FEATURES OF CLINICAL PROGRESS AND FUNCTIONAL INDICATORS IN DILATATION CARDIOMYOPATHY IN CHILDREN

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Abstract: Delated cardiomyopathy (DCMP) is a severe pathology in childhood, for early detection of which a thorough study of medical and biological factors, clinical data and data of modern methods of functional diagnostics (ECG, EchoCG) is necessary at an early stage. This scientific study aimed to determine the clinical and functional features of dilated cardiomyopathy in children. Materials and methods of research: we examined 42 children with DCMP aged from 2 months to 18 years, hospitalized at the cardioreumatology department of the Republican Specialized Scientific-Practical Medical Center of Pediatrics of the Ministry of Health of the Republic of Uzbekistan. The control group consisted of 30 practically healthy children. The results of echocardiographic studies showed that in children with DCMP the final volume of the left ventricle reached from 94 ml to 206 ml, which was associated with an increase in its filling pressure and pronounced dilatation of the left ventricle, which was accompanied with varying degrees of relative mitral insufficiency in cases and tricuspid valves. Conclusion. To prevent the development of DCMP in children, it is necessary to conduct preventive methods to avoid late delivery, ensure safe pregnancy and delivery, prevent and effectively treat diseases of viral etiology in mothers and children, and for a favourable outcome of these diseases early diagnosis and timely initiation of therapy is necessary.

Keywords: children, cardiomyopathy, echocardiography, radiography, electrocardiography.

Introduction According to modern concepts, dilated cardiomyopathy is defined as a disease of the cardiac muscle of unknown or obscure etiology, characterized by cardiomegaly due to dilatation of heart cavities, especially of the left ventricle, progressive reduction of myocardial contractility, which develops suddenly with progressive heart failure, arrhythmic and thromboembolic syndromes, which often end in sudden death [1]. Dilated cardiomyopathy occupies a leading position in the structure of disability and mortality in children and is the main cause of chronic heart failure in childhood [2]. It is more often found in boys. The proportion of dilated cardiomyopathy, among other cardiomyopathies, is 60% [3]. The frequency of sudden death among children with dilated cardiomyopathy ranges from 1.5% to 4%, arrhythmia being the cause of death in most cases. Cardiac rhythm disorders are both bradycardic (atrioventricular block) and tachycardic (unstable ventricular tachycardia). The risk factors for sudden death include polymorphic ventricular extrasystoles. However, heart rhythm disorders are not an independent risk factor for sudden death, as they are closely associated with left ventricular dysfunction. In the case of sudden death, ventricular fibrillation has been observed to be high, and a sharp disturbance of pumping function of the left ventricle and an increase in pressure in the cavity contribute to its appearance [4]. Wide introduction of highly informative instrumental methods of cardiac examination, first of all, echo doppler cardiography, makes it possible to regulate the idea of cardiomyopathy as a nosological unit [3]. According to European experts, the diagnostic criteria of DCMP are left ventricular ejection fraction (LV ejection fraction) less than 45% (according to echocardiography) or fractional shortening of anterior-posterior left ventricle size less than 25% [4]. According to genetic studies, family predisposition to autosomal-dominant inheritance is mainly important in the development of idiopathic DCMP. Autosomal recessive X-linked and mitochondrial

forms of the disease are also found [5,6]. Acute myocarditis plays an important role in the development of DCMP, when first myocardium is affected and then chronic inflammation develops, which in turn leads to remodelling of the heart and its dysfunction (post-inflammatory DCMP) [5].

It should be noted that in the overwhelming majority of family forms of DCMP, genetic disorders are combined with autoimmune ones. Viruses may be a trigger factor for DCMP development in persons with genetic predisposition [6]. In general, the etiology of DCMP remains unclear to date.

It should be noted that when making the diagnosis of idiopathic DCMP should be taken into account: its secondary origin on the background of systemic blood diseases, kidney pathology (uremic cardiomyopathy), an anomaly of the heart and large vessels (Gerland Blount White syndrome), inflammatory diseases of the main vessels, mitochondrial diseases, which requires additional methods of research.

