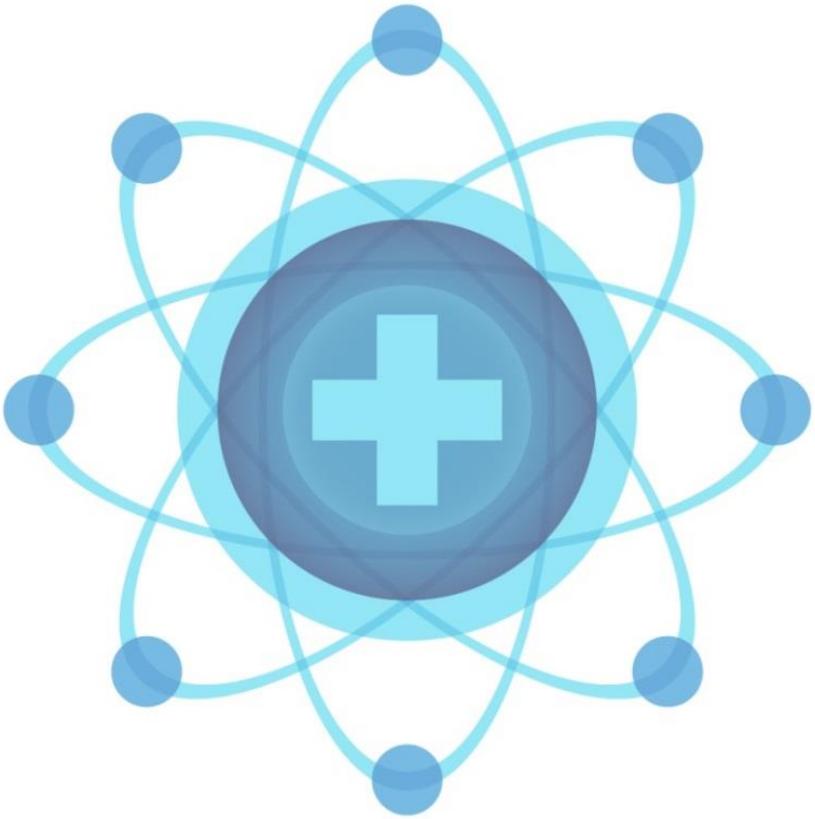

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# Myocarditis in older children

**Karimova Z.Sh. , Shaislamova G.S.**
Tashkent pediatric medical institute

**Abstract.** This article presents the basic principles for the diagnosis and treatment of acute myocarditis in older children. ECG, ECHO cardiographic data are given. Data on specific cardioenzymes are also given . The following laboratory tests were carried out according to generally accepted methods: complete blood count with determination of hemoglobin, counting of leukocytes and erythrocytes, determination of capillary blood leukocyte formula , erythrocyte sedimentation rate; general urine analysis: color, reaction, specific gravity, protein, sugar, sediment microscopy; biochemical blood test (rheumatological tests); total protein, albumins, globulins, protein fractions - tti , Og , P, y. C-reactive protein (CRP), seromucoid .

**Keywords:** myocarditis; ECG; ECHO; cardioenzymes ; older children

**Introduction.** The problem of acute myocarditis is currently due to its wide distribution, especially in childhood. The reason for this is the steady growth of viral infections and the allergization of the child population [5, 12].

One of the main causes of acute myocarditis today is acute respiratory viral infections (ARVI), which remain the most common and global diseases in children and adults. Despite the relative epidemiological well-being over the past 8-10 years, they still account for 70-90% of infectious diseases and cause enormous socio-economic damage. Each influenza epidemic is accompanied by an increase in the number of cases of acute myocarditis, which determines the relevance of studying this problem [10, 28]. The most important in clinical practice are complicated forms of ARVI, which cause a severe course of the disease and determine an unfavorable prognosis. The ever-increasing interest of pediatricians and cardiologists in Uzbekistan and abroad in the problem of acute myocarditis is also associated with diverging opinions on the terminology, pathogenesis, diagnosis and treatment of this disease [7, 17]. The terms “non-specific” and “non-rheumatic” myocarditis are still being discussed, which seem to be unsuccessful due to their lack of specificity, vagueness and little utility for the practitioner. It was not possible to develop uniform, clear diagnostic criteria [2, 8, 14, 20]. This is partly due to the peculiarities of the development of the disease, when, along with an acute onset and a typical clinical picture, there is often an asymptomatic course with sudden heart failure after many months and years [1, 6, 11]. Myocarditis occupies a special place in the classification, due to its wide prevalence, variety of forms and non-specific clinical manifestations. In clinical observations, there has been a steady increase in the incidence of myocarditis, especially among children and young people [3, 4, 9]. A. Frustaci et al . from 1983 to 2016, 4582 myocardial biopsies were examined and myocarditis was found in 37.4% of cases [10, 13]. In another study of 3055 endomyocardial biopsies performed for various indications, myocarditis was detected in 17.2% of cases [15]. Mortality in myocarditis is, on average, 1-7% [16]. The causes of death are sudden cardiac death, progressive heart failure, arrhythmias. According to the literature, from 2 to 42% of cases of sudden cardiac death develops in patients with chronic myocarditis. The etiological agents of myocarditis include infectious, immune factors, endocrine disorders, toxic effects [18]. Most often, myocarditis is caused by

