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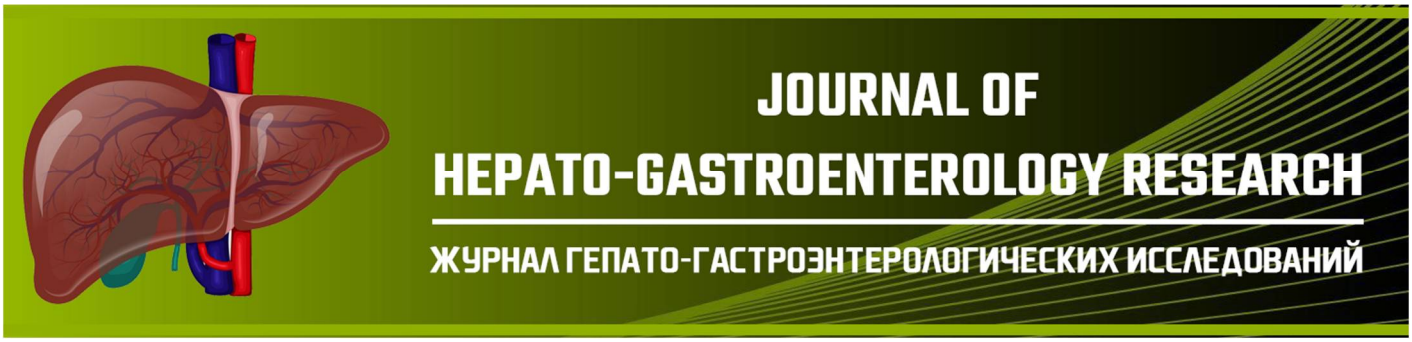

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INDICATORS OF THE ACTIVITY OF THE CARDIOVASCULAR SYSTEM IN CHILDREN AND ADOLESCENTS WITH EXCESS BODY WEIGHT AND OBESITY

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ANNOTATION
We examined 55 obese adolescents and children. It was revealed that the development of myocardial hypertrophy is influenced by child's body weight, blood pressure, vasoconstriction processes, as well as insulin resistance, hyperuricemia and atherogenic dyslipidemia. Some children have a metabolic syndrome, which requires therapy for this condition to prevent early complications and disability in adolescents in the adult period.
Key words: obesity, the cardiovascular system, arterial hypertension, left ventricular myocardial hypertrophy, adolescents, children.

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ПОКАЗАТЕЛИ ДЕЯТЕЛЬНОСТИ СЕРДЕЧНО-СОСУДИСТОЙ СИСТЕМЫ У ДЕТЕЙ И ПОДРОСТКОВ С ИЗБЫТКОМ МАССЫ ТЕЛА И ОЖИРЕНИЕМ

АННОТАЦИЯ
Обследовано 55 подростков и детей с избыточным массам тела и ожирением. Выявлено, что на развитие гипертрофии миокарда влияют масса тела ребенка, уровень АД, процессы вазоконстрикции, а также инсулинорезистентность, гиперурикемия и атерогенная дислипидемия. У части детей выявлен метаболический синдром, что требует терапии данного состояния для предотвращения ранних осложнений и инвалидизации подростков во взрослом периоде.
Ключевые слова: ожирение, сердечно сосудистая система, артериальная гипертензия, гипертрофия миокарда левого желудочка, подростки, дети.

Relevance. Currently, the main risk factors contributing to the development of cardiovascular disease in adults are arterial hypertension (AH) and abdominal obesity. At the same time, it is known that the risk of developing cardiovascular pathology is formed during childhood, therefore, an increase in overweight and obese children and adolescents is a factor in increasing the level of cardiovascular pathology and complications in adulthood [1]. This circumstance contributes to the need to recognize and correct the revealed violations of the earliest signs of pathology of the heart and blood vessels that arise in obesity and arterial hypertension [2, 4]. These circumstances contributed to the study and definition of the role of obesity and arterial hypertension in the development of myocardial remodeling. Thus, according to the authors, the formation of eccentric LVH occurs earlier in children with borderline arterial hypertension and obesity [3, 5,6].

Purpose. Determination of the impact of some risk factors in the development of myocardial remodeling and left ventricular myocardial hypertrophy in obese children.

Materials and research methods. The main group of the study consisted of 55 children and adolescents aged 9 to 17 years with exogenous constitutional obesity. The selection criterion for patients was the determination of BMI and waist volume in children and adolescents with identified overweight and / or obesity, which was above the 97th percentile for a certain age and gender (WHO, 2006).