The correct and timely diagnosis of DCMP remains a challenge. Diagnosis should be made based on a set of all methods, from anamnesis collection, clinical examination of the patient to the results of noninvasive and invasive research methods (6).

The clinical picture of DCMP is variable and determined mainly by the severity of circulatory disorders. Hemodynamic disorders are a consequence of a significant reduction in myocardial contractility and pumping function of the heart, first of all, of the left ventricle, which is accompanied by an increase in pressure in heart chambers, their dilatation with subsequent development of stagnation in small and large circulation circles.

In the early stages, unfortunately, the disease runs little or no symptoms. Occasionally, heart lesions are detected by accident on an ECG or X-ray examination is undertaken for a pathology of the bronchopulmonary system.

The first clinical sign of the disease may be cardiac rhythm disorders and thromboembolic syndrome (pulmonary artery thromboembolism and embolism in the artery of a large circulation circle, acute cerebral circulation disorder with stroke and myocardial infarction) [3].

Clinic of cardiac insufficiency depends on the degree of stagnation in small and large circulation circles, in the early stages are determined mainly the signs of lesions of the left side of the heart with progressive left ventricular insufficiency (with a clinical picture of the pre-edema and pulmonary edema), as the progression of the severity of the heart is joined by right ventricular insufficiency (occurrence of hepatomegaly, oedema syndrome).

Given the severity of clinical symptoms, the progression of clinical manifestations in the dynamics of the disease and the formidable complications that often lead to death, early diagnosis and differential diagnosis of DCMP in children is a pressing problem in clinical pediatrics in general, and in pediatric cardiology.

Based on the above, this scientific study aimed to determine the clinical and functional features of dilatation cardiomyopathy in children.

Materials and Methods.

We examined 42 children with DCMP aged from 2 months to 18 years who were hospitalized at the cardio-rheumatology department of the Republican Specialized Scientific-Practical Medical Center for Pediatrics of the Ministry of Health. The control group consisted of 30 practically healthy children.

Analysis of anamnesistical and objective data showed that children's DCMP was 16.6±3.4 months old on average. The diagnosis was made based on complaints, anamnesis data (obstetric history of the mother, history of the child's life and illness, past diseases, nature of the course and duration of the disease) and clinical and functional data (ECG, echocanalysis, Holter ECG monitoring), laboratory (general haematological analysis, biochemical blood analysis with the determination of cardio specific markers - creatine kinase, lactate dehydrogenase) and instrumental (chest X-ray, multispiral computer tomography of the chest) examination methods.

At the time of the examination, the age, sex, height and body weight of the child were taken into account. Body surface area (BSA, m^2) and body mass index (BMI, kg/m^2) was calculated based on body length/height and body weight. BSA was calculated using the DuBois formula: $BSA = M^{0.425} \times P^{0.725} \times 71.84 \times 10^{-4}$, where M is body weight (kg), P is body length/height (cm); BMI is calculated using the formula: $BMI = M/P^2$ ((kg/m^2)). ECG was carried out as planned to patients at each hospitalization in cardioreumatology department, both at the primary examination and repeated hospitalization in the department on the Aplio-500 ultrasound device ("Toshiba", Japan) by sector sensors 3.0-6.5 MHz. EchoCG was performed according to standard methods following national and foreign guidelines and recommendations. Two-dimensional echocardiography with the determination of echometric indicators was used. Left ventricular myocardial contractility was assessed by the Teicholtz or Simpson emission fraction (EF) and left ventricular myocardial shortening fraction (EF) [6].

Results and Discussion.

It is known that the birth of children with various diseases and congenital anomalies, as well as their subsequent development and health status, depend on the current state of health of their mothers.

It should be noted that the analysis of obstetric history showed that mothers of children with DCMP underwent VRI in 88.2% of cases during pregnancy, TORCH-infections (mainly cytomegalovirus and herpes virus) were detected in 50% of cases, toxicosis manifestations in the second half of pregnancy - in 47.5% of cases (preeclampsia of the 1st degree - in 28.5%, preeclampsia of the 2^{nd} degree - in 19.05%), and premature births in 28.5% of cases. In previous pregnancies, 19.55% of mothers had stillbirths, and 30.9% had miscarriages in the first and second trimesters. The age of mothers is of great importance. For example, 35.7 % of mothers of children with DCMP exceeded the age of 35.

