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Research Article

Physiological response of platelet activity in adolescents who are overweight to regular metered exercise

Savchenko A.P., Medvedev I.N.,
Belozerova TB and Agronina N.I.
Kursk State University,
Kursk, Russia

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ABSTRACT

Objective: To assess the correctional potential of dosed athletic loads in relation to increased platelet activity in overweight people in adolescents.

Material and methods: Under observation were 34 people over 18 years of age with overweight, including 18 males and 16 females with hereditary burdens of abdominal obesity and metabolic syndrome (two or more close relatives suffered from this pathology). The control group consisted of 147 people of adolescence of both sexes, without bad habits and hereditary burdens, who regularly undergo physical exertion in the general physical training section. Usedbiochemical, hematologicalandstatisticalresearchmethods.

Results: In recent years, overweight is becoming increasingly common among today's young people, the prevalence of which is increasing. The danger of this condition is associated with the risk of its transition to obesity and the possibility of platelet activation with increased platelet aggregation in the blood. The breadth of prevalence in modern society among young people and the risk of forming the basis of vascular disorders has long dictated the urgent need to develop options for the correction of overweight with normalization of platelet activity. The use of individually selected physical exertion in overweight people with hereditary predisposition to metabolic syndrome was able to normalize their body weight for 12 months, increased lipid peroxidation and bring the disturbed platelet hemostasis to normal. Further use of rational physical training has consolidated the achieved effect. The work clarified the possibility of transition of this category of patients to irregular physical activity after 4 years of training without prejudice to the achieved effect and without the risk of increasing the activity of platelet hemostasis.

Conclusion: Regular dosed exercise, started at 18 years of age in overweight individuals, is able to optimize body weight and reduce the activity of platelet aggregation to normal, which can serve as a basis for preventing the development of their subsequent obesity, metabolic syndrome and vascular disorders.

Keywords: Overweight, Exercise, Platelets, Adolescence, Heredity, Susceptibility to metabolic syndrome.

INTRODUCTION

The functional state of the body is under the control of complex regulatory systems.[1,2] Their functional activity can vary depending on many factors, the leading ones of which are age and state of health.[3] It is noted that the lower the age, the better the state of health.[4,5] At the same time, quite often at the beginning of ontogenesis, both in animals and in man, various dysfunctions can be registered[6,7], which violate the indices of homeostasis.[8,9] A very frequent cause of the violation of the optimum of the internal environment of the human body in modern society is excessive fat deposition in the body.[10]

It has been observed that in recent years, overweight is increasingly registered among today's young people, which tends to become obese.[11] The activation of platelets, noted with overweight, can further aggravate with the development of obesity and quickly lead to increased platelet aggregation in the formation of thrombophilia.[12] The wideness of the prevalence in developed countries among young people burdened with heredity in terms of the development of obesity dictates the need to search for the correction of overweight and the accompanying platelet dysfunctions. As a recovery with excessive fat deposition and impaired hemostasis, it is considered to be various options for non-drug exposure, including physical exercise.[13] At the same time, the possibilities of this variant of correction are not assessed in overweight people from adolescence in terms of attenuation of the excessive platelet activation often developing in them. In this regard, the aim of the work was to assess the correctional potential of metered athletics loads in relation to increased platelet activity in adolescents with overweight.

MATERIALS AND METHODS

This study was approved by the local ethics committee of the Kursk State University on May 14, 2015 (protocol №5).

Under observation were 34 people over 18 years of age with overweight, including 18 males and 16 females with hereditary burdens of abdominal obesity and metabolic syndrome (two or more close relatives suffered from this pathology). The control group consisted of 147 people of adolescence of both sexes, without bad habits and hereditary burdens, who regularly undergo physical exertion in the general physical training section.

