CLINICAL AND DIAGNOSTIC FEATURES OF SMALL ANOMALIES OF HEART DEVELOPMENT IN CHILDREN WITH HEART RHYTHM AND CONDUCTION DISORDERS

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Abstract. *Echocardiography (EchoCG) has opened up broad prospects for in vivo study of the morphology of the valvular apparatus and the connective tissue frame of the heart. It became possible, in addition to congenital malformations, to detect small structural changes - small anomalies in the development of the heart. We studied 95 children of preschool and school age with connective tissue dysplasia and small heart development abnormalities. One of the most informative methods for diagnosing diseases of the heart and blood vessels is echocardiography. Diagnostically valuable results of echocardiographic examination in children with cardiovascular pathology against the background of small anomalies of heart development are: disturbance of the heart rhythm and conduction, increase in EDV of the left ventricle and ejection fraction.*

Keywords: *small abnormalities of the development of the heart, connective tissue dysplasia, echocardiography, arrhythmia, children.*

Relevance. Echocardiography (EchoCG) has opened up broad prospects for life-time study of the morphology of the valvular apparatus and connective tissue framework of the heart. It became possible, in addition to congenital malformations, to detect small structural changes – small abnormalities of the development of the heart (SADH). Today, SADH is defined as "hereditary structural and metabolic changes in the valvular apparatus of the heart and/or its connective tissue framework, including the main vessels, in the form of various anatomical anomalies that are not accompanied by hemodynamically severe and clinically significant disorders" [2, 8]. SADH in children is a fairly common condition. According to various authors, SADH occurs from 2.2 to 10% of cases, in children with cardiovascular pathology-in 10-25% of cases (up to 68.9%, depending on the cohort of subjects) [6, 15]. Despite the extensive study of minor cardiac malformations over the past three decades, many issues related to the clinical course and prognosis remain the subject of discussion [3, 9, 13]. The main clinical significance of SADH, according to many authors, is that they are one of the possible causes of the development of cardiac arrhythmias [1, 4]. However, the mechanisms of arrhythmia occurrence and the nature of electrocardiographic changes are insufficiently studied [5, 7, 14]. The clinical picture of uncomplicated isolated minor anomalies largely consists of symptoms of constitutional autonomic dysfunction and signs of connective tissue dysplasia (skeletal abnormalities, features of the structure of the hands, feet, etc.). While isolated heart anomalies themselves (mitral valve prolapse, multiple heart valve prolapses, etc.) are a clinical manifestation of connective tissue dysplasia syndrome of the heart [10, 18].

Connective tissue dysplasia (CTD) is a multi-level process associated with both quantitative and qualitative changes in its main structures. Mutations of genes encoding the synthesis and spatial organization of collagen, responsible for the formation of extracellular matrix

components, as well as numerous enzymes involved in intra - and extracellular maturation of collagen and the processes of fibrillogenesis are of leading importance in the development of the clinical picture of CTD [12, 17]. Elongation (insertion) or shortening (deletion) of the collagen chain, various point mutations accompanied by the replacement of even one amino acid, cause a violation of the formation of cross-links in the collagen molecule, a decrease in its thermal stability, a slowdown in helix formation, a change in posttranslational modifications, and an increase in intracellular degradation [11].

CTD is a unique ontogenetic anomaly in the development of an organism, which is one of the most complex and far from studied issues of modern medicine [16, 18]. These anomalies are the morphological basis of functional changes in cardiac activity, and in the case of organic heart lesions, they can worsen their prognosis [9].

The aim of the study is to study the parameters of echocardiographic examination of small anomalies of heart development in children with clinical manifestations of connective tissue dysplasia.

Materials and methods of research. 95 children of preschool and school age who received impatient treatment in the departments of cardiorheumatology of Children's Clinical Hospital №4 of Tashkent. Of these, 75 children with CTD and SADH and 20 practically healthy children of the same age who made up the control group. Of the 75 children with CTD, 40 were in group I - with cardiovascular pathology on the background of small anomalies of heart development, and 35 were in group II - without cardiovascular pathology on the background of small anomalies of heart development.