Factors such as close marriage (19.05 %), hereditary predisposition (28.5 %) and childhood illnesses were of great importance for the development of children with DCMP. As can be seen from Table 1, all children with DCMP have had VRI in their history, and almost half of the children observed (47.6 %) had chickenpox. Bronchopneumonia, acute intestinal infections, purulent angina and pyelonephritis were followed up.

Table 1.

Transient diseases of children with DCMP

Transient diseases	**Children with DCMP (n=42), abs/%**
VRI	42 (100 %)
Chicken pox	20 (47,6%)
Bronchopneumonia	11 (26,2%)
Acute intestinal infections	6 (14,3%)
Pustular sore throat	5 (11,9%)
Pielonephritis	4 (9,5%)

The analysis of clinical manifestations showed that the symptoms of congestive heart failure were one of the most typical signs at admission. In 25 (59,5%) children with DCMP, there were cases of left ventricular insufficiency, in 17 (40,5%) - cases of total heart insufficiency (3^{rd}-4^{th} functional class, according to NYHA).

In 3 children admitted to the gastroenterology department with the dyspeptic syndrome (vomiting, fast stools and swelling in the lower extremities), the diagnosis of DCMP was established randomly at a routine EchoCG examination, which revealed a significant reduction in myocardial contractility with a reduction in the ejection fraction to 25%. In 6 children (14.3%) DCMP was

diagnosed with sudden death within the first 6 hours from the onset of cardiac insufficiency; in 4 children (9.5%) it was diagnosed with the syncopal condition under physical activity.

14 children (31.8%) were diagnosed with postmyocarditic DCMP. It took an average of 1 year from the beginning of myocarditis to the diagnosis of DCMP.

X-ray examination of children with DCMP revealed an increase in heart size mainly due to leftwards in 57.1% of children, total expansion - in 11.9% of children, the cardiothoracic index averaged 63.3±0.5% (Fig.1).

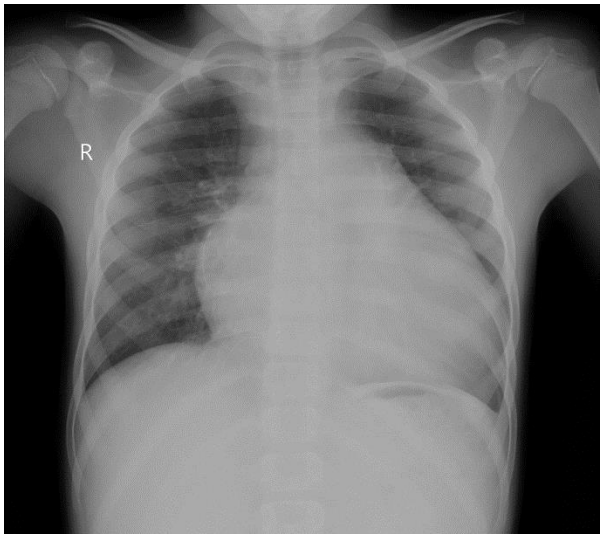


Fig. 1. Sick D., 6 years old. On the chest x-ray in the direct projection, the heart is enlarged in both directions (more to the left), the heart arcs are not differentiated on both sides. Cardiothoracic index (CTI) =0.68. Stagnation in the lungs.

Sinus rhythm rigidity with tachycardia tendencies prevailed on ECG in 30 (71.4%) children; cardiac rhythm disorders in the form of extrasystole were registered in 12 (28,5%) children, supraventricular tachycardia - in 20 (47,6%) children, conduction disorders in the form of a blockade of branches of Gis bundle, more often in left anterior branch - in 36 (85,7%) children that were accompanied by the sharp deviation of the electric axis to the left (EAL). Signs of left ventricular hypertrophy were observed in 42 (100%) children, and in 10 (23,8%) children - both ventricular hypertrophy.

