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VIRAL INFECTION AS A RISK FACTOR IN THE DEVELOPMENT OF ACUTE CARDITIS IN CHILDREN

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Annotation: Despite the advancement of modern research methods, the diagnosis of viral lesions of the myocardium remains one of the most challenging tasks in clinical practice. Acute carditis may accompany almost any infectious process; however, the main etiological factor is viral infection (70–95%), particularly in children during the first years of life. It is important to note that in nearly one-third of cases, the pathology develops in the presence of superinfection.
Keywords: Acquired carditis, acute viral infection, heart failure, electrocardiography, community-acquired pneumonia, children who are often ill.

Relevance. Non-rheumatic heart lesions (acquired carditis) often complicate the course of various infectious diseases, predominantly of viral origin.[1,8,10] The high prevalence of viral infections, their tropism for endothelial cells and the myocardium, as well as the ability of pathogens to persist in the body for long periods, determine the sustained research interest in the problem of viral heart damage. [2,4,11]

It should be emphasized that, to date, reliable data on the true prevalence of viral carditis are lacking, which is primarily due to the objective difficulties of diagnosis. [2,5] Despite the available evidence base, the identification of viral myocardial lesions remains one of the key and most challenging tasks in modern cardiology. [1,7,8]

Carditis of viral etiology may occur at different stages of the infectious process. In the acute phase of infection, physicians usually take into account the likelihood of its development; however, clinical manifestations and ECG changes are nonspecific and are often interpreted as signs of intoxication syndrome typical of viral diseases. [2,3,9]

Particular attention is currently drawn to the study of carditis in children who have experienced intrauterine or postnatal infection with herpes viruses, cytomegalovirus, and coronavirus infection. It has been proven that intrauterine infection can lead to severe and often fatal myocardial damage in the fetus and may also be considered a potential etiological factor and a predisposing condition for the development of acute acquired carditis in children of different age groups, especially in early childhood. [3,6,9]

Based on the above, the aim of this study was to determine the significance of acute viral infection as a leading risk factor in the development of carditis.

Materials and methods. The study was conducted at the Cardiorheumatology Department of the Andijan Regional Multidisciplinary Children's Medical Center. The study included 40 children with acute acquired carditis.

AMERICAN ACADEMIC PUBLISHER
INTERNATIONAL JOURNAL OF MEDICAL SCIENCES
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At the initial stage, interviews were conducted with the children and their parents, followed by a targeted clinical examination and analysis of laboratory and instrumental data. In conversations with mothers, special attention was paid to the characteristics of the ante- and perinatal period, including viral infections during pregnancy and possible complications of its course.

Instrumental examination of each patient included recording a 12-lead ECG, performing echocardiography with Doppler imaging, as well as chest X-ray with calculation of the cardiothoracic index.

Results and Discussion. The age composition of the examined children showed a fairly wide range, varying from 6 months to 15 years. The largest proportion was accounted for by children under 3 years of age (6–12 months – 40% and 1–3 years – 35%). In terms of gender distribution, boys were observed 1.5 times more frequently (57.5% vs. 42.5%).

To obtain results, we used the perinatal history data of all children included in the study with acute acquired carditis (n=40), which had developed as a complication after an acute viral infection.

During interviews with the mothers of children hospitalized with acute acquired carditis, it was revealed that all women had experienced complicated pregnancies, characterized by both toxicosis and threatened miscarriage, as well as frequent acute viral infections occurring at different stages of pregnancy.

Risk factors of the antenatal period

	abs	**%**
Adverse factors during pregnancy:		
- Toxicosis	**40**	**100%**
- Threatened miscarriage	**16**	**40%**
- Fetoplacental insufficiency	**6**	**15%**
- Preeclampsia	**3**	**7,5%**
***Diseases experienced during pregnancy*:**		
Acute respiratory viral infection (**ARVI**)		
— once	**18**	**45%**
— twice	**22**	**55%**
of which, COVID-19	**5**	**12,5%**
TORCH infection	**8**	**20%**
Anemia — moderate severity	**28**	**70%**
— severe	**12**	**30%**

A very high percentage of women were found to have experienced acute viral infections during pregnancy, including coronavirus infection. This risk factor influenced not only the timing of delivery but also the complicated course of the neonatal period in the examined children. We established that in 35% of women, pregnancy ended in preterm birth. Neonatal asphyxia during labor was recorded in 30% of children, two-thirds of whom had umbilical cord entanglement around the neck.