The survey included the determination of the value of anthropometric indicators: body mass, body mass index, waist circumference, hip circumference with the calculation of the ratio of waist circumference to hip circumference. In the work, we determined the value of the functional reactivity index of the cardiovascular system by the traditional method.[14] According to the value of its increment against the background of psycho-emotional load, the type of reactivity of the cardiovascular system was evaluated: 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 of less than 10 conventional units the response to the load was assessed as hypofunctional, and with the value of the functional reactivity index from 10 to 20 used units. type of functional reactivity was considered normal. The activity of plasma lipid peroxidation (LPO) by determining the content of thiobarbituric acid-active products in it using the Agat-Med kit, taking into account the level of antioxidant potential of the liquid part of blood.[15] Intra thrombotic POL was assessed by the content of malonicdialdehyde in platelets in the reduction reaction with thiobarbituric acid.[15] The number of platelets in capillary blood in the Goryaev chamber was counted. Platelet aggregation (AP) activity was assessed by a visual micromethod, using as inducers ADP (0.5×10^{-4} M), collagen (1:2 dilution of the main suspension), ristomycin (0.8 mg/ml), thrombin (0.125 units/ml), adrenaline (5×10^{-6} M) and hydrogen peroxide (7.3×10^{-3} M).[16] All 34 young overweight young men under observation were given regular dosed physical exercises, including morning hygienic gymnastics, therapeutic and preventive gymnastics and physical exercises distributed throughout the day.[3] The study conducted an initial assessment of all indicators taken into account and their registration after 1.2 and 4 years of regular physical activity, as well as three years after the transition to irregular training (at the age of 25 years). Statistical processing of the obtained results was carried out using Student's t-test.

RESULTS

In the initial state, the average body weight of the examined was 84.1±0.17 kg, with a body mass index of 29.5±0.15 kg/m^2 and a ratio of waist circumference to hip circumference of 1.05±0.015.

After 1 year of regular dosed physical training for young men who were overweight at age 18, their body weight decreased to 71.2±0.17 kg, with a decrease in their body mass index to 24.9±0.11 kg/m^2 and a decrease the ratio of waist circumference to hip circumference to 0.96±0.09. Subsequent observations showed the stability of the achieved levels of these indicators.

A significant increase in the level of POL in plasma was observed in the result of the study of overweight young men in the outcome. Thus, the concentration of thiobarbituric acid-active products in their plasma was 3.38±0.12 μmol/l, in the control - 3.21±0.81 μmol/l ($p<0.05$). The level of malonicdialdehydein platelets, they also turned out to be increased to 0.60±0.17 nmol/10^9 platelets with its level in the control - 0.49±0.16 nmol/10^9 platelets ($p<0.01$). Activation of free-radical oxidation in the examined people with overweight became possible due to the weakening of the antioxidant activity of their body to 34.0±0.15% against 38.8±0.22% in control ($p<0.01$).

The use of overweight people in adolescents rationally dosed physical exertion after a year of training was accompanied by the normalization of LPO in their plasma and platelets. Thus, in their plasma, the content of thiobarbituric acid-active products by this time was 3.24±0.12 μmol/l, while its antioxidant activity was enhanced to 38.2±0.09%. Against the background of regular training in people of youthful age, there was a decrease in the activity of POL in platelets - malonicdialdehyde during these periods of observation was 0.50±0.21 nmol/10^9 platelets.

All further observations showed the stability of the achieved level of these indicators.The number of platelets in the blood of observable people with overweight before and against the background of the correction was within the normal range. The acceleration of AP was found in the youth of the study before the beginning of the training. Its most pronounced increase was noted under the influence of collagen - by 14.9% compared with the control. Somewhat slower AP developed in overweight individuals under the influence of ADP and ristomycin. They were also accelerated compared with the control by 12.9% and 9.6%, respectively. AP in response to H_2O_2 in the group of persons with overweight came 9.9% earlier than in the control. Thrombin and adrenaline antibodies also developed faster than in control by 11.7% and 11.9%, respectively (table).

Regular physical activity contributed to having overweight at the age of 18 years, contributed to an increase in AT time under the influence of all the inductors tested. Already on the background of 12 months of training, platelet aggregation in them returned to normal. The most active inducer of AP in them was still collagen. ADP, ristomycin and H_2O_2 were somewhat less active. More recently, AP developed ($p<0.01$) under the influence of thrombin and adrenaline.

Continued observation of people who were overweight at the age of 18, against the background of regular physical training for three years, and also against the background of three years of irregular physical training did not reveal the negative dynamics of all previously normalized functional and laboratory parameters. All of them remained at the optimum level until the end of the observation.