The study included 27 girls (45%) and 33 (55%) boys, whose average age was 16.87 ± 0.19 years. The groups were divided based on the BMI score. Group 1 consisted of 22 overweight adolescents with grade 1 obesity (30.3 ± 1.2 kg / m2), group 2 consisted of 20 adolescents with BMI of 33.4 ± 1.1 kg / m2. Group 3 included 18 adolescents with a BMI of 36.1 ± 1.4 kg / m2. The control group consisted of 20 healthy adolescents of the same age with a BMI of 22.5 ± 0.9 kg / m2. The study was carried out by means of a general clinical standard examination.

Body weight was assessed using percentile tables of the ratio of linear height to body weight or body mass index (Quetelet index) for a specific age and gender (WHO, 1998). The volume of the waist (OT) and hips (OB) was determined, the ratio of which is an indicator of abdominal obesity. With OT / OB values> 0.85 in girls and> 0.9 in boys, their condition was regarded as abdominal obesity (IDF, 1997).

Arterial hypertension was diagnosed in accordance with the criteria developed by the Committee of Experts of the All-Russian Scientific Society of Cardiology and the Association of Pediatric Cardiologists of Russia (Moscow, 2009) [5]. Morphometric parameters of the myocardium (myocardial mass - LVMM, myocardial mass index - LVMI, thickness of the interventricular septum - TMV, thickness of the posterior wall of the left ventricle - LVDV) were assessed by ultrasound echocardiography using an Aloka Alpha 7 ultrasound scanner with a cardiological package. The laboratory study included the determination of the level of cholesterol, high density lipoproteins and triglycerides in the blood serum using a biochemical analyzer.

Serum insulin levels were determined by enzyme immunoassay. Insulin resistance was assessed using the HOMAR index, which reflects the ratio of glucose (in mg / dl) and insulin (in μIU / ml).

The criterion for the presence of IR was considered the value of the index above 2.7 conventional units.

Research results and discussion. First of all, according to the purpose of the work, we determined the relationship between the degree of BMI and the level of systolic and diastolic pressure in adolescents.

The results of the work showed that the level of systolic and diastolic blood pressure for all time intervals was significantly higher in adolescents of group 3 (135.2 ± 9.1 mm Hg, p <0.05 and p <0.05) compared with values of adolescents with obesity of 1 and 2 degrees (116.1 ± 7.2 and 123.2 ± 6.7 mm Hg). At the same time, a direct correlation was revealed between BMI and systolic pressure, diastolic pressure and average blood pressure per day (r = 0.601; r = 589 and r = 0.603, respectively, p <0.01 for all indicators).

It should be noted that according to the results of a study of blood pressure among adolescents with overweight and obesity, “white coat hypertension” was revealed in 22.9% of cases, labile hypertension in 16.3%, and stable hypertension in 13.1%. At the same time, the stable form was reliably more often detected in obesity of the 3rd degree (6.5%) in comparison with obesity of the 1st degree and obesity of the 2nd degree (4.5%).

An echocardiographic study showed that in obesity in combination with arterial hypertension, a structural and geometric restructuring of the left ventricular myocardium occurs.

This primarily increases the wall thickness. We found a statistically significant relationship between BMI and the thickness of the posterior wall of the left ventricle (r = 0.588; p <0.01), as well as the thickness of the interventricular septum (r = 0.501; p <0.05).

It should be noted that hypertrophy of the walls of the left ventricle is formed initially as an adaptive response of the myocardium to pressure load and ensures that the contractile function of the left ventricle corresponds to the increased load. The main indicators characterizing left ventricular myocardial hypertrophy are myocardial mass and left ventricular myocardial mass index.

Our data showed that the incidence of left ventricular hypertrophy was 40.9% in group 1, 50% in group 2, and 61.1% in group 3. At the same time, when analyzing the mass index of the left ventricular myocardium, depending on the variant of arterial hypertension, no significant differences were found. With white coat hypertension - 35.7 ± 3.4 g / m2.7, with labile hypertension - 35.9 ± 4.7 g / m2.7 and with stable - 36.4 ± 4.6 g / m2.7 ... This fact suggests that it is obesity that makes a significant contribution to the degree of increase in the mass of the left ventricle.

