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Physiological Response Of Intravascular Platelet Activity In Boys With High Normal Blood Pressure To Regular Physical Exercise.

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ABSTRACT

The author has set a goal - to find out the severity of the effect of measured physical activity on the intravascular platelet activity in adolescents with high normal blood pressure. 34 persons of 18 years of age with high normal blood pressure were included in the study, risk 1-2, who were prescribed regular dosed physical training with an assessment of the dynamics of cardiovascular reactivity, lipid peroxidation activity and intravascular platelet activity. In the outcome, 18 year olds with high normal blood pressure showed high reactivity of the cardiovascular system, activated lipid peroxidation in the liquid part of blood and platelets, and increased intravascular platelet activity. As a result of regular physical training during the year in individuals who had a high normal blood pressure at the age of 18, normalization of blood pressure, body weight and intravascular platelet activity was noted. The continuation of physical activity has consolidated the achieved optimization of the indicators taken into account in youthful individuals with high normal blood pressure. The use of individually selected physical exertion in the observed young men for 12 months completely normalized their cardiovascular system reactivity, blood pressure level, lipid peroxidation and initially increased intravascular platelet activity, maintaining the achieved result while continuing training.

Keywords: blood pressure, physical exertion, intravascular platelet activity, adolescence, hemostasis.

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INTRODUCTION

The progress of modern medical science in developed countries has provided a significant improvement in the quality of medical care [1,2], however, the prevalence of arterial hypertension (AH) still tends to increase [3,4], manifesting already at a rather young age and adversely affecting the ability to work working population [5-7]. An important early predictor of this disease is high normal blood pressure [8]. Numerous studies have allowed to prove that hypertension causes platelet activation, which is the basis for the development of subsequent intravascular thrombosis [9,10]. At the same time, despite the high scientific and practical significance of the problem of thrombocytopeny formation in adolescents with high normal arterial pressure, threatening the occurrence of hypertension, intravascular platelet activity and approaches to its correction are not very well evaluated [11]. Previous studies have shown the dynamics of platelet activity in healthy people, people with overweight and patients with arterial hypertension against the background of the use of regular static and dynamic exercise. At the same time, the possibility of correcting the functional activity of platelets in adolescents with high normal blood pressure is not evaluated with their help.

Taking into account these circumstances, in this study, the goal was set: to find out the severity of the effect of measured physical activity on the intravascular activity of platelets in adolescents with high normal arterial pressure.

MATERIAL AND METHODS

The research was approved by the Ethics Committee of Russian State Social University (record №5 from 12.05.2014).

There was no conflict of interest in this work. The study was performed on 34 people of 18 years of age with high normal blood pressure. Those included in the study showed a hereditary predisposition to cardiovascular and metabolic diseases, including hypertension, abdominal obesity, metabolic syndrome and, in some cases, smoking. The control group consisted of 147 healthy people of adolescence, who do not have bad habits and hereditary burden, who regularly exercise physically as part of general physical training.

The study was performed in accordance with Good Clinical Practice standards and the principles of the Helsinki Declaration. The study protocol was approved by the Ethics Committees of all participating clinical centers. Prior to inclusion in the study, all participants received written informed consent. In all the observed individuals, the functional reactivity of the cardiovascular system was evaluated. According to the value of its increment against the background of psycho-emotional load, the type of reactivity of the cardiovascular system was assessed: when the value of the functional reactivity index was more than 20 standard units. reactivity was considered hyperfunctional, with the value of the functional reactivity index less than 10 conventional units the response to the load was assessed as hypofunctional, with values of the functional reactivity index from 10 to 20 used units type of functional reactivity was considered normal.

The subjects recorded the plasma lipid peroxidation (LPO) intensity according to the content of thiobarbituric acid-active products with the Agat-Med kit, the antioxidant potential of the liquid part of blood, the activity of intraplatelet lipid peroxidation by the concentration of malondialdehyde (MDA) in the recovery of thiobarbituric acid. The number of platelets in the capillary blood in the Goryaev chamber was counted. Intravascular platelet activity was determined visually using a phase contrast microscope. Everyone taken under the supervision of a youth of high age with high normal blood pressure was recommended regular regular physical training, including morning hygienic gymnastics, therapeutic and preventive gymnastics and fractional exercise during the day. An assessment was made of the indicators taken into account in the outcome and their dynamics after 1 (19 years), 2 (20 years) and 4 (22 years) years of regular physical activity, as well as after another 3 years (25 years) with their irregular implementation. Statistical processing of the results obtained was carried out using Student's t-test.