viruses ( parvovirus , Epstein- Barr virus , Coxsackie B virus, herpes virus and others), persistence [19]. However, to date, there are no clear diagnostic and therapeutic criteria for acute myocarditis in children.

**The aim of the study** . To optimize the tactics of treating older children from 11 to 15 years old with myocarditis.

**Material and research methods.** We examined 90 children aged 11 to 15 years with a complicated course of ARVI. The observed were divided into two groups: the main group (A), which in turn was divided into two subgroups ( Ai and Ag ) and the comparison group (B). In follow-up for 3 months, 40 children were observed (20 from each subgroup). The comparison group (B, u = 30) included children with clinical and laboratory signs of ARVI, but without acute myocarditis. The principle of selecting children in the group was the presence of characteristic clinical symptoms of possible acute myocarditis. The following general clinical research methods were used in the work: history taking, analysis of primary medical documentation, objective examination of sick children by organs and systems in accordance with traditional methods (with a primary focus on the cardiovascular system), follow-up study. The following laboratory tests were carried out according to generally accepted methods: complete blood count with the determination of hemoglobin, the count of leukocytes and erythrocytes, the determination of the leukocyte formula of capillary blood, the erythrocyte sedimentation rate; general urine analysis: color, reaction, specific gravity, protein, sugar, sediment microscopy; biochemical blood test (rheumatological tests); total protein, albumins, globulins, protein fractions - tti , Og , P, y. C-reactive protein (CRP), seromucoid , antistreptolysin O (ASL - O) and alatschaminotransferase ( AlAT ), aspartate aminotransferase ( AST ), potassium. To conduct a biochemical blood test, a KFK-3 KFKMP photoelectrocalorimeter with a microprocessor and a flame photometer were used. To compare the data of the two study groups, the paired Student's test (for absolute values) and the Z-test (for percentages) were used . To assess the effectiveness of treatment, non-parametric statistical methods were used: the Wilcoxon test and the paired Student's test - for one group before and after treatment, the Mann-Whitney test - for two groups

**Research results.** Clinical and laboratory characteristics of the main groups of the examined. In the social and age aspects, the children of groups A and B did not have significant differences at the time of the examination. Middle age ! in the main group was 5.8 ± 0.6, in the comparison group - 5.9 ± 0.6. In the group with acute myocarditis, boys predominated (61.6%) in most cases of preschool age, in contrast to the comparison group, where boys accounted for 43.4%. Analysis of the perinatal history showed that in the main group (A) a greater number of women had a pathological course of pregnancy, in the form of preeclampsia in the first and second half of pregnancy (75% versus 63.3%), the threat of miscarriage (56.7% versus 26.7% ), which is significantly (p = 0.036) more often than in the comparison group (B). Chronic maternal diseases and a burdened obstetric history were more common in the main group (25% versus 16.7% and 21.7% versus 13.3%, respectively). In group A, only in 64.9% of cases, childbirth proceeded physiologically, while in group B this figure was 76.7%. When studying the premorbid background, we found that in