External and internal phenotypic signs, the nature of complaints, as well as the characteristics показателей of echocardiographic study parameters were studied.

Results and their discussion. The clinical picture in children with small abnormalities of heart development is quite diverse. Its manifestations often begin in adolescence. Analysis of complaints in patients with SADH shows that significantly more often complaints were presented by children with SADH, burdened with cardiovascular pathology. Arrhythmic syndrome was the leading cardiovascular pathology in the children with SADH examined by us (Figure 1).

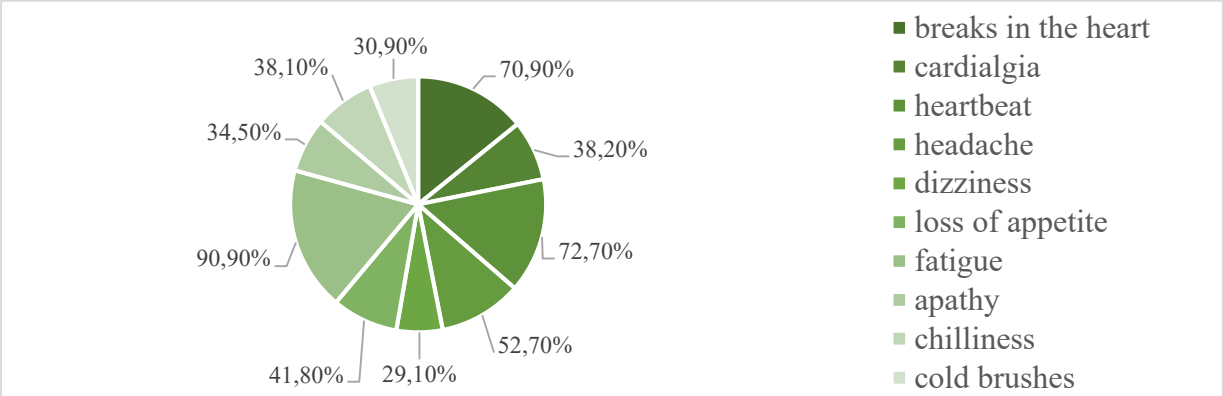

Figure 1. Characteristics of the frequency of complaints in patients with SADH

Complaints of "aching" pain in the heart, palpitations, cephalgia and dizziness, increased fatigue, a feeling of "chilliness" and cold hands at room temperature were more often presented by children with a combination of MVP and AHLV. Vertigo appeared when changing the body position (from wedge - to ortho-position) and with a sharp turn of the head in 2/3 of children.

Among other complaints, 15.8% of the total population of children with SADH also had dyspeptic disorders in the form of abdominal pain, not always associated with food intake, heartburn, a feeling of heaviness in the right hypochondrium, rapid satiety, constipation.

Skin pallor was observed in 41.0% of children with MVP, 32.0% with AHLV, and 47.4% with a combination of MVP and AHLV.

One of the most informative methods for diagnosing heart and vascular diseases is echocardiography (Echo-CG). Echocardiography with Doppler analysis was used to assess such parameters as: end-diastolic size (EDS) of the left ventricle; end-systolic diameter (ESD) of the left ventricle, systolic thickness of the interventricular septum and posterior wall, the size of the right ventricle, right and left atria, and the degree of valve regurgitation was detected. Objective assessment of blood circulation is carried out according to the main parameters of central hemodynamics, among which the main place is occupied by cardiac output. Considering that most of the examined patients with SADH were adolescent children, when studying the state of central hemodynamics, we analyzed its main parameters in adolescents (Table 1.).