EchoCG in children with DCMP revealed heart chamber dilation, systolic dysfunction with reduction of ejection fraction from 40% to 16%, regurgitation on mitral and tricuspid valves. Echocardiographic signs in the examined children are presented in Table 2.

Table 2.

Echocardiographic signs in children with DCMP

Echocardiographic signs	**Children with DCMP n=42 (%)**
Valve regurgitation (TC and MC)	42 (100%)
Systolic dysfunction	42 (100%)
Reduction of the emission fraction to 40%	42 (100%)
Left ventricular wall hypokinesia (LV)	42 (100%)
Paradoxical interventricular septal movements (IVSM)	20 (47,6%)
Hypertrophy with dilatation	5 (11,9%)

As can be seen from Table 2, all children with DCMP had systolic dysfunction, reduction of ejection fraction below 40%, and left ventricular wall hypokinesia. Paradoxical movements on IVSM were observed in 20 (47.6%) children.

The results of echocardiographic studies showed that in children with DCMP, the final volume of the left ventricle reached from 94 ml to 206 ml, which was associated with an increase in its filling pressure and pronounced dilatation of the left ventricle, which was accompanied with varying degrees of relative insufficiency of mitral, in some cases, and tricuspid valves. According to our data, an increase in finite-diastolic pressure in the left ventricle above 12 mmHg was observed in 57.1% of children, and an increase in systolic and diastolic pressure in the pulmonary artery above 30 and 12 mmHg, respectively. - in 42.9% of children. This was also accompanied by an increase in right ventricular filling pressure above 6 mmHg. Right ventricular dilatation in 42.9% of children was accompanied by a dilatation of hollow and hepatic veins, which is typical for the stagnation of blood in a large circulation circle.

By predominant localization of myocardial lesion by echocardiographic criteria, the children were divided into six variants of DCMP:

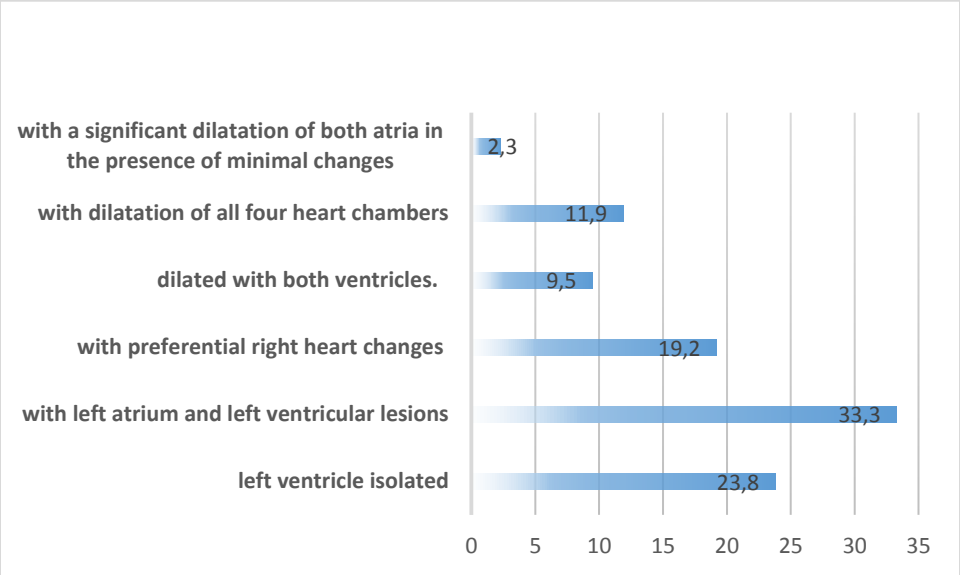
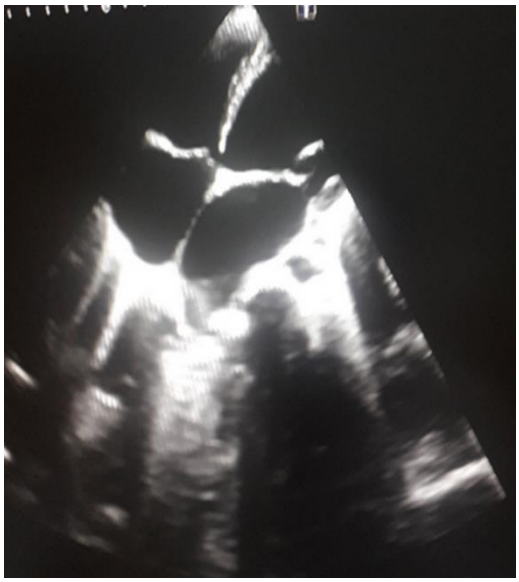