children with acute myocarditis it was more unfavorable than in children of the comparison group. Rickets were more common - in 90% of children; anemia - in 53.4%; chronic malnutrition by the type of malnutrition - in 25%, allergies in the first year of life were in 58.3%, perinatal CNS damage was observed in 86.7%. The physical and neuropsychic development of children in both groups had no significant differences and in 90% of cases did not differ from the average population parameters. Burdened heredity for diseases of the cardiovascular system significantly more often ($p = 0.039$) occurred in patients with acute myocarditis (66.7%), while in children of the comparison group it occurred only in 36.7% of cases. When analyzing the state of health of children In both groups, we observed that acute myocarditis significantly more often ($p < 0.05$) developed in children with pathology of the ENT organs, in particular, with chronic tonsillitis and hypertrophy of the palatine tonsils. They were more likely to have allergies and chronic somatic pathology, reduced resistance. The average incidence of acute respiratory viral infections in the main group was $4.9 \pm 0.3$ times a year. According to the results of our studies, acute myocarditis in 80% of cases developed against the background of a complicated course of ARVI in the form of bronchopneumonia and obstructive bronchitis caused by adenovirus infection and influenza. Clinically, in all children, ARVI and complications proceeded typically. All children had catarrhal syndrome and endogenous intoxication. However, in children with acute myocarditis, complaints were more common: prolonged weakness and lethargy (56.7%), excessive sweating (58.3%), pain and interruptions in the heart area (11.7% and 21.6%, respectively). ), while in the comparison group these complaints were much rarer or absent (Fig. 1).

**Fig. 1. Complaints of children of the main group and comparison group.**

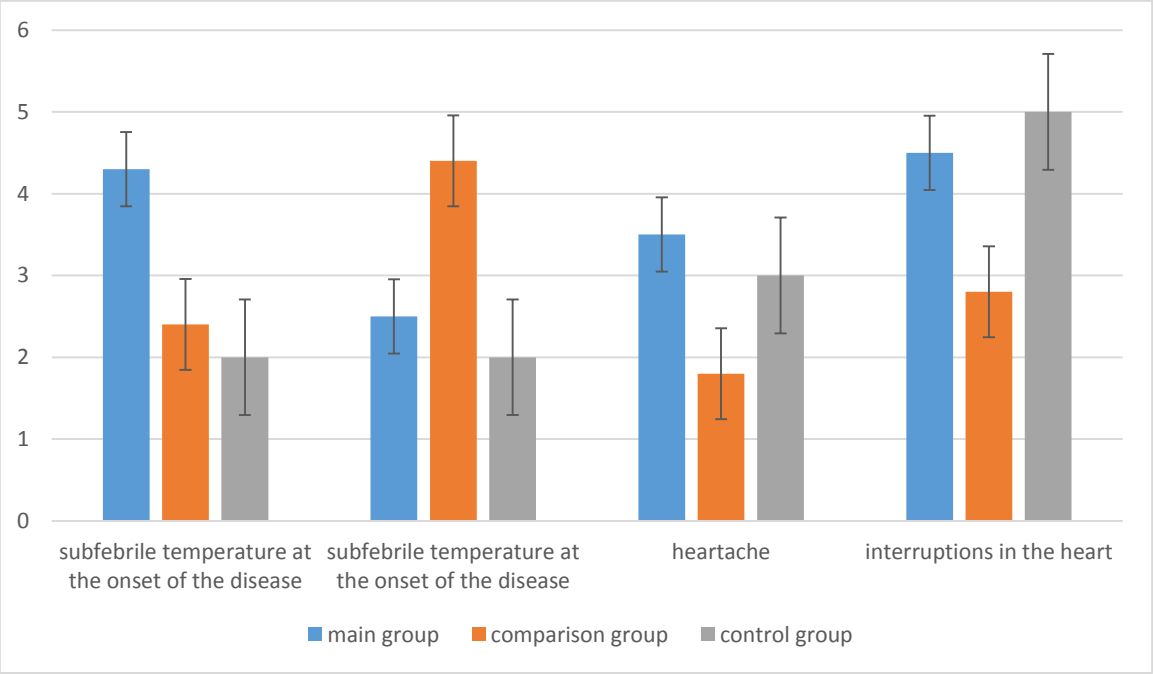
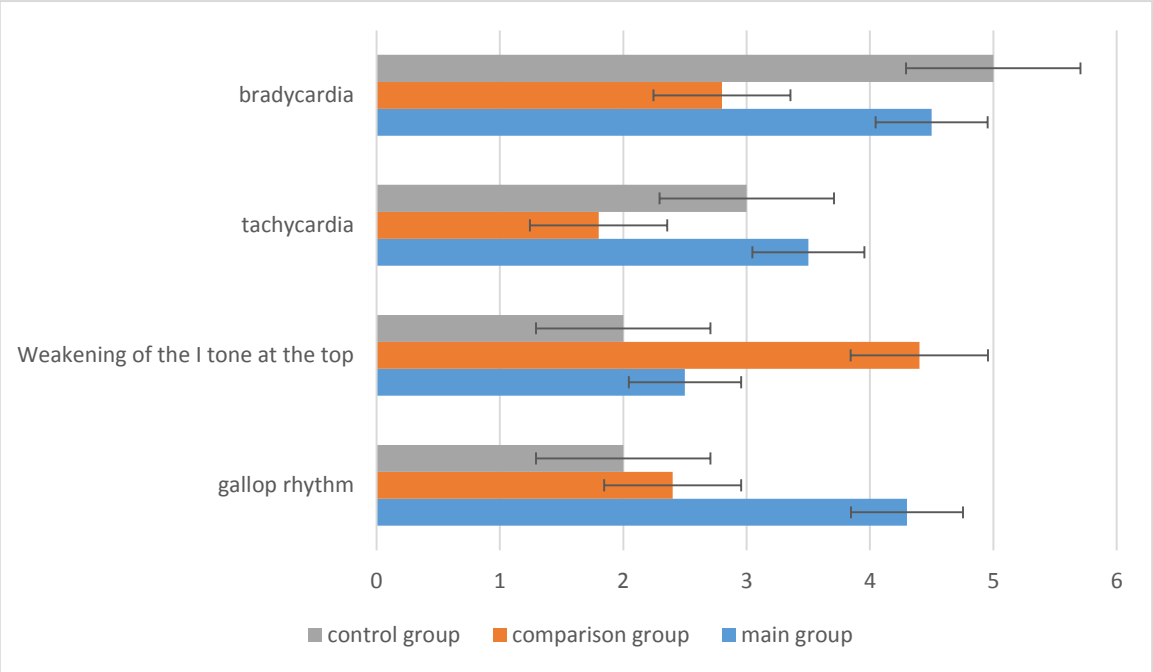



