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Functional Features Of Intravascular Platelet Activity In Adolescents With High Normal Blood Pressure, Overweight Or A Combination Of Them Against The Background Of Regular Physical Exertion.

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ABSTRACT

In developed countries, the prevalence of metabolic syndrome and its main elements - arterial hypertension and abdominal obesity tend to increase and manetheest at a young age. Among the early predictors of these diseases are high normal blood pressure, overweight, and their combination. Numerous studies have allowed to prove that arterial hypertension, abdominal obesity and metabolic syndrome cause activation of platelets, which is the basis for the development of subsequent intravascular thrombosis. However, despite the high scientific and practical significance of the problem of thrombocytopathy formation in adolescents with high normal blood pressure and / or overweight, threatened by the onset of arterial hypertension, abdominal obesity or metabolic syndrome, intravascular platelet activity and approaches to its correction identified very insufficiently. The study included 95 people of 18 years of age with high normal blood pressure and / or overweight. All surveyed were prescribed regular dosed physical training according to the scheme developed by the authors. The use of individually selected physical exertion in patients with high normal blood pressure and / or overweight normalizes their cardiovascular reactivity, body weight, blood pressure and lipid peroxidation. The use of rational physical exertion for 12 months fully optimizes the increased intravascular activity of platelets, fixing the achieved results with continued training. The continuation of physical activity fixes the achieved optimization of the indicators taken into account in adolescents with high normal blood pressure and / or overweight, reducing their risk of arterial hypertension, abdominal obesity and metabolic syndrome and prevents the possible increase in intravascular platelet activity in the future.

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

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INTRODUCTION

Despite the success of modern medical science in developed countries, the prevalence of metabolic syndrome (MS) [1,2] and its main elements - arterial hypertension (AH) [3,4] and abdominal obesity (AO) [5,6] tend to increase , manifesting already at a fairly young age and adversely affecting the working ability of the working population [7,8]. Early predictors of these diseases include high normal blood pressure [9], overweight [10], and a combination thereof [11]. Numerous studies have allowed us to prove that hypertension, AO and MS cause platelet activation, which is the basis for the development of subsequent intravascular thrombosis [13,14]. However, despite the high scientific and practical significance of the problem of thrombocytopathy formation in adolescents with high normal arterial pressure and / or overweight, threatened by the occurrence of hypertension, AO or MS, the intravascular activity of platelets and approaches to its correction are not well defined. In previous studies on the correction of manifestations of thrombocytopathy in arterial hypertension and varying severity of overweight, a sufficiently high efficiency of regular static and dynamic exercise has been shown [15,16]. However, the possibility of using them for the functional activity of platelets in adolescents with high normal blood pressure and overweight and their combination remains insufficiently evaluated.

Taking into account these gaps in the system of scientific knowledge, the goal of the present study was set: to determine the effect of measured physical activity on the severity of intravascular platelet activity in adolescents with high normal arterial pressure and / or overweight.

MATERIAL AND METHODS

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

The study included 95 people 18 years of age with high normal blood pressure and / or overweight (34 people with high normal blood pressure, 34 people with overweight and 27 people with a combination of high normal blood pressure and overweight). Those included in the study had a hereditary predisposition to cardiovascular and metabolic diseases, including hypertension, AO, MS 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.

In all the observed, a number of anthropometric indices were determined: body mass, body mass index, waist circumference, hip circumference with the calculation of the waist circumference / hip circumference ratio. In all the observed individuals, the functional reactivity of the cardiovascular system was evaluated. The type of reactivity of the cardiovascular system was assessed by the magnitude of its increment against the background of psycho-emotional load; with a value of the functional reactivity index of more than 20 conventional units, the reactivity was considered hyperfunctional, with the value of the functional reactivity index less than 10 used units. the response to the load was assessed as hypofunctional, with the values of the functional reactivity index from 10 to 20 conventional units, the type of functional reactivity was considered normal. The subjects recorded the plasma lipid peroxidation intensity according to the content of thiobarbituric acid-active products with the Agat-Med kit, the antioxidant potential of the liquid part of blood, and intraplatelet lipid peroxidation according to the concentration of basal 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. All adolescents under high observation with high normal blood pressure and / or overweight were recommended to do regular regular physical exercises, including morning hygienic gymnastics, therapeutic and preventive gymnastics and fractional exercise during the day. The initial assessment of the indicators taken into account and their dynamics were made 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.

