [5] under the conditions of a controlled laboratory experiment convincingly showed that in preparation for the implementation of test exercises with maximum intensity, the experiment participants had a preliminary increase in adrenaline concentration, the amplitude of which was higher than in the case of preparation for performing exercises with submaximal intensity. No similar changes in the concentration of NA could be found, which indicates that the mechanism responsible for the preliminary increase in the level of catecholamines involves the activation of the adrenal glands which is secrets of adrenaline in the largest quantities.

The purpose of this work was to study the dynamics of changes in the concentration of adrenaline in the blood of athletes in the recovery period after exercise.

2. Methods

The persons attracted to the study were divided into 2 groups: the first experimental group consisted of 12 Masters of sports in athletics, the second control group consisted of 8 practically healthy young men who were not involved in sports. To study the effect of physical activity on the dynamics of changes in the concentration of adrenaline in the blood of athletes, we used the veloergometric test PWC₁₇₀. The subject

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on a veloergometer performs two loads of different power (P1 and P2) for 5 minutes each, with a 3-min rest between them with a pedal speed of 60 rpm. At the end of each load (at the last min.), the heart rate was measured (accordingly HR_1 and HR_2). Health indicator was calculated by the formula:

$$PWC_{170} = P1 + (P2 - P1) (170 - HR_1) \setminus (HR_2 - HR_1)$$

To determine the concentration of adrenaline in the blood after performing exercise for 1, 5, 15 minutes of the recovery period, 2 mL of blood was taken from the cubital vein of each athlete. The amount of adrenaline in the blood was determined by enzyme immunoassay using the device "IBL" (Hamburg). In addition, for assessing the state of the cardiovascular system in athletes, the frequency of heart contractions in athletes was registered by the conventional method [6] using the "UMP-310".

3. Results and Discussion

The results of the studies showed that after the physical exercise, the background indicators of the concentration of adrenaline in the blood changed considerably. So, at rest in athletes the amount of adrenaline in the blood was 0.25 ± 0.01 ng/mL, while for young men not involved in sports it was 0.48 ± 0.03 ng/mL. The frequency of cardiac contractions among athletes was approximately 65 ± 2.3 beats/min, while in practically healthy young men these indicators were relatively higher and were within 76 ± 3.7 beats/min. After performing physical activity, the frequency of heart contractions in athletes increased to 140 ± 6.4 beats/min, and in young men not involved in sports it reached 152 ± 9.4 beats/min. The amount of adrenaline in this case was 2.8 ± 0.12 ng/mL and 3.1 ± 0.17 ng/mL respectively, and there were much more background values. At the 5th minute of the recovery period, there was a tendency for the amount of adrenaline to decrease in athletes to 1.93 ± 0.11 ng/mL (31%), in healthy young men to 2.7 ± 0.14 ng/mL (13%). The heart rate decreased and made respectively 104 ± 9.7 and 106 ± 8.7 beats/min 10 min after

exercise. The amount of adrenaline in athletes made 0.28 ± 0.04 ng/mL, in healthy ones it was 0.62 ± 0.06 ng/mL, which corresponded to 55%, and the number of heart beats was 68 ± 2.3 and 87 ± 6.4 beats/min. At the 15th minute of the recovery period, the amount of adrenaline in the athletes was 20% less compared to the rest, the number of heart beats was lower compared with intact data 64 ± 3.5 beats/min. The amount of adrenaline in healthy young men was 0.67 ± 0.04 ng/mL more relative to the control indicator, that is, they were not fully recovered, and the number of heart beats was leveled to 78 ± 2.7 beats/min.

As was shown at rest, the amount of adrenaline and heart beats in athletes were lower than in healthy young men. This may be connected with physiological reorganization in the regulation of adrenaline secretion as a result of an increase in the work of the heart under the action of physical activity [7, 8]. After performing physical exertion, the increase in the amount of adrenaline in the blood of athletes may be associated with the maximum mobilization of the body's energy potential compared to non-athletes. At the 10-min recovery period, the amount of adrenaline in healthy young men was 22% higher than that of athletes. The reason for that is the slow mobilization of the forces of unadapted organism after physical exertion during the recovery period [2, 9, 10]. At the 15-min recovery process, the cause of the decrease in the amount of adrenaline is due to its production use.

Thus, a comparative analysis of the dynamics of changes in the concentration of adrenaline in the blood of athletes and young people not involved in sports in the process of performing physical activity revealed its dependence on the level how well they are trained [8, 11]. As a result, the study found that adrenaline is important in the mobilization of the body's energy abilities during prolonged physical exertion and sports training [1, 3, 4]. However, it must be borne in mind that with the wrong approaches to the use of motor activity, it can also have a negative impact. 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 these make sport an extreme factor that requires the mobilization of functional reserves and compensatory-adaptive mechanisms controlled by the nervous, endocrine and immune systems. Motor activity the subjects exposes the mechanisms for maintaining the normal functioning of the body to a serious verification.

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