There was a significant difference in the parameters of the ejection fraction in groups I and II – 63.5 ± 2.1% and 62.3 ± 2.2% for MVP, 62.6 ± 1.3% and 61.1± 1.2% for AHLV. In children with SADH, there was a tendency to increase the final diastolic volume (EDV) of the left ventricle. Changes in this parameter indicate the presence of emerging myocardial hyperfunction. The morphological manifestation of this emerging hyperfunction is subsequently a tendency to increase the thickness of the interventricular septum and the size of the left atrium. In adolescents with SADH, the indicators of TPWLV; TPWLV, EDS dimensions, and ESS in relation to the comparison group remain unchanged. Echocardiographically verified significantly higher EDV ($p< 0.05$), especially in patients with MVP. EDV was increased in all groups with SADH ($p < 0.05$).

Table 1.

Echocardiographic characteristics of small cardiac malformations (M±m)

Impressions - Indicators	I-group (n=35)		II-group (n=27)		III-group (n=20)
	MVP	AHLV	MVP	AHLV	Healthy children
EDS	46,5,5±4,9	47,6,6±6,6	45,5,5±3,66	37,5,5±6,7	43,6,6±1,00
ESS	28,0,0±1,4	28,5±3,8	27,2,2±2,77	26,8,8±3,2,2	27,0,0±2,4,4
TPWLV	6,1±1,4	6,2±0,9	5,2,2+1,0	6,1±0,8	5,1±1,5
TIS	6,1±1,4	6,3±0,88	5,5,±1,0	6,1±0,8	5,3,3±1,00
EDVLV	83,5,5±2,1*	81,6,6±16,7**	81,3,3±12,1,1***	78,4,±2,7****	80,0±4,22
EF	63,5,5±2,1*	62,6,6±1,2**	62,3,3±2,1***	61,1,1±1,2****	66,5,±1,00
RV	13,0,0±0,11	14,1,±0,8	12,6,±1,0	13,4±1,0	12,3,3±1,1
BV	14,2±0,8	4,8,8±0,4	13,3±1,0	13,7±0,4	12,5±1,1

Note 14: * ($p<0.05$) - significance between the I-group with MVP and the comparison group, * * - significance between the I-group with AHLV and the comparison group, * * * - significance

between the II-group with MVP and the comparison group, **** - significance between the II-group with MVP and the comparison group.the group with AHLV and the comparison group.

It should be noted that in the groups of children with MVP there were certain factors affecting the level of hemodynamic parameters, such as hemodynamically significant MVP, MK insufficiency. In MVP, SC insufficiency was 6.75%, and grade II mitral regurgitation occurred in MVP in 24.8% of cases.

We examined echocardiographic parameters in children with SADH depending on the severity of CTD (Tables 2 and 3). The analysis of the data obtained shows that in children of group I with AHLV, there is a decrease in EDS parameters at all degrees of CTD severity - 39.0±6.3 for I degree, 36.5±6.9 for II degree and 36.5±9.2 in the third degree of CTD severity, and a low ESS score in the third degree of CTD severity - 23.5±4.9. The EDVLV index was increased in comparison with the control group in children with MVP at grade I - 87.6±1.9 and at grade II CTD - 86.9±2.3. A decrease in the EF index was found in children with MVP and AHLV at all degrees of CTD severity.

Table 2.

Echocardiographic characteristics of connective tissue cardiac dysplasia depending on severity group I (M±m)

	I degree (n=16)		II degree (n=14)		III degree (n=5)	
	MVP	AHLV	MVP	AHLV	MVP	AHLV
EDS	43,8±3,2	39,0±6,3	43,9±3,9	36,5±6,9	42,7±0,66	36,5±9,22
ESS	30,3±2,9	26,9±4,66	30,1±2,77	26,4±4,22	30,7±4,0	23,5±4,9
TPWLV	5,9±1,1	5,9±1,1	5,9±1,1	5,9±1,1	5,9±1,1	6.5±0.7
TIS	5,9±1,1	5,9±1,1	5,9±1,1	5,9±1,1	5,9±1,1	6,5±0,7
EDVLV	87,6±19,9	72,1±17,88	86,9±2,33	77,3±2,33	77,3±2,99	82±4,2
EF	62,9±1,44	61,9,±1,3	61,0±1,44	61,4±1,5	60,7±1,1	60,5,5±2.2
RV	18,3,3±1,0	17,5,5±0,99	17,2,2±1,0	17,0,0±1,11	19,3,3±1,1	18,0,0±1,1
BV	3,7±0,5	3,8±0,4	3,2,2±1,0	4,1±0,5	4,7,±1,1	3,0±0,4

Table 3.

