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# ULTRASONIC ASSESSMENT OF CEREBROVASCULAR REACTIVITY IN SCHOOL-AGE CHILDREN DEPENDING ON AGE BODY MASS INDEX

**Summary.** According to the literature, the prevalence of obesity among children and adolescents in the world is steadily increasing. 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.

Early (preclinical) diagnosis of the state of the vascular bed in overweight children is of great importance, which is of great importance in preventing the development of the clinical cardiovascular stage of the disease in adolescence.

**Key words:** cerebrovascular pathology, central nervous system, diagnostic algorithm, angiocerebral disorders.

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# УЛЬТРАЗВУКОВАЯ ОЦЕНКА ЦЕРЕБРОВАСКУЛЯРНОЙ РЕАКТИВНОСТИ У ДЕТЕЙ ШКОЛЬНОГО ВОЗРАСТА В ЗАВИСИМОСТИ ОТ ВОЗРАСТНОГО ИНДЕКСА МАССЫ ТЕЛА

**Резюме.** По данным литературы распространенность ожирения среди детей и подростков в мире неуклонно растет. Известно, что детское и подростковое ожирение, переходящее затем во взрослую жизнь, имеет более тяжелое течение, сопровождающееся выраженным увеличением массы тела и частотой сопутствующих заболеваний, чем ожирение, дебютировавшее во взрослом возрасте.

Большое значение имеет ранняя (доклиническая) диагностика состояния сосудистого русла у детей с избыточной массой тела, что имеет большое значение в предупреждении развития клинической сердечно-сосудистой стадии заболевания в подростковом возрасте.

**Ключевые слова:** цереброваскулярная патология, центральная нервная система, алгоритм диагностики, ангиоцеребральные нарушения.

**Relevance.** Recently, it has been noted that the foundations of cerebrovascular pathology are laid in early childhood, more often due to perinatal brain damage (Filosofova M.S. et al., 1994, 1996; Dyakonova E.N., 1996; Khaletskaya O.V., 1998; Lobanova L.V. 2000; Zhdanova L.A., 2002). According to the authors, in parallel with the decline in fertility, the number of premature babies, newborns with low body weight and intrauterine growth retardation is increasing. Most of these children have pre- and perinatal pathology of the central nervous system, congenital micro- and macroanomalies of the cerebral vessels (Evtushenko S.K. et al., 2003; Higgins I. et al., 1991; Ball W., 1994). At the same time, with the undoubted influence of pre- and perinatal hazards on the development of cerebrovascular disorders, deciphering the specific "contribution" of these factors causes significant difficulties (Yakunin Yu.A., Ermakov A.Yu., 1995; Evtushenko S.K. et al., 1991; Riala A., Roach S., 1993).

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CVA in children of the first year of life and early age are more often transient in nature, but may persist in the postnatal period. A multi-organ somatic neurological disorder of growth and development processes in adolescence has been proven (Novikov A.E., 1998; Shnitkova E.V. et al., 2000).

The implementation of cerebrovascular disorders in childhood and young age after perinatal CNS damage is closely associated with the characteristics of individual organically altered somatic, cerebrovascular, vestibulo-vegetative reactivity and neurodynamics of the brain (Andreev A.V., 1994, 2000).

Despite the significant compensatory capabilities of the child's body and more favorable conditions for the blood supply to the brain in comparison with adults, CVA in children is accompanied by persistent and irreversible, often disabling neurological disorders (Ganesan V. et al., 2000; Kirkham F.J. et al., 2000).

All this dictates the need to develop programs aimed at the prevention and early diagnosis of cerebrovascular pathology, determining the prognosis of cerebrovascular disorders in childhood and young age after perinatal damage to the central nervous system.

**Purpose of the study.** Establish clinical, neurological, neurofunctional features and leading mechanisms of the formation of cerebrovascular pathology in childhood and young age after perinatal lesions of the central nervous system, develop an algorithm for diagnosing and predicting the development of angiocerebral disorders.

**Materials and research methods.** 50 practically healthy children of school age (7-16 years old) will be examined. Based on the age-related body mass index (BMI), 2 groups of children will be distinguished:

1) overweight (above the 90th percentile of age-related BMI) - 25 children (main group);

2) with normal weight (with normal age BMI) - 25 children (control group).

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The ratio of boys and girls in the study groups will be approximately the same.

The analysis of the obtained material will be carried out taking into account gender, age, anamnestic information regarding potential risk factors for the development of cerebrovascular diseases. All children will undergo a diagnostic complex of studies aimed at assessing anthropometric indicators: weight (kg), height (cm), age-specific BMI (percentile), as well as the level of systolic and diastolic pressure.