RESEARCH RESULTS

In boys with a high normal blood pressure in the initial state, the systolic blood pressure was 138.4 ± 2.16 mm. Hg Art., diastolic - 88.9 ± 2.01 mm. Hg Art., heart rate - 88.4 ± 2.69 beats per 1 min. The increment of the functional reactivity index at the load was 30.1 ± 2.60 used units, which was regarded as a

manifestation of hyperfunction of the cardiovascular system. After 12 months of correction in those included in the study with high normal blood pressure, the systolic blood pressure steadily decreased to 130.2 ± 2.74 mm. Hg Art., diastolic - up to 85.2 ± 1.25 mm. Hg Art., heart rate decreased to 84.0 ± 1.93 beats per 1 min. When the load was fulfilled, a decrease in the increments of the functional reactivity index to 11.5 ± 2.24 standard units was observed, which indicated a stable elimination of the hyperfunction of the cardiovascular system, an increase in its tolerance to psycho-emotional stress and the economization of cardiac activity.

In the outcome of the observed young men with high normal blood pressure there was a significant increase in plasma lipid peroxidation. Thus, the concentration of thiobarbituric acid-active products in their plasma was 3.46 ± 0.16 $\mu\text{mol/l}$, in the control - 3.21 ± 0.81 $\mu\text{mol/l}$ ($p < 0.05$). The level of MDA in platelets was also increased (0.64 ± 0.25 $\text{nmol}/10^9$ platelets), versus control (0.49 ± 0.16 $\text{nmol}/10^9$ platelets, $p < 0.01$). The activation of free-radical oxidation in them became possible due to the weakening of the antioxidant activity of their organism up to $32.2 \pm 0.20\%$ against $38.8 \pm 0.22\%$ in the control ($p < 0.01$).

The use of rationally dosed physical loads caused a normal normalization of plasma lipid peroxidation (3.23 ± 0.15 $\mu\text{mol/l}$) with an increase in its antioxidant activity in $36.9 \pm 0.16\%$ after a year of training in people with high normal blood pressure. Against the background of regular workouts, a decrease in the activity of lipid peroxidation in platelets was achieved in the observed ones - the basal MDA in them was 0.50 ± 0.17 $\text{nmol}/10^9$ platelets.

The content of platelets in the blood of the observed persons before and during physical exertion was within the normal range. The number of discocytes in the blood of 18 year olds with high normal blood pressure before exercise began was $79.2 \pm 0.16\%$, significantly increased by the age of 19 to $84.7 \pm 0.16\%$ and remained unchanged with continued training (at 22 years - $84.9 \pm 0.07\%$). The termination of regular morning gymnastics, treatment-and-prophylactic gymnastics and fractional exercise during the day did not affect this indicator in the examined 25 years of age ($84.6 \pm 0.07\%$). The number of disco-echinocytes, spherocytes, sphero-echinocytes and bipolar forms of platelets in their bloodstream decreased by 19 years, also remaining stable during regular training and after the transition to irregular exercises until the final age taken into account. As a result, the initially increased amount of active forms of platelets was optimized already after a year of regular classes, without undergoing significant changes in subsequent years and amounted to $15.4 \pm 0.17\%$ in 22 years.

Termination of regular physical activities with the transition to irregular workouts maintained over the next 3 years the amount of the active forms of platelets at the same level as for adolescence (25 years old - $15.4 \pm 0.17\%$). In the bloodstream of people with high normal blood pressure, regularly experiencing physical exertion at the age of 18-22, the levels of freely circulating small and large platelet aggregates by the age of 19 decreased to optimal values: 2.9 ± 0.10 and 0.07 ± 0.011 per 100 free-standing platelets, remaining at this level throughout the entire youthful age (at 22 years old 2.9 ± 0.05 and 0.06 ± 0.003 per 100 free-lying platelets). The termination of regular physical activities with the transition to irregular workouts did not affect their level until the end of observation. The number of platelets involved in the process of aggregation in individuals with high normal blood pressure, regularly experiencing physical exertion, decreased during the year of observation to normal values, not experiencing further significant fluctuations and at 19 years of age $6.0 \pm 0.10\%$ and $5.7 \pm 0.07\%$ at 22 years. When switching to irregular physical training, this indicator in the observables remained at the level similar to that of youth (25 years old - $5.8 \pm 0.05\%$).