Echocardiographic characteristics of connective tissue cardiac dysplasia depending on severity group II (M±m)

	I degree (n=13)		II degree (n=10)		III degree (n=4)	
	MVP	AHLV	MVP	AHLV	MVP	AHLV
EDS	45,5±4,9	39,6±6,77	44,5±3,7	35,6±6,9	41,7±1,5	34,0,0±3,1,1
ESS	29,0±1,4	28,3±3,8	30,2±2,9	25,8±4,2	31,0±3,6	28,5±2,1
TPWLV	6,0±1,4	6,2±0,9	6,1+1,0	6,1±0,9	6,3±1,22	5.0±0.88
TIS	6,0±1,4	6,2±0,9	6,1±1,11	6,1±0,9	6,3±1,22	5,0±0,88
EDVLV	80,5±2,1	73,6±1,6,6	83,3±2,44	77,0±2,3	80,0±4,66	78,5±0,7
EF	61,5±2,1	60,6±1,33	61,3±2,22	61,1±1,55	61,0±1,7	61,5±2,1
RV	17,0,0±1,1	16,6,6±0,8	18,3,3±1,0	17,1,1±1,11	19,3,3±1,22	18,0,0±1,1
BV	4,0±0,8	3,8±0,4	4,3,3±1,0	3,7±0,55	4,7,±1,22	3,0±0,4

Children of group II with AHLV showed a decrease in the EDV index, which progresses as the severity of CTD increases. A similar dynamic of ESS is observed in MVP. The EDVLV index was reduced in children with AHLV compared to the control group. There is a decrease in the EF index in children with MVP and AHLV at all degrees of CTD severity.

Other manifestations of SADH, namely: prolapse of the tricuspid and aortic valves (AV), pulmonary artery valve, bicuspid aortic valve, abnormally located right ventricular chords, aneurysm of the atrial or interventricular septum, valve insufficiency, and others were found in rare cases. The most common echocardiographic findings in patients were tricuspid valve dysfunction (TPV), mitral regurgitation of the first degree. TPV dysfunction occurred in children with SADH in 38.7% of cases. In MVP, TPV dysfunction was registered in every second child and amounted to 51.2%. In 30.2% of cases, regurgitation on the tricuspid valve of the first degree was noted, in 9.7% - II degree.

It should be noted that 2/3 of children with MVP had tricuspid valve dysfunction, and almost every second patient with AHLV. The predominant degree of mitral regurgitation in MVP and AHLV was grade I regurgitation ($p<0.001$). In children with SADH and cardiovascular pathology, both specific (the presence of changes according to echocardiography) and non-specific echocardiographic signs (an increase in left ventricular EDV and a decrease in EF) were detected, which indicate the presence of connective tissue dysplasia and initial myocardial hyperfunction.
Thus, the state of systemic blood flow in children with smallcardiac anomalies indicates a decrease in the adaptive capabilitiesof the cardiovascular system due to shifts in the dynamics and energyof heart contraction, and violations of vegetative regulation. An increase in the ejection fraction can be considered early signs of straining the functional capabilities of the heart and blood vessels. With sufficient frequency, children with SADH are diagnosed with cardiac arrhythmias, which also leads to a decrease in the efficiency of the heart. This situation is aggravated by the presence of complications in the form of valvular insufficiency of the heart and structural changes in the myocardium.

Conclusions.

The analysis of clinical and phenotypic manifestations of connective tissue dysplasia syndrome in children with small heart malformations revealed that significantly more often complaints were presented by children with SADH, burdened with cardiovascular pathology;
Diagnostically valuable results of echocardiographic study in children with cardiovascular pathology on the background of SADH are: violation of heart rhythm and conduction, increased left ventricular EDV and EF.

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