**Fig. 2. Features of an objective examination of children with myocarditis**




As can be seen from Figure 2, an objective examination of the cardiovascular system revealed clinical features in children in the group with acute myocarditis, namely, the expansion of the boundaries of relative cardiac dullness (10%), diffuse apex beat (10%), tachycardia in 53.3% (I degree - 35%, II degree - 11.6%, III degree - 6.7%) ($p < 0.001$ ) and gallop rhythm (28%) ($p < 0.05$), which was not determined in children of the comparison group . In addition, significantly more often ($p < 0.001$ ) in children of the main group, auscultation observed a weakening of the first tone at the apex (78.3%) and an accent of the second tone on the pulmonary artery (71.6%). Systolic murmur of relative mitral valve insufficiency (in 28%) was detected only in children with acute myocarditis ($p < 0.001$ ). Other auscultatory phenomena due to the presence of small anomalies in the development of the heart (additional chord of the left ventricle, open oval window, mitral valve prolapse) occurred in all cases in the comparison group and in 66.7% in patients with acute myocarditis. OAK in children with acute myocarditis did not reveal any specific signs of acute myocardial damage and did not have significant differences (both in terms of red blood and leukocyte count) with the comparison group . In a biochemical blood test, every third child with acute myocarditis showed an increase in acute phase indicators of inflammation - hypoalbuminemia , hyper ag - globulinemia , increased ASL-O, seromucoid and PSA. In half of the children, we observed changes in humoral immunity, including an increase in immunoglobulin ( Ig ) M. However, we did not find significant differences with the comparison group. When studying the levels of cardiospecific enzymes in the blood serum of all children with acute myocarditis, we observed their significant increase ($p < 0.05$, $p < 0.001$), which was not observed in children with ARVI without myocarditis (Table 1).

**Table 1. Results of the study of cardiospecific enzymes.**

| Indicators | N (norm) | Main group | Comparison group | Control group |
|---|---|---|---|---|
| KK-MV (cardiac | up to 25 | 42.2±3.486 | 19.47±0.967 | 13.6±1.092 |

| | | | | |
|---|---|---|---|---|
| **fraction)** | | | | |
| **QC-total** | **Up to 190** | **200.0±40.61** | **144.7±19.416** | **103.8±11.24** |
| **LDH (total)** | **225-450** | **760.6±33.47** | **655.1±26.75** | **538.4±17.16** |