All children will undergo transcranial triplex scanning of the main and middle cerebral arteries to assess blood flow at rest, as well as during functional tests (hyperventilation and apnea test) to determine cerebrovascular reactivity on the Daiwei DW-5 ultrasound diagnostic apparatus using a multi-frequency sector sensor with a frequency of 1-4 MHz. The hyperventilation test will be used as a functional test for hypocapnia. In this case, the subject will breathe deeply and often until the blood flow decreases to the formation of a "plateau", and this indicator will be recorded - V (-). As a functional test for hypercapnia, an apnea test will be used, in which the subject will hold his breath without a previous deep breath as much as possible, but not less than 30 seconds, V (+) will be recorded - the maximum value of the blood flow velocity immediately after the first breath.

**Research results.** According to the research results, developed the following table with normative indicators for practically healthy children different age groups. Analyzing the obtained quantitative indicators of blood flow in the extracranial sections of the brachiocephalic arteries, essential no age differences were found. Quantitative Changes blood flow in the arteries of the circle of Willis are presented in the table. The results obtained are based on a change in the morphological structure of the vascular wall, which ensures the active growth and development of the child's brain tissue, which determines the formation of his neuropsychic functions.

At an early age, the middle muscular layer of the arteries develops more intensively. Wall vessel is mainly represented by a well-developed elastic

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membrane and developed muscle fibers. Density increase of the vascular wall occurs in parallel with an increase in the rate of cerebral blood flow and, accordingly, cerebral metabolism. The number of nerve fibers in the walls of intracranial vessels reaches a maximum by 6 years of age. (their highest concentration is in the SMA). After At 6 years, the radius of the vessels does not change significantly, but the morphological differentiation of the arteries occurs up to 12 years. In the pubertal period, the amount of elastic fibers, the lumen of the arteries increases, and their wall becomes thinner. A new structural and hemodynamic concept of the development of cerebrovascular disorders after perinatal CNS damage is presented, which consists in the fact that hypoxic-ischemic changes in the brain are localized in areas of adjacent blood circulation that are directly related to the regulation of vegetative-visceral functions and the limbic system, as a result of which conditions are created for disruption of auto-regulation of cerebral blood flow and the occurrence of cerebrovascular accidents, which subsequently determines a persistent neurological defect, which is aggravated under the influence of adverse socio-biological factors.

The features of the most characteristic clinical and neurological consequences of perinatal brain lesions in preschool, primary school, adolescence and young age, leading to the development of cerebrovascular pathology, are highlighted.

Structural and morphological changes in the brain in patients with perinatal CNS lesions were verified, the leading of which are cortical atrophy, ventriculomegaly, arachnoid cysts, vascular foci in the mediobasal areas of the frontotemporal cortex, which form a stable pathological state of the brain.

A persistent lag in the maturation of the bioelectrical activity of the brain after perinatal CNS damage has been proven both in different periods of childhood and at a young age.

The ideas about the vagal-sympathetic balance in children and young people with the consequences of perinatal CNS damage were supplemented by

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the characteristics of the initial autonomic tone and autonomic reactivity when modeling orthostatic, rotational and hyperventilation tests.

A detailed assessment of the features of cerebral hemodynamics was obtained, and age-related patterns of changes in cerebrovascular reactivity in individuals who had perinatal CNS damage were identified.

The influence of biological and social factors on the course of the consequences of perinatal CNS lesions in different age periods is shown, and risk factors for cerebrovascular pathology are identified.

The role of perinatal brain lesions in the manifestation of initial manifestations of insufficiency and transient disorders of cerebral circulation, as well as cerebral strokes in children and young adults, has been proven.

The structure of the consequences of cerebral stroke in childhood and young age, the frequency of their occurrence has been specified, the influence of age on the severity of outcomes has been proven.

It has been established that perinatal CNS lesions have an adverse effect on the course and outcome of cerebral strokes.

A system of measures for the prevention of cerebrovascular pathology has been substantiated, including prognostic and diagnostic algorithms based on anamnestic data.

The prognostic value of risk factors of social and biological history in the occurrence of cerebrovascular pathology has been established, a diagnostic table has been developed to distinguish among children and young adults with perinatal CNS lesions at risk for the development of angioneurological disorders.

The volume of an in-depth diagnostic examination to identify clinical manifestations of cerebrovascular pathology in individuals who have undergone perinatal CNS damage has been substantiated.

A system of measures for the prevention of the pathology of the musculoskeletal system in children with a stroke is proposed.

**Conclusion**: or diagnosing cerebrovascular pathology and identifying the leading mechanisms of its development in individuals who have suffered

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perinatal damage to the CNS, an integrated approach with an analysis of clinical neurological, neurohemodynamic, neuropsychological, and peer imaging data is highly informative.

Perinatal damage to the nervous system is accompanied not only by a delay in the development of peyroontogenesis in childhood, but also by the formation of a stable pathological state of the brain, manifested by structural and neurohemodipamic disorders.

Ultrasound transcranial dopplerography with functional stress tests is the best method for assessing the functional state of the cerebral circulatory system and predicting the development of cerebrovascular pathology in children and young adults after perinatal CNS damage.

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