



## PECULARITIES OF ARTERIAL HYPERTENSION IN CHILDREN: IT PATHOGENESIS AND CORRECT DIAGNOSTICS



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**Abstract.** Arterial hypertension is one of the biggest problem of nowadays. Especially, when it appears in childhood. We had investigated the main pathophysiological causes of development of arterial hypertension in children, the way of clinical diagnostics and the main possibilities of prophylaxis.

It is very important to create a new percentile standart of arterial pressure level, that will give a possibility to quick diagnostics of arterial hypertension.

**Keywords:** arterial hypertension, pathophysiology, children, vegetative dystonia, cardiovascular system.

Over the past 10 years according to the data of Institute of Cardiology. N.D. Strazhesko, mortality from cardiovascular diseases among the population of Ukraine increased by 23.8%. These include hypertension (AH) is the most common pathology, prevalence of which among children and adolescents is 1 to 14%, the incidence of vascular dystonia in children, according to different authors, ranging from 12 to 25%, and in school-age – 7.1 to 43.7%. At the same time, many researchers have noted a tendency to "rejuvenate" the GCC and increased incidence of complications such as coronary heart disease (CHD), heart failure, arrhythmias, etc. One of the main problems of modern pediatric cardiology are: development of measures of primary prevention of CHD, including AH and dystonia, and the allocation of risk for the development of these diseases for their follow-up, implementation and possible ways of correcting violations and optimal preservation of the cardiovascular system (CVS).

**The aim** of this work is based on the allocation of existing screening methods and examination in accordance with standard indicators developed regional risk for violation of functional state of the cardiovascular system of children and the development of measures to correct these violations. Improved methods for diagnosis and prediction of functional disorders of the cardiovascular system in newborns with perinatal pathology

**Objectives:** 1. To study the prevalence of primary hypertension and metabolic syndrome in children Chernivtsi region; 2. Assess factors contributing to the occurrence and progression of primary hypertension and metabolic syndrome in children; 3. To develop models for assessing and forecasting relative risk of primary hypertension and metabolic syndrome; 4. Develop prevention and correction algorithm for high blood pressure in children; 5. Based on the results scientifically substantiate and implement preventive measures to improve and optimize medical monitoring and clinical supervision for health reasons specified contingent; 6. Determine the risk factors for disorders of the functional state of the cardiovascular system in infants in the early neonatal period; 7. To study the clinical features of functional disorders of the cardiovascular system of children in the presence of perinatal pathology.

**The phenomena that will be studied.** When performing the work will be explored: 1) Morphofunctional parameters of the cardiovascular system (heart rate, blood pressure, pulse, electrocardiogram and echocardiogram); 2) The clinical characteristics of children to be examined; 3) Indicators of physical development of children surveyed; 4) Internal (genetic) factors and external microenvironment that surrounds the baby; 5) Quality of life of children; 6) the predictability of violations of the functional state of the cardiovascular system in neonates risk groups based on multivariate correlation analysis.

**Materials and methods:** clinical, anthropometric, echocardiographic, electrocardiographic, clinical, sociometric, statistics.

In hypertension of any origin may be a combination of these factors, except that the leading role of one of them. In essential hypertension in the pathogenesis of the central role given to increase the intracellular concentration of free ionized calcium in the smooth muscle cells of arteries, which leads to an increase in their tone. When vasorenal hypertension in the early stages cause increased blood pressure is the activation of the renin-angiotensin-aldosterone system. Prolonged preservation AG factors begin to dominate the increased activity of the sympathetic nervous system, inhibition of renal vasodepressorsubstances and violation of autoregulation of peripheral vascular tone. Hypertension in renal parenchymal disease largely associated with the violation excretion of sodium and water.

**Results and discussion.** The average index of systolic blood pressure during the first measurement was  $120.67 \pm 1.3$  mmHg (min – 74 mmHg, max – 182 mmHg). According to the second measurement it amounted to  $113.78 \pm 1.07$  mmHg (min – 77 mmHg, max – 164 mmHg) for the third –  $113.12 \pm 1.18$  mmHg (min – 74 mmHg, max – 172 mmHg). In general average systolic blood pressure in children surveyed amounted to  $115.86 \pm 1.1$  mmHg (min – 82 mmHg, max – 169 mmHg).