This fact made it possible to accurately state that the children of the main group had damage to cardiomyocytes with the release of cardiospecific enzymes in the blood serum, while to a greater extent this concerned CK - MB and a - HBDG. These enzymes were significantly ($p < 0.001$ ) elevated only in children with acute myocarditis in 100% and 78.3% of cases, respectively. At the same time, the level of general CK, which is not highly cardiospecific , was not always elevated in acute myocarditis and was only 30% in our study. The number of children with elevated levels of total LDH in the group with acute myocarditis was 98.3% versus 63.3% in the comparison group. The increased activity of this enzyme indicated to a greater extent the presence of an acute process in the epithelium of the bronchopulmonary system and, to a lesser extent, an acute inflammatory process in the myocardium. The fact that the average figure for the activity of total LDH and a greater percentage of patients with an increase in the activity of this enzyme was in children in the group with acute myocarditis confirmed the assumption that myocardial damage develops more often in children with more severe ARVI and more severe damage to the bronchopulmonary system. . Quantitative analysis of ECG symptoms in children of the main group made it possible to establish that acute myocarditis most often has a combination of three to four ECG symptoms, while children in the comparison group had an average of one or two ECG symptoms characteristic of the current SARS. Echo-South study revealed a significant predominance ($p < 0.05$) in children with acute myocarditis, a decrease in the pumping function of the left ventricle in 28% of cases, while this was not noted in the comparison group. Among the pathology identified in patients with acute myocarditis, according to the results of PRCG, the most common was a decrease in the pumping function of the heart (81.8%) and an increase in total peripheral vascular resistance (45.4%). High energy consumption of the myocardium was observed in 36.3% of cases. Plain chest radiographs showed signs of current SARS, bronchitis and pneumonia in all children. However, only in children with acute myocarditis in 8.1% of cases, we observed an increase in the cardiothoracic index up to 65%, which spoke in favor of an increase in the cavity ventricle and did not exclude the presence of acute myocarditis in children of the main group. Comparing the results of sputum culture on the flora of children in both groups, we did not obtain significant differences in the microbial spectrum, which suggests the leading role of viral infection in the etiology of acute myocarditis. Thus, acute myocarditis against the background of acute respiratory viral infections developed significantly more often in boys of preschool age with aggravated heredity for diseases of the cardiovascular system against the background of reduced body resistance. At the same time, the most informative, sensitive and specific test for diagnosing acute myocarditis, especially at its early stage and with an erased clinical

picture against the background of ARVI, was enzyme diagnostics (determination of cardiospecific enzymes) with subsequent calculation of the corresponding coefficients and TgT - diagnostics.

The effectiveness of special therapy was assessed by clinical data and repeated studies of cardiospecific enzymes and immunoglobulins in the blood serum, as well as with the help of ECG and Echo-KG. Both subgroups were examined immediately after the main inpatient treatment and 1 month after it. After inpatient treatment, no one showed signs of ARVI. However, there were various kinds of objective residual signs of acute myocarditis. Sweating was detected in 13.4% of patients in both subgroups. Weakness and lethargy persisted in 36.6% of patients in the Ai subgroup and in 30% of the Aa subgroup . An increase in the boundaries of the heart, a diffuse apex beat, a weakening of the first tone at the apex and an accent of the second tone on the pulmonary artery remained in 10% of children in subgroup A) and in 3.3% in subgroup AG - Systolic murmur up to 2/6 - 3/6 systole along the left edge of the sternum with the epicenter at the Botkin- Erb point with conduction to the apex of the heart, due to relative insufficiency of the mitral valve against the background of an increase in the cavity of the left ventricle, occurred only in 6.6% in the Ai subgroup and in 3.3% of patients in the Lg subgroup . Approximately half of the children retained somewhat elevated values of CC - MB, a - HBDG, and to a lesser extent - values of CC total . and LDH total. Indicators of the coefficients proposed by us K ^ f -i and K ^ ^ f .2. also pointed to incomplete recovery of cardiomyocytes after acute myocarditis in children of both subgroups. In 2/3 of the children, ECG showed dysmetabolic disorders in the ventricular myocardium, less often - disturbances in repolarization processes and prolongation of the QT interval, and according to the results of echocardiography, some children retained residual myocardial remodeling , in the form of an increase in the cavity of the left ventricle. Thus, after the main treatment in the hospital (that is, before the course of special therapy in the AD subgroup, both subgroups did not have significant differences between themselves, which made it possible to consider them clinically and paraclinically homogeneous . 1 month after the main treatment (against the background conducted course of special therapy), we noted a significant positive trend in terms of complaints in subgroup A. In 90% of the children of the subgroup ($p < 0.05$ ) there were no complaints, while in the subgroup AG this figure was 60%. we observed a decrease in sweating (from 13.4% to 3.4%) and weakness (from 36.6% to 6.6%; $p < 0.05$ ) in patients of subgroup A], while in children of subgroup AG these indicators did not differ significantly from the data that were immediately after the main treatment (sweating - in 13.4%, weakness - in 26.7%).When comparing the dynamics of complaints between the two subgroups 1 month after the main treatment, we noted a significant decrease in sweating ($p < 0.05$) in the first subgroup (Fig. 6). We observed a clear trend towards normalization of the boundaries of relative cardiac dullness, apex beat and disappearance of systolic murmur in all children in the first subgroup. In the AG subgroup, 3.3% of children retained enlarged heart boundaries, a diffuse apex beat, and a “soft” systolic murmur at the apex due to relative mitral valve insufficiency. The number of children in the first subgroup with elevated levels of CK - MB in serum after treatment decreased by 5 times (from 56.7% to 11.1% ($p < 0.001$ )), the