Fig.2. Distribution of children with DCMP depending on echocardiographic variants of myocardial lesions

The distribution of children with DCMP depending on echocardiographic variants is presented in Fig. 2. As can be seen from the figure, according to the predominant localization of the lesion in the myocardium by echocardiographic criteria are divided into six variants: 10 (23,8%) children with 1 variant - isolated lesion of the left 2.3

; 14 (33,3%) children with 2 variants - lesions of the left atrium and left ventricle; 8 (19%) children with 3 variants - predominant change of the right heart; 4 (9,5%) children with 4 variants - dilatation of both ventricles; 5 (11,9%) children with 5 variants - dilatation of all four heart chambers; 1 (2,4%) child with 6 variants - significant dilatation of both atria with minimal changes in the morphofunctional state of ventricles. In children with 3 echocardiographic variants of DCMP differentiation with arrhythmogenic dysplasia of the right ventricle was made. Among echocardiographic variants 1 and 2 variants (57,1% of children) were the most frequent, which are manifested by left ventricular and left atrial dilatation. In such children, differentiation of DCMP with nonrheumatic myocarditis was made. Among them, 23.8% of children, against the background of adequate complex therapy, had positive dynamics with the improvement of functional indices, namely, improvement of myocardial contractility, an increase of discharge fraction (up to 45.0% in dynamics), reduction of FDV LV. In 1 child there was observed the elimination of the signs of cardiac

insufficiency with the restoration of the pumping function of the heart (40%, dynamics 60%), which was the reason for changing the initial diagnosis of DCMP to nonreumatic myocarditis. In 5 (11.9%) children, a fatal outcome was noted despite the comprehensive therapy as a result of increased heart failure and arrhythmic syndrome, which is one of the most formidable complications of DCMP. In children of this group, dilatation of all four heart chambers was visualized on the EchoCG (5 variant of DCMP).



A **B**

Fig.3.Echocardiogram of patient A., 2 years old, diagnosis: DCMP: a - total hypokinesia of LV walls; b - dilatation of all heart cells in four-chamber position.

1 and 2 variants of echocardiographic parameters in DCMP have similarity with echocardiographic signs of acute myocarditis, especially in young children (Fig.3). Distinctive signs of DCMP in children are progressive course of cardiac insufficiency and refractoriness of anti-inflammatory therapy, i.e. progressive reduction of myocardial contractility, lesions and other cardiac chambers to a total expansion of all cardiac chambers.

Conclusions

The following factors influence the development of dilated cardiomyopathy in children:

1. The mother's age over 35 years, the mother's diseases during pregnancy (more viral etiology), complicated course of pregnancy (eclampsia, miscarriages), premature delivery, hereditary predisposition to cardiomyopathy in close relationships, as well as children's diseases of viral etiology, especially VRI.
2. DCMP in children is characterized by features in the functional indicators of the cardiovascular system: echocardiographic disorders, such as systolic dysfunction, a decrease in the ejection fraction below 45%, hypokinesia of the left ventricular wall. Children with DCMP are also characterized by paradoxical movements on IVSM (47.6% of cases).
3. By predominance of myocardial localization in children with DCMP, six echocardiographic variants are distinguished, with a predominance of variants with lesions of the left atrium and left ventricle (33,3%) and with isolated lesion of left ventricle (23,8%).

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