The presence of underlying diseases in early childhood was also considered as a risk factor that adversely affects health in later age periods (anemia – 100%, rickets – 100%, protein-energy malnutrition – 5%, etc.).

AMERICAN ACADEMIC PUBLISHER
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According to the literature, frequent respiratory viral infections, especially those complicated by pneumonia, are an undeniable risk factor for the development of acute acquired carditis. This was confirmed in our study, since all the children we examined belonged to the group of "frequently ill children" due to recurrent acute viral infections (twice a year – 65%, three or more times – 35%) and acute pneumonia – two or more times a year (47.5%).

Upon hospital admission, the condition of two-thirds of the children was assessed as severe. In 11 children (27.5%), the diagnosis of acute carditis was established upon admission with an initial diagnosis of acute community-acquired pneumonia, while in the remaining patients (72.5%), signs of cardiac involvement were identified 2–3 weeks after an acute respiratory infection.

The complaints of children upon admission were characterized by a wide range of clinical manifestations. The most frequent were dyspnea (100%), progressive weakness (100%), moaning respiration (80%), cough (60%), fever (45%), and sleep disturbances (20%). Less frequently, cardialgia (5%) was observed, predominantly in older children, whereas in younger children rare urination combined with edema (20%) was reported. Hepatomegaly, as a manifestation of heart failure, was present in 70% of children.

Based on subjective and objective findings, more than two-thirds of children had carditis with signs of heart failure, assessed as grade IIB (70%).

In addition to clinical manifestations, we also identified electrocardiographic signs of acute carditis. From a prognostic perspective, unfavorable findings included signs of subendocardial ischemia, determined by changes in the ST segment and T wave. Specifically, in 6 children (15%), there was ST-segment depression below the isoelectric line with a flattened T wave in the left precordial leads (V5–V6), and in 3 children, the same leads showed a negative pointed T wave.

ECG of patient R. Kholiknazarova, 5 years old, case history № 3078/395

ECG findings: sinus tachycardia (HR 150), subendocardial ischemia.