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RESEARCH RESULTS

In the observed individuals with 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 conventional units, which was regarded as a manifestation of hyperfunction of the cardiovascular system. In the study with overweight, before the test with psychoemotional stress, the systolic and diastolic blood pressure was 128.6±2.20 mm. Hg st. and 84.2±1.54 mm. Hg Art., respectively. At the same time, the increment of the functional reactivity index at the load was 31.7±1.49 conditional units, indicating an excessively high functional activity of the cardiovascular system of this cohort examined. When included in the study in individuals with high normal blood pressure and overweight, systolic blood pressure reached 137.6±1.84 mm. Hg Art., diastolic - 89.0±1.96 mm. Hg Art., heart rate - 90.1±2.12 beats in 1 min The increment of the functional reactivity index on the load was 40.7±1.46 used units, which indicated the presence of a marked hyperfunction of the cardiovascular system in the examined.

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 executing the load, a decrease in the increments of the functional reactivity index to 11.5 ± 2.24 conventional 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. Regular training in obese individuals led to 19 years of age to a stable normalization of the functional reactivity of the cardiovascular system, which was due to the normal increment of the functional reactivity of the cardiovascular system (17.2±1.91 conventional units). As a result of 12 months of correction in patients with high normal blood pressure and overweight, systolic blood pressure dropped to 131.3 ± 1.92 mm. Hg Art., diastolic - up to 84.6 ± 2.07 mm. Hg Art., heart rate up to 82.0 ± 1.38 beats per 1 min. When performing the load, a decrease in the increment of the values of the functional reactivity index by 20.1±1.16 standard units was observed, which indicated the elimination of the pronounced hyperfunction of the cardiovascular system. At the same time, the complete stable normalization of reactivity in their cardiovascular system was achieved only after 2 years of training (the increment value of the functional reactivity index reached 16.4±2.07 conventional units), which lasts until the end of observation.

For those with overweight, the body weight was 84.1±0.17 kg, the body mass index was 29.5±0.15 kg/m^2 with a waist size / hip volume of 1.05±0.015, respectively. After 1 year of regular dosed physical training, their body weight steadily decreased to 71.2±0.17 kg, with a decrease in body mass index to 24.9±0.11 kg/m^2 and waist volume/hips to 0.96± 0.09. In the initial state in individuals with high normal blood pressure and overweight, the body weight averaged 82.9±0.15 kg, body mass index 29.8±0.11 kg/m^2 with a ratio of waist volume / hip volume 1.06±0,006. At the same time, those who had a high normal arterial pressure and overweight at the age of 18, after a year of training, these indicators steadily decreased to 72.4±0.11 kg, 26.0±0.06 kg/m^2 and 0.85±0.006, respectively.

A significant increase in plasma lipid peroxidation was observed in the observed individuals with high normal blood pressure in the outcome. Thus, the concentration of thiobarbituric acid-active products in their plasma was 3.46±0.16 µmol/l, in the control - 3.21±0.81 µmol/l ($p<0.05$). The level of MDA in platelets was also increased (0.64 ± 0.25 nmol/10^9 platelets), in the control - 0.49±0.16 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±0.20% against 38.8±0.22% in the control ($p<0.01$). In the group of overweight people in the outcome, the concentration of thiobarbituric acid-active products in plasma was 3.38±0.12 µmol/l with an MDA level in platelets of 0.60±0.17 nmol/10^9 platelets and the level of antioxidant activity of their body 34.0±0.15%. In individuals who had a combination of high normal blood pressure and overweight, a significantly more pronounced increase in plasma thiobarbituric acid-active products (3.61±0.19 µmol/l) and the concentration of MDA in platelets (0.69±0.09 nmol/10^9 platelets) against the background of a more significant weakening of the antioxidant activity of their body (30.6±0.12%).