DISCUSSION

It is known that regular dosed physical training even with severe obesity can improve metabolism, lowering body weight and stimulating the body's hidden reserves.[17]

In the study, as a result of the use of physical training in overweight people in adolescents, a decrease in body weight was noted, which reduced the risk of their subsequent obesity, primarily in the abdominal type, which is the most unfavorable in terms of metabolic and vascular disorders.[18]

The revealed initial enhancement of free-radical oxidation in plasma and platelets in people of adolescence who were overweight at age 18 turned out to be possible as a result of weakening the antioxidant system of their body. The increased formation of malondialdehyde in the platelets examined can be viewed as a marker of the onset of increased metabolism in their membrane phosphoinositols and increasing thromboxane formation.[19] Under the influence of a complex of physical training, these violations were eliminated by the end of the first year of observation. The decrease in the level of MDA in platelets in adolescent individuals who were overweight at age 18 indicated a decrease in the background of regular physical activity of the activity of arachidonate exchange enzymes in platelets[20] with the achievement of the physiological level of activity of formation of thromboxane in them.[21,22]

Inhibition of AP in persons who were overweight at the age of 18 against the background of the use of metered exercise in them indicates a positive effect on platelet hemostasis.[23,24] The achieved effects are due to the improvement of metabolic processes, weight loss due to a decrease in the fat content in the body and optimization of POL in plasma and platelets.[25] Lengthening the time of onset of AP under the influence of ristomycin in observable people of adolescence who had overweight at age 18, during training indicated a decrease in the content of von Willebrand factor in their blood.[26,27] The positive dynamics of antibodies in response to H_2O_2 spoke to them about the increase in the activity of the components of the antioxidation system in platelets [28], primarily their catalases and superoxide dismutase[29,30]. In other words, rational physical exertion in adolescents who were overweight at age 18 should preferably be applied immediately after the fact that their body weight is excessive is established. This is able to most effectively optimize their fat metabolism and platelet hemostasis during the year of training. Continuing the exercise regularly for the next 3 years, and then irregularly can reinforce the achieved optimization of body weight and the activity of platelet hemostasis in people who were over 18 years old. This helps reduce their risk of obesity and atherosclerosis of vessels of different localization at an older age.[31,32]

CONCLUSION

The use of dosed physical loads in people of adolescence with overweight normalizes it after a year, weakening the excess activity of lipid peroxidation and bringing the initially increased activity of platelet hemostasis to the normal level. The identified positive changes reach their maximum by the end of the year of study and provide effective prevention for people who are over 18 years old when they develop an increase in platelet hemostasis and thrombophilia.

Table: Platelet aggregation in adolescents who are overweight

Registered Indicators	Overweight boys, n=29, M±m					Control, n=147, M±m
	Original values	Regular physica ltraining			Termination of regular physical training	
	18years, n=29	19 years, n=29	20 years, n=29	22 years, n=29	25years, n=29	
Platelet aggregation with ADP, s	40.9±0.24	46.3±0.19 $p_1<0.05$	46.7±0.15 $p_1<0.05$	46.2±0.10 $p_1<0.05$	45.9±0.17	46.2±0.12 $p<0.05$
Platelet aggregation with collagen, s	30.1±0.17	35.0±0.15 $p_1<0.05$	34.8±0.12 $p_1<0.05$	33.8±0.10 $p_1<0.05$	33.4±0.14	34.6±0.17 $p<0.05$
Platelet aggregation with thrombin, s	51.2±0.09	57.1±0.12 $p_1<0.05$	56.8±0.11 $p_1<0.05$	57.6±0.17 $p_1<0.05$	56.8±0.14	57.2±0.16 $p<0.05$
Platelet aggregation with ristomycin, s	44.7±0.14	48.9±0.09 $p_1<0.05$	49.6±0.07 $p_1<0.05$	48.5±0.11 $p_1<0.05$	48.2±0.12	49.0±0.15 $p<0.05$
Platelet aggregation with H_2O_2, s	45.6±0.19	49.7±0.14 $p_1<0.05$	49.4±0.16 $p_1<0.05$	49.2±0.09 $p_1<0.05$	49.0±0.15	50.1±0.17 $p<0.05$
Platelet aggregation with adrenaline, s	90.1±0.12	102.9±0.08 $p_1<0.05$	100.6±0.07 $p_1<0.05$	101.7±0.15 $p_1<0.05$	100.9±0.11	103.4±0.19 $p<0.05$

Legend: p - reliability of differences of outcome and control,p_1 - the reliability of differences in outcome indicators and the results of the correction in different periods of observation.

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