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ULTRASOUND ASSESSMENT OF CEREBROVASCULAR REACTIVITY IN SCHOOL-AGE CHILDREN DEPENDING ON THE AGE-RELATED BODY MASS INDEX

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Abstract
In recent years, researchers in various fields of medicine have been paying increased attention to the study of the state of cerebral hemodynamics, due to the increasing increase in morbidity and mortality from cerebrovascular disorders. MK is the most acceptable for studying the vegetative support of adaptation processes, since it is an independent functioning system, occupying an exceptional position among other organ vascular basins and possessing its own regulatory mechanisms. Reduced adaptation and compensatory capabilities of MC lead to hypoxia, cerebral dysfunction and the initial manifestations of cerebrovascular insufficiency, which is associated with a violation of autoregulatory mechanisms.

Keywords: cerebrovascular reactivity, transcranial duplex, hyperventilation test.

Introduction

According to WHO (20-20), overweight and obesity are the fifth most important risk factor for death in the population. Overweight andobese individuals account for 44% of diabetes cases, 23% of coronary heart disease cases, and 7% to 41% of certain cancers. In recent years, there has been a tendency to increase the prevalence of arterial hypertension among obese schoolchildren (Lurbe E., Tsifkova R. etal., 2009). It is known that childhood and adolescent obesity, which then passes into adulthood, has a more severe course, accompanied by a pronounced increase in body weight and the frequency of concomitant diseases, than obesity that debuted in adulthood (Averyanov A. P., 2009, Rozyhodzhaeva G. A., 2014).

Studies of cerebrovascular reactivity in school-age children as a function of body mass index (BMI) may be important for understanding the relationship between cardiovascular health and body weight.

Ultrasound assessment of cerebrovascular reactivity involves measuring blood flow velocity and vascular diameter before and after stimulation, such as hypercapnia. This allows us to evaluate the

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response of brain vessels to changes in blood flow and pressure. Research in this area can help identify possible associations between children's body mass index and the function of their cerebrovascular system, which may be important for understanding the risks and developing strategies for the prevention and treatment of cardiovascular diseases.

The purpose of the study

To study cerebrovascular reactivity during functional tests (hyperventilation and apnea test) in children aged 7-16 years, depending on the age-related body mass index.

Materials and methods of research

Research was done with 31 obese children (the main group) and 29 practically healthy children (the control group) of school age (7-16 years) were studied. Children from each group were divided into subgroups depending on their age: the first groups were from 7 to 10 years; the second group was from 11 to 14 years; and the last group included children aged 15-16 years. All children underwent transcranial duplex scanning the main and midbrain arteries to assess blood flow at rest, as well as functional tests (hyperventilation and apnea tests) to determine cerebrovascular reactivity in «the Nilufar-M clinic», Andijan, using AlokaSSD-3500 ultrasound diagnostic devices-3500» and "Dawei DW-T6" using a multi-frequency cedetector sensor with a frequency of 1-4 MHz.

Results

When assessing the vasodilation reserve , a decrease in the reactivity coefficient to hypercapnic load Cr(+) in the main artery wasfound in children with labile hypertension. In the labile stage of hypertension in overweight and obese children, Cr(+) below the norm was recorded in 73.3% of cases, and in non-obese children 50%. The obtained values of Cr(+)were significantly lower incomparison with children in the control group (p=0.02 and p=0.044, respectively). Vasodilation reserve in children with stable hypertension was not reduced regardless of body weight.

Consequently, both endothelial dysfunction and structural changes in the vertebral arteries contribute to the formation of disorders of cerebral blood flow. In children with labile hypertension, regardless of body weight, there is a change in the functional reserve of cerebral vessels, manifested by a decrease in the vasodilation reserve in the main artery. These changes may be due to an adaptation of cerebral blood flow autoregulation that has not yet been formed. With labile and stable hypertension in children with normal body weight, an increase in peripheral vascular resistance in the basins of the main and medial cerebral arteries is determined, and in obese children such deviations are less common, despite the fact that the average duration of hypertension was higher. Analyzing the results obtained, it can be assumed that the above-described changes may be associated with various mechanisms of hypertension, depending on the presence of obesity. In primary arterial hypertension in children with normal BMI, the leading role in the pathogenesis of hypertension is assigned to neurohumoral regulation mechanisms - hyperactivation of the renin-angiotensin-aldosterone system, an increase in the content of angiotensin II, which is one of the most powerful vasoconstrictors. Under its influence, peripheral vascular resistance increases significantly, as indicated by an increase in the pulsation index in labile and stable hypertension in children without obesity. The formation of hypertension in obese children occurs through the interaction of neurohumoral, metabolic and endothelial mechanisms,

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the leading of which, apparently, is metabolic. Hyperinsulinemia, which occurs compensatorily against the background of a decrease in tissue sensitivity to insulin, contributes to an increase in the activity of the central departments of regulation of the sympathetic nervous system, increased reabsorption of Na+ in the proximal and distal tubules of the nephron and, as a result, fluid retention and the development of hypervolemia. It is logical to assume that arterial hypertension is secondary in obese children.

Conclusions

Children with obesity and hypertension have endothelial dysfunction, which leads to a decrease in the ability of vasodilation associated with excess body weight.

Violations of the rheological properties of blood, characterized by a tendency to develop thrombosis, are associated with overweight ($r=-0.60$; $p<0.05$).

1. Quantitative indicators of cerebral hemodynamics in boys and girls depend on the age-related body mass index ($r=0.68$, $p<0.05$).
2. Indicators of average blood flow velocity (58+3.5cm/sec, 64+6.8 cm/sec) and peripheral resistance indices (0.62+0.1; 0.73+0.4) according to the middle cerebral and main arteries in school-age children with increased BMI, they were lower than in children with normal body weight ($p<0.05$).
3. Cerebrovascular vascular reactivity during functional tests (hyperventilation and apnea test) with calculation of vasoconstrictor (0.87+0.3) and vasodilation (0.56+0.8) reserve coefficients differed in children with increased BMI compared with school-age children with normal age BMI (0.42+0.3;0.63+0.4, respectively, $p<0.05$).
4. The coefficients of vasoconstrictor and vasodilator reserve in school-age children are interrelated with both anthropometric indicators and blood pressure indicators.

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