Appointment to persons with high normal blood pressure rationally dosed physical exertion after a year of workouts consistently normalized plasma lipid peroxidation (3.23±0.15 µmol/l) with an increase in its

antioxidant activity of 36.9±0.16%. Against the background of regular training, the observed activity showed a decrease in the activity of lipid peroxidation in platelets - the basal MDA in them was 0.50±0.17 nmol/10^9 platelets. In the group of overweight people, physical exercise after a year of training normalized plasma lipid peroxidation (3.24±0.12 µmol/l) as a result of a steady increase in its antioxidant activity (38.2±0.09%) until the end of observation. This was combined with a decrease in the intensity of lipid peroxidation in their platelets (0.50±0.21 nmol/10^9 platelets). In the group of individuals with high normal blood pressure and overweight, as a result of a year of regular physical training, stable normalization of plasma lipid peroxidation and platelet oxidation was achieved: thiobarbituric acid-active plasma products 3.32±0.10 µmol/l, plasma antioxidant activity 37.8±0.17%, MDA of platelets 0.50±0.12 nmol/10^9 platelets.

The content of platelets in the blood of individuals who made up all three groups of observables was within the normal range before and during physical exertion. The level of discocytes in the blood of 18-year-olds with high normal blood pressure before exercise began was 79.2 ± 0.16%, significantly increased by the age of 19 to 84.7 ± 0.16% and remaining unchanged with continued training (at 22 years - 84.9 ± 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 ± 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 ± 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±0.17s). 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 ± 0.10% and 5.7±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±0.05%).

In the blood of 18 year olds with overweight before the onset of physical exertion, the level of discocytes was 79.6 ± 0.20%, significantly increased by the age of 19 to 84.9±0.12% and remained unchanged as the chronological age of the observed (at 22 years old - 84.9±0.16%). The termination of regular physical activities and the transition to irregular workouts did not affect this indicator at the most senior age (in 25 year olds - 84.3±0.16%). The number of active forms of platelets in the bloodstream of the examined decreased by 19 years old, also remaining stable during the period of regular training and after switching to irregularly performing morning exercises, treatment-and-prophylactic exercises and fractional exercise during the day before the final age to be considered. The transition to irregular physical exertion did not affect the number of active forms of platelets over the next 3 years (in 25 years - 15.5±0.05 s). In the bloodstream of overweight people experiencing from 18 to 22 years old regular exercise, the levels of freely circulating small and large platelet aggregates by the age of 19 have decreased to optimum values (3.0 ± 0.11 and 0.08 ± 0.005 per 100 free-lying platelets), remaining unchanged during the entire adolescence (at 22 years old 2.8 ± 0.10 and 0.06 ± 0.004 per 100 free-lying platelets). The transition to irregular loads did not affect their level until the beginning of the mature first age was taken into account. The number of platelets involved in the aggregation of persons who were overweight at the age of 18, during physical exertion, steadily decreased over the year of their implementation and did not change subsequently (at 19, 5.9 ± 0.12% and 5.6 ± 0.06% at 22 years old). In those who stopped regular physical training and switched to irregular ones, this indicator remained at a level comparable to that in adolescence (in 25-year-olds - 5.8 ± 0.06%).

The content of discocytes in the blood of 18 year olds with a combination of high normal blood pressure and overweight prior to the start of physical training was 78.1±0.20%, significantly increasing by the age of 19 to 84.5±0.19% and remaining unchanged at continuation of training (at 22 years old - 85.0±0.10%).

The refusal of regular physical exertion and the transition to irregular classes did not affect this indicator in the examined after 22 years (25 years - 84.8±0.06%). Initially, the increased amount of active forms of platelets after a year of regular training also returned to normal, without undergoing significant changes in the following and making up at 22 years old 15.0±0.10%. The transition to irregular workouts did not affect the number of active forms of platelets in their bloodstream over the next 3 years (at 25 years old - 15.2±0.07 s). At the same time, in the blood of this category of observables on the background of regular physical training in 18-22 years, the levels of freely circulating small and large platelet aggregates decreased already by the age of 19 to the optimum values: 2.9 ± 0.17 and 0.08 ± 0.010 per 100 free-standing platelets, remaining at this level during the entire youthful age (at 22 years old 2.9±0.07 and 0.06±0.004 per 100 free-lying platelets). Refusal from regular physical activities with the transition to their irregular performance did not affect their level at the beginning of I mature age. The level of platelet involvement in the process of aggregation, among people who had high normal blood pressure and overweight at the age of 18, on the background of regular training, significantly decreased after a year of their performance (at 19 years old 5.9±0.12% and 5.8±0.05% at 22 years old), without changing after the termination of regular physical activities (at 25 years old - 5.9±0.03%).