DISCUSSION

Currently, young men are increasingly spreading high normal blood pressure, which subsequently can lead to the formation of hypertension in them [12,13]. It becomes clear that high normal blood pressure is accompanied by the development of platelet dysfunctions, which impede the blood rheology, the occurrence of hypoxia and metabolic disorders in tissues [14], further worsening the state of health and creating the threat of thrombosis [15,16]. At the same time, it is known that timely corrective action on the body, including through the use of physical exertion, is able to remove platelets from hypersensitive status, causing a decrease in their activity [17,18]. However, until now, the selection of means and methods for the correction of overweight, high blood pressure and their combination in adolescents does not sufficiently take into account the possibility of long-term regular physical training in terms of their positive effect on platelet hemostasis dysfunctions in order to resist normalization [19-25].

The possible dynamics of platelet functions in adolescents with high normal blood pressure under the influence of general physical training sessions, including regular training from 18 years of age with switching to irregular after 22 years of age, remained unclear. This emphasized the unresolved problem of the influence of ordered muscle activity on the functional activity of platelets in preclinical conditions, which could not satisfy modern cardiology [26].

It was established that regular dosed physical exertion in adolescents among people who had high normal blood pressure at the age of 18 was able to normalize hemodynamics and metabolic processes, reducing the stimulation of platelets from the outside.

With regular physical training in adolescents with high normal blood pressure, it is possible to achieve a stable normalization of blood pressure, proving the possibility of a pronounced positive effect of physical training on sympathetic tone and metabolism. At the same time, all observed individuals with high normal blood pressure showed a stable suppression of lipid peroxidation in plasma, which manifested itself maximum physical activity for the year and persisting not only until the end of regular training (22 years), but also until the end of observation, that is, background irregular physical activity between 22 and 25 years. Probably, this is largely due to the stable enhancement of plasma antioxidant activity during the oxidase depression that develops during exercise. Reducing the formation of MDA by platelets in physically trained people suggests that they have a stable normalization of arachidonate metabolism in the blood plates with the optimization of thromboxane formation during the year of training [27,28].

The basis of all the positive effects of regular training on platelet hemostasis in vivo in 18 year olds with deviations from homeostasis is a stable normalization of hemodynamics, cardiovascular reactivity, optimization of humoral influences and achieving a balance between catabolism and anabolism in adipose tissue [29]. Receptor rearrangements of the membranes of the blood platelets lead to a decrease in the number of activated platelets and their aggregates of all sizes freely moving along the bloodstream [30]. This contributes to the reduction of damage to their endothelium, leveling the expression of subendothelial structures and their contact with blood, reducing the severity of intravascular platelet activity. At the same time, a decrease in the intravascular activity of platelets facilitates microcirculation, including in vasa vasorum, reducing the risk of atherogenesis at an older age [31].

In the mechanisms of lowering the functional activity of platelets against the background of regular physical exertion, an important place should be given to lowering the effect on the blood plates of decreasing levels of catecholamines, glucocorticoid and thyroid hormones [32-34]. The weakening of their joint action on the functional activity of platelets largely contributes to the return of indicators of their adhesion and aggregation to the level of the physiological norm [35]. In addition, dosed hypoxia has a significant positive effect on the state of platelet hemostasis, which regulates lipid peroxidation in platelet membranes, thereby normalizing the level of intravascular platelet activity in the process of adaptation to regular feasible exercise [36].

The severity of the correction of intravascular platelet activity through regular training in general physical training suggests its use is preferable in people who have had high normal blood pressure at age 18, in order to reduce the risk of microthrombosis [37,38]. In the absence of a direct disaggregating action, dosed physical training reduces the intravascular platelet activity through stabilization of hemodynamics, cardiovascular reactivity, and weakening of body overdose with optimization of microcirculation [39,40].

Considering the preservation of the positive effects of regular physical activity on platelet hemostasis in observed individuals who have had high normal blood pressure at 18 years of age, after their transition to irregular exercise from the age of 22, there is reason to widely recommend adherence to regular physical activity during adolescence.

CONCLUSION

In 18 year olds with high normal arterial pressure, a high reactivity of the cardiovascular system, activated lipid peroxidation in the liquid part of blood and blood platelets, and increased intravascular platelet activity are detected. As a result of regular physical training throughout the year, individuals who had high normal blood pressure at the age of 18 have normalized blood pressure, body weight, and intravascular

platelet activity. The continuation of physical activity fixes the achieved optimization of the considered parameters in adolescents with high normal blood pressure, helping to reduce their risk of hypertension and prevent the possible increase in the future of intravascular platelet activity.

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