Further evaluation of the performance conducted by percentile tables. Generally use tables are separated by sex, age and height (in the form V corridors). For percentile considered an indicator within 90-95% age-height percentile. Index above 95% at the first measurement was assessed as hypertension. If repeated measurements in two weeks these children had normal rate, we believe that they must place labile hypertension. If the blood pressure remained high, we determined the degree of hypertension (I

or II depending on the indicator). In our study, 11 children were registered with systolic blood pressure within 90-95%. We also found 44 children with blood pressure above 95 percentile-age-height. As for diastolic blood pressure, the number of children with high blood pressure was significantly lower. Thus, within the 90-95% recorded 9 children, and above 95% – 24 children.

This is not a high correspondence between systolic and diastolic blood pressure and presence of renal pathology in children, for which a typical increase in systolic pressure, maintaining normal diastolic, and the presence of a high pulse. In these children, when carrying out screening urine more often observed in the presence of microalbuminuria (7 out of 12 children).

The conventional wisdom that the main cause of high blood pressure in children have kidney disease, in this case, confirmed a history: in 2 children have chronic pyelonephritis, 17 children with 55 in the last 3 years have been reported acute diseases of the urinary system (cystitis, pyelonephritis, dismetabolic nephropathy).

Rhythm disorders can be congenital or acquired and caused by cardiac, and combined extracardiac reasons [2, 3, 5]. By cardiac arrhythmia causes include congenital and acquired heart disease, rheumatic heart disease and non-rheumatic carditis, infective endocarditis, cardiomyopathy and other heart disease [4]. Found a clear correlation arrhythmias and small abnormalities of the heart [7]. Arrhythmias may develop in diseases of the nervous and endocrine systems, many somatic disorders, acute and chronic infectious diseases, poisonings, overdose or inadequate response to medications, deficiency of certain minerals (magnesium, selenium). The formation of rhythm disorders affect emotional and physical overload and vegetative dystonia syndrome and psychogenic disorders associated with extracardiac pathology [6]. The main pathogenetic factor arrhythmias find violations formation speed of momentum and excitement as a result of suppression of sinus node activation ectopic pacemakers and operation of additional pathways. These disorders result from inflammatory, degenerative, necrotic and sclerotic processes in cardiac muscle and conductive system of heart or as a result of electrolyte imbalances, leading to changes in cellular metabolism and ion composition of the internal environment cardiomyocytes [5].

The basic method of detection and estimation of arrhythmias - record the ECG. You can use it to detect asymptomatic arrhythmias such as extra-rare syndrome, Wolff-Parkinson-White, slow atrioventricular conduction, pacemaker migration. Often during the ECG in children show respiratory sinus arrhythmia isolated and incomplete right bundle branch block, which are age norms option [4].

Often there is a combination of hypertension and arrhythmias in children, especially school children.

We recorded arrhythmias in 67 children, representing 16.75% of the total surveyed. Of these, 32 girls and 36 boys. Distribution by age group: 7-9 years – 6 (8.95%) children (4 boys, 2 girls); 10-13 years – 40 (59.7%) children (22 boys, 18 girls); 13-16 years – 25 (37.3%) children (10 boys, 15 girls).

The largest number of arrhythmias account for prepubertal and early pubertal period. It should be noted that one reason for arrhythmias in children in the age group 13-16 years may be smoking. Thus, 13 of the 25 children who have detected arrhythmias, admitted that they, at least once a day smokers for more than two months.

It should be noted that 30 of the 67 children were found increased blood pressure during at least one of the three measurements. This indicates the presence of a certain relationship between lability of blood pressure and arrhythmia in students, and needs

further scrutiny.

Thus, the gradual definition of arrhythmias can optimize screening leading cardiac function in children of school age.

Evaluation of the functional state of the cardiovascular system in children and adolescents represents one of the most important trends in pediatrics, because the criteria are basic in terms of identifying and predicting physical health, physical status, and possible limitations of certain types of physical activity [5]. Detection of abnormalities in healthy children is an important preventive task of Contemporary Medicine [1].

At the same time isolated functional state registration parameters cardiovascular system reduces their information value [2]. The most promising is the comprehensive approach of establishing linkages with anthropometric indicators, results of stress tests of autonomic tests, etc. However, such studies unfortunately rare [1, 4].