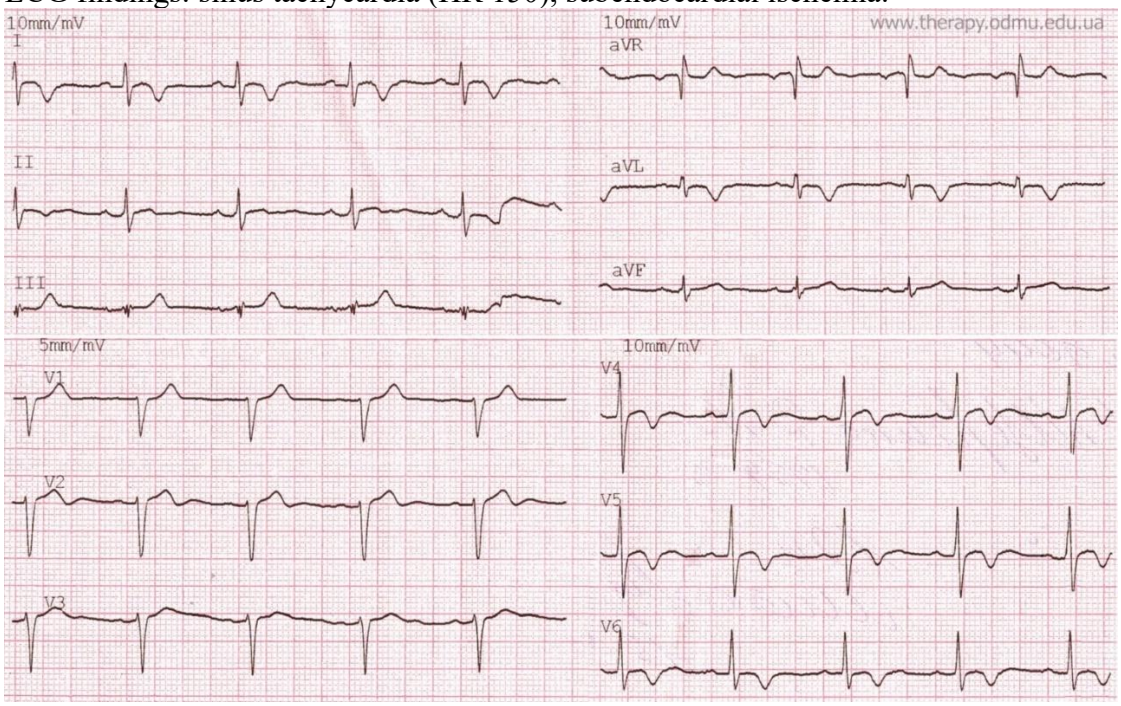

Table 1. Electrocardiographic Findings in Children with Acute Carditis.

AMERICAN ACADEMIC PUBLISHER
INTERNATIONAL JOURNAL OF MEDICAL SCIENCES
ISSN NUMBER: 2692 - 5206 Volume 5,August ,2025

ECG Parameter	Findings	Number of Patients (n=40)	Percentage (%)	Clinical Significance
Heart rhythm	Sinus tachycardia (HR up to 150 bpm)	-	-	Marker of myocardial dysfunction
ST segment changes	Depression below isoelectric line (leads V5–V6)	6	15%	Subendocardial ischemia
T wave changes	Flattened T wave (leads V5–V6)	6	15%	Subendocardial ischemia
T wave changes	Negative pointed T wave (leads V5–V6)	3	7.5%	Severe ischemic changes

Echocardiography provided us with information on the size of the heart chambers, an increase in the end-diastolic and end-systolic dimensions of the left ventricle, as well as a decrease in the ejection fraction. End-systolic size values ranged from 15 mm to 44 mm, and end-diastolic size values ranged from 36 mm to 58 mm. The ejection fraction in all children was below age-related norms, ranging from 28% to 50%.

Confirmatory criteria of acute carditis were the echocardiographic findings of elevated end-systolic and end-diastolic dimensions and a reduced ejection fraction (28–50%). The degree of cardiomegaly was assessed using the cardiothoracic index (CTI) on chest X-ray.

Chest radiography revealed an enlarged cardiac silhouette due to left ventricular dilatation and signs of pulmonary congestion, manifested as increased pulmonary markings. The minimum CTI value was 64%, while the maximum reached 70%.

Chest radiograph of patient I. Mamadalieva, 2 years old, case history No. 19031/1053.

The X-ray shows cardiomegaly, CTI 68%, and congestion in the lungs.

AMERICAN ACADEMIC PUBLISHER
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Table 2. Echocardiography and Chest X-ray Findings in Children with Acute Carditis

Parameter	Range / Findings	Clinical Significance
Left ventricular end-systolic size (LVESD)	15–44 mm	Increased compared to age norms
Left ventricular end-diastolic size (LVEDD)	36–58 mm	Increased compared to age norms
Ejection fraction (EF)	28–50%	Reduced below age-related norms
Cardiothoracic index (CTI)	64–70%	Indication of cardiomegaly
Chest X-ray (heart silhouette)	Enlargement due to LV dilatation	Confirms cardiomegaly
Chest X-ray (pulmonary findings)	Increased pulmonary markings	Signs of pulmonary congestion

Summary of Clinical and Instrumental Findings in Children with Acute Acquired Carditis.

Table 3. Clinical Manifestations on Admission (n=40)

Symptom	Number of Patients	Percentage (%)
Dyspnea	40	100%
Progressive weakness	40	100%
Moaning respiration	32	80%
Cough	24	60%
Fever	18	45%
Sleep disturbances	8	20%
Cardialgia (older children)	2	5%
Oliguria with edema (younger children)	8	20%
Hepatomegaly	28	70%
Heart failure (grade IIB)	28	70%

Table 4. Electrocardiographic Findings.

