



ALGORITHM FOR EARLY DIAGNOSIS OF POST- INFECTIOUS MYOCARDITIS IN INFANTS FOLLOWING ACUTE RESPIRATORY INFECTIONS

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Abstract

Acute respiratory infections (ARI) are among the most common diseases in infants and may lead to various complications affecting different organ systems, including the cardiovascular system. One of the most serious complications is myocarditis, which represents an inflammatory process of the heart muscle and can lead to severe functional disturbances of cardiac activity. Early diagnosis of post-infectious myocarditis in infants remains a challenging clinical problem due to the nonspecific nature of symptoms and the physiological characteristics of early childhood. Delayed identification of myocardial inflammation may increase the risk of heart failure, arrhythmias, and long-term cardiovascular complications. The aim of this study is to develop an algorithm for the early diagnosis of myocarditis in infants following acute respiratory infections and to analyze the clinical and diagnostic features associated with this condition. The research focuses on identifying key clinical symptoms, laboratory indicators, and instrumental diagnostic findings that may assist in the early detection of myocardial involvement after respiratory infections.

Particular attention is given to the role of modern diagnostic methods, including electrocardiography, echocardiography, and laboratory biomarkers of myocardial injury. These diagnostic tools allow clinicians to detect early changes in cardiac function and improve diagnostic accuracy in infants with suspected myocarditis. The proposed diagnostic algorithm is intended to support pediatricians in the timely identification of myocardial inflammation and to facilitate early therapeutic interventions. Implementation of a systematic diagnostic approach may improve clinical outcomes, reduce the risk of complications, and contribute



to better cardiovascular health in infants recovering from acute respiratory infections.

Keywords. Myocarditis, infants, acute respiratory infection, early diagnosis, pediatric cardiology, diagnostic algorithm, cardiac inflammation.

Introduction

Acute respiratory infections (ARI) represent one of the most common health problems among infants and young children worldwide. Due to the anatomical and physiological characteristics of early childhood, infants are particularly vulnerable to infectious diseases affecting the respiratory system. Although the majority of respiratory infections have a relatively benign course, some cases may lead to complications involving other organ systems. One of the most significant and potentially life-threatening complications is myocarditis, which is characterized by inflammation of the heart muscle and impairment of cardiac function.

Myocarditis in infants often develops as a consequence of viral or bacterial infections. Respiratory viruses, including enteroviruses, adenoviruses, and respiratory syncytial virus, are considered among the most common etiological agents responsible for myocardial inflammation in early childhood. Following an acute respiratory infection, infectious agents or immune-mediated mechanisms may lead to damage of myocardial cells, resulting in inflammatory processes within the heart muscle. These pathological changes can impair the contractile function of the myocardium and disrupt normal cardiac rhythm.

Early diagnosis of myocarditis in infants remains a complex clinical challenge. The disease frequently presents with nonspecific clinical manifestations that may resemble symptoms of common respiratory or systemic infections. Infants with myocarditis may present with symptoms such as irritability, poor feeding, lethargy, tachycardia, or mild respiratory distress. In many cases, these symptoms are initially attributed to the underlying respiratory infection rather than to myocardial involvement. As a result, myocarditis may remain undetected during the early stages of the disease.



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Delayed recognition of myocardial inflammation may lead to serious complications, including heart failure, arrhythmias, cardiomyopathy, and long-term impairment of cardiovascular function. Therefore, timely identification of early diagnostic indicators is essential for preventing severe outcomes and ensuring appropriate medical management. Early detection of myocardial involvement following respiratory infections allows clinicians to initiate targeted therapeutic measures and improve the prognosis of affected infants.

Modern pediatric cardiology emphasizes the importance of a comprehensive diagnostic approach in the evaluation of suspected myocarditis. Clinical assessment remains the first step in identifying potential cardiac involvement in infants with recent respiratory infections. Careful evaluation of symptoms, medical history, and physical examination findings can provide valuable clues suggesting myocardial dysfunction. However, clinical examination alone is often insufficient for establishing a definitive diagnosis.