Reconstruction of the geometry of the left ventricle was found in almost 1/3 of adolescents with obesity, while in group 1 - in 30.4%, in group 2 - in 35.0% and in group 3 - in 33.3%. Eccentric left ventricular hypertrophy was diagnosed in 16.3% of patients, concentric remodeling - in 11.4%. It should be noted that concentric left ventricular hypertrophy is associated with the maximum risk of cardiovascular complications; in our studies, it occurred in 4.9% of cases and only in the group of adolescents with grade 3 obesity. Structural and geometric restructuring included changes in the geometry of not only the left ventricle, but also the left atrium. Thus, the difference in the mean values of the left atrium size was revealed between all observation groups (31.4 ± 1.2 mm; 31.8 ± 0.8 mm and 34.5 ± 1.4 mm in groups 1, 2, and 3, respectively) ... There was also a statistically significant correlation between the size of the left atrium and BMI (r = 0.608; p <0.01). Most likely, changes in the structure of the left atrium are the earliest stage of myocardial remodeling. The compensatory reaction of the cardiovascular system in response to obesity also affected central hemodynamics. Thus, the volume of circulating blood and the total peripheral vascular resistance changed. The minute volume of blood circulation gradually increased with the progression of obesity (5.5 ± 1.1 l / min., 5.8 ± 0.9 l / min. And 6.2 ± 1.1 l / min., Respectively, in 1, 2 and 3 groups), which indirectly indicates an increase in the volume of circulating blood. The increase in minute volume was accompanied by a decrease in total peripheral vascular resistance with increasing body weight (1318.8 ± 289.1 dynes / cm / s 5; 1299.9 ± 274.3 dynes / cm / s 5 and 1287.4 ± 284.1 dyne / cm / s 5 in groups 1, 2 and 3, respectively). Also, the total peripheral resistance depended on the type of arterial hypertension. So, with labile arterial hypertension, this indicator was 1287.8 ± 250.7 dynes / cm / s 5, and with stable arterial hypertension - 1325.6 ± 301.5 dynes / cm / s 5, which characterized the depletion of the adaptive capabilities of the organism and the growth of the total peripheral vascular resistance. It was also of interest to us to study the state of lipid and carbohydrate metabolism, in violation of which the risk of atherogenic changes in the vascular wall sharply increases.

To determine the type of carbohydrate metabolism disorder, a glucose tolerance test was performed, which revealed violations in 22.9% of adolescents, mainly in groups 2 and 3 (30% and 44.4%). But even the glucose tolerance test does not always reflect the degree of carbohydrate metabolism disorders, in connection with which we studied the level of immunoreactive insulin in the blood with the subsequent determination of the HOMA R index. The results of the study showed that the level of immunoreactive insulin was statistically significantly higher in obese children (14.2 ± 1.2 μIU / ml; 16.7 ± 1.5 μIU / ml; 19.3 ± 2.1 μIU / ml; c 1, 2 and 3 groups, respectively) compared with the control group (9.3 ± 0.8 μIU / ml), with a normal level of fasting glucose. The incidence of

insulin resistance in obese patients was 24.5%. As obesity progressed, the incidence of insulin resistance increased. So, in group 1, insulin resistance was detected in 13.6%, in group 2 - in 25% and in group 3 - in 38.8% of cases. Correlation analysis showed direct links between the level of immunoreactive insulin and BMI ($r = 0.545$; $p < 0.01$), as well as the relationship between BMI and the HOMA index ($r = 0.704$; $p < 0.01$). The data obtained allow us to conclude that insulin levels directly and significantly depend on excess fat accumulation. When comparing insulin resistance and the form of arterial hypertension, it was found that in adolescents with white coat hypertension, insulin resistance was diagnosed in 3.2%, in adolescents with labile hypertension - in 8.1%, and in children with stable hypertension - in 11.4% of cases.

This proves that insulin resistance is a key mechanism around which a chain of hemodynamic and metabolic pathologies is formed. When analyzing the results of the lipid composition of the serum of the studied contingent of adolescents, it was revealed that as obesity progressed, both the level of triglycerides ($r = 0.621$; $p < 0.01$) and the level of low-density lipoproteins ($r = 0.501$; $p < 0.05$) increased. and the level of high density lipoproteins decreased ($r = 0.703$; $p < 0.001$).

Thus, the data obtained show that the presence of dyslipidemias against the background of insulin resistance, accompanied by hypertension and obesity indicate the formation of a complete metabolic syndrome in this contingent of adolescents, which in our studies was revealed in 19.6% of cases, incomplete metabolic syndrome was diagnosed in 36 , 0% of cases.

Conclusions. The development of myocardial hypertrophy is facilitated by increased body weight, high blood pressure, vasoconstriction processes, as well as insulin resistance and atherogenic dyslipidemia. These parameters served as early markers of myocardial hypertrophy. Also, in children with obesity and AH, in 1/5 of cases, complete metabolic syndrome was revealed and in 1/3 of cases, incomplete metabolic syndrome, which requires immediate treatment of this condition to prevent early complications and disability in adolescents in the adult period.

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