Among the factors that determine individual characteristics of intra-cardiac hemodynamics, the most important is the level of physical activity [6]. Thus, the study of intracardiac hemodynamic parameters during orthostatic test in children involved and not involved in sports, has shown that the effectiveness of the heart in foreign trained children and teens lying above [3, 4].

According to research results S.A. Lokteva, H.A. Makarovoy, T.V. Radchenko and others (1999), all parameters of the functional state of the cardiovascular system in children and adolescents should be assessed differently, depending, again, on the nature and closeness of their relationship with major anthropometric indicators.

One of the criteria of the functional state of the cardiovascular system, reflecting myocardial oxygen consumption is double product index (PPD) (H.A. Makarova, 2002), widely used in recent years. The value consists of PPD heart rate and systolic blood pressure at rest. Assessment values PPD conducted on the principle – «average», «above average» and «below average».

It is interesting to compare the value received index depending on the sex of the child. Yes, boys average index was  $9.64 \pm 0.95$ , and the girls –  $11.13 \pm 0.88$ , with it likely the difference was  $p < 0.05$ . Average index Ruffe boys can be assessed as satisfactory, while in girls, the figure was already within poor. This can be partly explained by earlier physical development of girls, which leads to an imbalance of the autonomic nervous system.

By studying the factors that have led to a reduction coefficient of endurance in children, we conducted a series of correlations. Yes, we saw mass index correlates with the size of the works Ruffe index  $r=0.16$  ( $p < 0,05$ ). In addition there is a direct correlation between this index and systolic blood pressure  $r=0,21$  ( $p < 0,05$ ), and diastolic blood pressure  $r=0,19$  ( $p < 0,05$ ). Accordingly, businesses increased mass index and increased blood pressure are major factors in the deterioration of the functional state of the cardiovascular system.

Currently believe that the severe hypertension is necessary to reduce blood pressure to a safe level before the diagnostic measures.

Initial examination of the child with hypertension should include a detailed analysis of blood, urine, urine on bacteriuria, research serum urea, creatinine, electrolytes, renal ultrasound, ECG and chest X-ray. If possible, run a two-dimensional echocardiography, nephrostytsigrafic examination, excretory urography (in the absence of severe renal failure), the definition of aldosterone and plasma renin activity. In most cases, on the basis of the data can not determine the most likely group of diseases causing increased blood pressure, as well as get information about the old days on the degree of hyper-

tension left ventricular hypertrophy.

Further diagnostic tactic can be more focused in nature. After exclusion of secondary genesis of hypertension need to conduct in-depth study of CAS to determine the features and differential diagnosis between pre-arterial hypertension PAH and dystonia in hypertensive type. As you know, psycho-vegetative syndrome may be a potential early phase PAH psychosomatic disease, limits between which it is difficult to determine. Some authors point to the importance and complexity of the question whether the transient forms of manifestation arterial hypertension AH or dystonia sympathoadrenal vascular vegetative paroxysm.

In practice, often a child with dystonia on hypertonic type diagnosed «GC first stage», although not known to be formed, it will continue or not. However, differentiation of patients with mild hypertension and dystonia not only has diagnostic value, but also largely determines the treatment strategy and prognosis. One method of differential diagnosis of these conditions is to monitor blood pressure, it is necessary to also conduct in-depth of vegetative diagnosis that should be the basis for early diagnosis and prevention of dystonia [4, 5].

If an analysis of published data, it should be noted that carrying out in-depth diagnosis of vegetative system takes 2-3 times longer than examination of the child with organic disorders. This necessitates the development of screening methods for screening of children to detect early disorders of the SPA and the exclusion of other types of pathology. At the present time IRR is diagnosed by exclusion. The main stages of examination of the child with suspected dystonia are:

A. Definition: 1) initial vegetative tone child tables of A.M.Veyn modified to childhood; 2) autonomic reactivity with additional pharmacological, physical tests and cardiointervalography using klino-ortostatyc sample (KOS); 3) support of the vegetative (test with dosed physical load carrying KOS);