ECG Parameter	Findings	Number of Patients	Percentage (%)	Clinical Significance
Heart rhythm	Sinus tachycardia (HR up to 150 bpm)	–	–	Myocardial dysfunction marker
ST segment changes	Depression below isoelectric line (V5–V6)	6	15%	Subendocardial ischemia
T wave changes	Flattened T wave (V5–V6)	6	15%	Subendocardial ischemia
T wave changes	Negative pointed T wave (V5–V6)	3	7.5%	Severe ischemic changes

AMERICAN ACADEMIC PUBLISHER
INTERNATIONAL JOURNAL OF MEDICAL SCIENCES
ISSN NUMBER: 2692 - 5206 Volume 5,August ,2025

Table 5. Echocardiographic Findings.

Parameter	Range / Findings	Clinical Significance
LV end-systolic size (LVESD)	15–44 mm	Increased compared to age norms
LV end-diastolic size (LVEDD)	36–58 mm	Increased compared to age norms
Ejection fraction (EF)	28–50%	Reduced below age-related norms

Table 6. Chest X-ray Findings.

Parameter	Findings	Range / Values
Cardiothoracic index (CTI)	Increased	64–70%
Heart silhouette	Enlargement due to LV dilatation	Confirms cardiomegaly
Pulmonary findings	Enhanced pulmonary markings	Signs of congestion

Summary of Findings.

The analysis of clinical manifestations revealed that dyspnea and progressive weakness were the most universal symptoms, observed in all patients, while hepatomegaly and signs of heart failure (grade IIB) were present in more than two-thirds of cases. Less frequent but clinically significant findings included oliguria with edema in infants and cardialgia in older children, indicating age-related differences in disease presentation.

Electrocardiographic data confirmed the presence of subendocardial ischemia in a subgroup of patients. ST-segment depression and abnormal T-wave morphology (flattening or inversion) in leads V5–V6 were identified as unfavorable prognostic markers, reflecting myocardial injury. Sinus tachycardia was a common sign of myocardial dysfunction.

Echocardiography demonstrated enlargement of the left ventricular chambers and a significant decrease in ejection fraction (28–50%), confirming systolic dysfunction. Chest radiography supported these findings by showing cardiomegaly with a cardiothoracic index of 64–70% and pulmonary congestion as a marker of circulatory compromise**.**

Taken together, these clinical and instrumental findings highlight the significant role of viral infections in the development of acute acquired carditis in children. The combination of frequent respiratory infections, adverse perinatal history, and structural-functional myocardial changes underscores the need for early diagnostic vigilance and timely management strategies in pediatric patients at risk.

Conclusions.

1. Acute viral infections represent a leading risk factor in the development of acute acquired carditis in children, particularly in those with a complicated antenatal history and frequent respiratory illnesses in early childhood.
2. The majority of patients demonstrated a severe clinical course, with more than two-thirds presenting with signs of heart failure (grade IIB), highlighting the prognostic importance of timely recognition.

AMERICAN ACADEMIC PUBLISHER
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3. Instrumental studies (ECG, echocardiography, and chest X-ray) confirmed structural and functional myocardial involvement, with subendocardial ischemia, ventricular dilatation, reduced ejection fraction, and cardiomegaly as key diagnostic criteria.
4. The findings emphasize the necessity of early diagnostic vigilance, comprehensive monitoring of children with a history of frequent viral infections, and targeted preventive measures to reduce the risk of acute carditis and its complications.

Our study demonstrated that in all examined children, the development of acquired carditis was causally associated with a preceding viral infection, confirming the decisive role of viral agents in the etiology of this pathology. Furthermore, the high prevalence of comorbid background conditions was found to be of substantial importance, as these may serve as predisposing factors contributing to recurrent viral illnesses and, consequently, to repeated myocardial involvement. These findings underscore the necessity of considering both acute viral infections and underlying health conditions when assessing risk, developing preventive strategies, and ensuring timely clinical management of pediatric patients vulnerable to acquired carditis.

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