number of children with elevated levels of LDH total. and a - HBDG decreased from 46.7% to 18.5% ($p < 0.05$), and from 43.3% to 3.7% ($p < 0.05$) i.e. 3 and 11 times, respectively. In the AH subgroup (1 month after the main treatment), a similar decrease was not statistically significant (Fig. 7). A similar picture was observed in relation to the calculated coefficients of these enzymes. According to the results of Kksfi ($0.91 \pm 0.007$ ), Kksf -2 (0.62 - fc 0.04) and Kksf -3 ($0.72 \pm 0.01$) in the first subgroup, we obtained a significant ($p < 0.05$ and $p < 0.001$, respectively) positive dynamics of the calculated coefficients against the background of the course of special therapy (Table 2). When comparing the results of the calculated coefficients between the two subgroups 30 days after the main treatment, we observed a significantly ($p < 0.05$ and $p < 0.001$) positive result for Kk^f -2 and for Kk^f .3 in the first subgroup, while the values of Kksf -2 and Kksf .^ in the second subgroup did not change 1 month after the main treatment compared with the data immediately after the main treatment. When analyzing humoral immunity, there was a significant increase ($p < 0.05$) in children with normal levels of immunoglobulins of all classes from 43.3% to 76.8%, and a significant decrease ($p < 0.05$) in the number of children with a low level of immunoglobulins Ig A from 33.3% to 7.4% during the course of special therapy. A decrease in IgG after the course of therapy was observed in 3.7% of the children of the subgroup, while before the course of therapy this figure was 10%. We did not note significant changes in the level of immunoglobulins in the second subgroup. Analysis of ECG symptoms in the first subgroup allowed us to state a significant ($p < 0.001$ ) decrease in the number of ECG symptoms from $2.36 \pm 0.2$ to $1.06 \pm 0.16$ against the background of special therapy. In subgroup Aj, this decrease was from $2.23 \pm 0.24$ to $1.76 \pm 0.21$ and was not significant.

In the AG subgroup , on the contrary, there was no significant decrease in the percentage of occurrence of ECG symptoms 30 days after the main treatment. When comparing the ECG results between the two subgroups 30 days after the main treatment, we observed a significant ( $p < 0.001$ ) decrease in dysmetabolic changes in the ventricular myocardium in the first subgroup against the backdrop of a course of special therapy (Table 4). We did not receive any significant changes in Echo-KG against the background of special therapy. Persistent positive clinical and electrocardiographic effects after a course of special therapy, we observed in the first subgroup in follow-up after 3 months. All children had no complaints and changes in the cardiovascular system. On the ECG, we observed a significant ( $p < 0.001$ ) continuing decrease in the number of ECG symptoms from $2.36 \pm 0.2$ to $0.8 \pm 0.15$ (Table 3). Qualitative ECG analysis of the first subgroup showed a significant (( $p<0.05$ ) decrease in the incidence of dysmetabolic disorders in the ventricular myocardium, repolarization disorders and prolongation of the QT interval from 63.3% to 15%, from 56.6% to 10% and from 53.3% to 5% respectively

**Conclusions:** Acute myocarditis more often (in 80%) develops in older boys against the background of a complicated course of SARS in the form of bronchopneumonia and obstructive bronchitis with aggravated heredity for diseases of the cardiovascular system against the background of reduced body resistance and chronic pathology of the ENT organs. Modern acute myocarditis is accompanied by both typical clinical signs (excessive sweating, lethargy, fatigue, persistent

tachycardia, muting of the first tone at the apex, moderate-intensity systolic murmur with an epicenter at the apex and the Botkin-Erb point), and erased, atypical manifestations .

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