B. Identification: 1) the possible main etiological factor; 2) the presence of intracranial hypertension;

B. Application of other additional methods (electroencephalography, rheoencephalography etc.).

PAH + Dystonia. An interesting study submitted relationships between dystonia and PAH. K previously noted granted PAH is a development against the background of the dystonia in hypertensive type [6] should clearly draw the line between the two diseases. However, in the literature there are works devoted to the examination of children who manifested a combination of PAH and dystonia. This raises the question whether there is one disease burden to others, or a combination of some evidence of adaptive changes in the body of the child. According to the research Novosibirsk scientists [14] found that the combination of PAH and dystonia leads to the transformation of certain hormones in the body that indicate some adaptive changes rather than burdening one disease to others. Thus, noted that the index stresu vannya patients PAH + dystonia where output catecholamine excretion minimum - maximum. According to the authors this prevents continuous growth hormones and exhaustion system. There were also found some differences in metabolic processes and content of certain substances. Yes, it was observed that patients PAH - higher levels of cortisol, the high reactivity of vessels to the action of noradrenaline. When PAH + dystonia – moderate hyperinsulinemia and decreased excretion of norepinephrine and, compared with patients with PAH level lower reactivity to norepinephrine, which researchers associated with concomitant hyperinsulinemia. When comparing the levels of blood pressure in patients with PAH

(without dystonia) and PAH + dystonia was observed that children with PAH (without dystonia) have higher blood pressure.

**Pathogenesis of dystonia.** The pathogenesis of autonomic dysfunction is complex and has significant differences in terms of suprasedgmental and segmental autonomic disorders. Most researchers believe that the IRR available disregulative changes mainly due to SSS primary or secondary abnormalities in segmental and suprasedgmental vegetative centers [1, 14, 20]. By suprasedgmental autonomic dysfunction leading centers congenital (hereditary predisposition to dystonia, adverse pregnancy and birth, malformations of the central nervous system and the endocrine glands) and acquired (emotional stress, chronic source of infection, hormonal imbalance) factors [11]. Hypoxic brain damage involving violations of intracerebral relationships, the formation of intracranial hypertension in section III ventricle [14, 16].

Hypoxia is a universal reaction embryonic structures on the effect of various pathological agents. O.S. Tretyakovoyu et al. when analyzing the ultrastructure of cellular components of the heart in children who have suffered hypoxia in pre- and intrapartum periods were found deep breach in cardiomyocytes and in particular in their energy unit, which the authors believe can not affect the heart clinic lesions newborn hypoxia [18, 21].

Interesting presented results of the study, which was featured as the relationship between the SPA and the position of the spine. Thus, in most children with vegetative-visceral dysfunction is marked scoliosis of the spine. The authors noted [12] that the violation autonomic innervation impairs changes in the spine and the activity of internal organs, on the other hand state VNS most children determined by the position of the spine. N.O. Nikitina explained by the theory of Oriental medicine, according to which there is a curvature of the spine in violation of the value lines pelvis and spine resulting from birth trauma lumbar, followed by the formation of muscle hypertonus pelvic area and shortening the length of the respective legs.

Hereditary factor determines the characteristics of the structure and functions of the hypothalamus and other structures. Emotional stress disrupt limbico-reticular complex where mental and localized autonomic centers. Neurologists in turn believe that pathogenetic basis dystonia is disintegration limbico-reticular complex, the most significant of which is often the cause of emotional stress. IRR reflected changes in autonomic reactivity and security, and as a result, causes: a) metabolic disorders (hypercholesterolemia, dysproteinemia, hyper- and hypoglycaemia), violation of blood coagulation, fibrinolysis, erythro-, granulocyte-, lymphopoiesis and immunogenesis; b) violation of innervation of internal organs, which leads to dyskinesia of the gastrointestinal tract, functional cardiomyopathy (arrhythmias, blockades), vascular dysfunction (hypo- to hypertensive and type), c) violation of neurotransmitter and humoral regulation of biologically active substances, d) hypo- and hypersensitivity peripheral and central receptors. Pathogenesis of segmental autonomic disorders in nursing spinal cord injury is reduced to the stimulation of the receptors vertebral artery wall, leading to disruption of the autonomic innervation of the vascular region. Hypothalamic disorders may be secondary and related disorders of blood circulation in the vertebrobasilar pool [14]. Observer A.M. Wayne [9], in adults vertebrobasilar vascular insufficiency is a common pathogenetic factor autonomic dysfunction, which suggests that the roots of the disease date back to childhood.

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