DISCUSSION

Under the conditions of modernity, overweight, high normal arterial pressure and their combination are spreading among young people, which later can lead to the formation of a number of socially significant diseases [17-20], including hypertension and MS [21-25]. It becomes clear that overweight, high normal arterial pressure and their combination are accompanied by the development of platelet dysfunctions causing difficulty in blood rheology, the occurrence of hypoxia and metabolic disorders in tissues, worsening subsequent health and creating thrombosis [26,27]. At the same time, it is known that timely corrective action on the body, including through the use of physical exertion [28,29], is able to remove platelets from a hypersensitive status [30], causing a decrease in their activity [31]. 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 prolonged regular physical training in terms of their positive effect on platelet hemostasis dysfunctions in order to resist normalization [32, 33].

The lack of clarity of possible platelet function in adolescents with deviations from homeostasis under the program of general physical training, including regular classes from 18 years of age with the transition to irregular training after 22 years of age, emphasizes the unresolved problem of the effect of ordered muscle activity on platelet functional activity in preclinical conditions that can not satisfy modern cardiology [34].

The authors found that regular dosed physical exertion in adolescence in persons who had high normal blood pressure and / or overweight in 18 years of age, can ensure the normalization of hemodynamics and metabolic processes, reducing the stimulation of platelets from the outside.

It was found that with regular physical training in adolescents with high normal blood pressure and / or overweight it is possible to achieve a stable normalization of blood pressure and decrease to normal body weight, proving the possibility of pronounced positive effect of physical training on sympathetic tone and metabolism [35 , 36]. At the same time, all observed people with high normal arterial pressure and / or overweight had stable suppression of POL in blood 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 against the background of irregular physical exertion between 22 and 25 years. Probably, this is largely due to the stable increase in plasma antioxidant activity during the NADPH/NADH 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 optimization of thromboxane formation during the year of training [37].

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 [38]. Receptor rearrangements of blood plate membranes lead to a decrease in the number of activated platelets and their aggregates of all sizes freely moving along the bloodstream [39]. This contributes to the reduction of damage to their endothelium, leveling the expression of subendothelial structures and their contact with the blood, reducing the severity of intravascular platelet activity [40]. At the same time, the

reduction of intravascular platelet activity provides relief of microcirculation, including in vasa vasorum, reducing the risk of atherogenesis at an older age.

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 [36]. 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. In addition, a significant positive effect on the state of platelet hemostasis has metered hypoxia that regulates the processes of lipid peroxidation in the membranes of platelets, thereby normalizing the level of intravascular platelet activity in the process of adaptation to the action of regular feasible exercise.

The degree of correction of intravascular platelet activity through regular training in general physical training suggests that its use is preferable in people who at 18 have high normal blood pressure and / or overweight, in order to reduce the risk of microthrombosis. In the absence of a direct disaggregating action, dosed physical training reduces the intravascular activity of platelets by stabilizing hemodynamics, cardiovascular reactivity, enhancing lipid catabolism in their depot, and weakening overdose in the body with microcirculation optimization.

Considering the continued positive effects of regular physical activity on platelet hemostasis in observed individuals who at 18 had high normal blood pressure and / or overweight, after their transition to irregular exercise from the age of 22, there is reason to widely recommend that regular physical exercise be observed adolescence.

CONCLUSION

For 18 year olds with high normal blood pressure and / or overweight, high reactivity of the cardiovascular system, activated LPO in the liquid part of blood and blood platelets and increased intravascular platelet activity are characteristic. As a result of regular physical training throughout the year, individuals who have had high normal blood pressure and / or overweight at the age of 18 have normalized their 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 and / or overweight, reducing their risk of forming hypertension, AO, and MS and preventing the possible increase in the future of intravascular platelet activity.

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