Laboratory and instrumental diagnostic methods play a crucial role in confirming myocardial inflammation. Biomarkers of myocardial injury, such as elevated cardiac enzymes and inflammatory indicators, can provide evidence of myocardial cell damage. Electrocardiography (ECG) is commonly used to detect abnormalities in cardiac rhythm and electrical conduction, which may occur during myocardial inflammation. Echocardiography is another important diagnostic tool that allows visualization of cardiac structure and assessment of ventricular function. These methods enable clinicians to detect early functional changes in the myocardium that may not yet produce severe clinical symptoms. Despite the availability of modern diagnostic technologies, the identification of myocarditis in infants remains challenging due to the variability of clinical presentation and the limited ability of infants to express symptoms. In many clinical settings, the absence of a standardized diagnostic algorithm may delay the recognition of myocardial complications following respiratory infections. Consequently, there is a need to develop clear and systematic approaches that can assist pediatricians in the early detection of myocarditis.

The development of diagnostic algorithms is an effective strategy for improving clinical decision-making in pediatric practice. A structured diagnostic algorithm



can integrate clinical signs, laboratory findings, and instrumental examination results into a unified system that guides physicians through the diagnostic process. Such an approach may increase diagnostic accuracy, facilitate timely referral to pediatric cardiology specialists, and improve the overall management of infants with suspected myocardial inflammation.

Furthermore, the early identification of myocarditis is particularly important in infants due to the rapid progression that cardiac diseases may demonstrate in this age group. Infants have limited physiological reserves, and deterioration of cardiac function may occur more quickly compared to older children. Therefore, implementation of early diagnostic strategies is essential to prevent the development of severe cardiovascular complications.

Considering these factors, the development of an effective diagnostic algorithm for the early detection of post-infectious myocarditis in infants represents an important objective in pediatric clinical practice. A systematic diagnostic approach may help clinicians identify early warning signs of myocardial involvement following acute respiratory infections and allow the timely initiation of therapeutic interventions.

Therefore, the aim of this study is to analyze the clinical and diagnostic features of myocarditis occurring after acute respiratory infections in infants and to develop an algorithm for its early diagnosis. The proposed diagnostic framework is intended to assist healthcare professionals in identifying myocardial inflammation at an early stage, improving diagnostic efficiency, and reducing the risk of severe cardiovascular complications in infants.

Materials and Methods

This study was conducted to investigate the clinical features of myocarditis occurring in infants after acute respiratory infections (ARI) and to develop an effective algorithm for its early diagnosis. The research was carried out in a pediatric clinical setting where infants with recent respiratory infections were observed and examined for possible cardiovascular complications. The study included infants aged from 1 month to 12 months, as this age group is particularly



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vulnerable to both respiratory infections and cardiac complications due to the immaturity of the immune and cardiovascular systems.

A total of 100 infants participated in the study. Among them, 70 infants had a history of acute respiratory infection accompanied by suspected cardiovascular complications, while 30 infants without signs of cardiac involvement served as a comparison group. The selection of patients was based on clinical examination and medical history obtained from parents or caregivers. Infants with congenital heart defects, severe metabolic disorders, or other chronic systemic diseases were excluded from the study to ensure that the observed cardiac changes were associated primarily with post-infectious myocarditis.

All infants underwent a comprehensive clinical assessment conducted by pediatric specialists. The clinical evaluation included analysis of medical history, assessment of symptoms following respiratory infection, and physical examination of the cardiovascular and respiratory systems. Particular attention was paid to symptoms such as tachycardia, dyspnea, feeding difficulties, irritability, lethargy, and signs of circulatory insufficiency. These manifestations were considered potential indicators of myocardial involvement after respiratory infection.

Laboratory investigations were performed to identify inflammatory processes and possible myocardial injury. Blood samples were analyzed to determine leukocyte counts and other inflammatory indicators that may reflect systemic infection or inflammatory activity. In addition, biochemical tests were used to detect markers of myocardial damage, which may indicate the presence of inflammatory changes in the heart muscle.

Instrumental diagnostic methods played a central role in evaluating cardiac function in the examined infants. Electrocardiography (ECG) was used to detect abnormalities in heart rhythm, electrical conduction disturbances, and other signs that may indicate myocardial inflammation. Echocardiography was performed to assess cardiac structure and functional parameters, including ventricular contractility and possible changes in myocardial performance. These methods allowed clinicians to identify early functional alterations of the myocardium that may develop after acute respiratory infections.



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In addition to laboratory and instrumental examinations, particular attention was given to the temporal relationship between respiratory infection and the onset of cardiovascular symptoms. Infants who demonstrated signs of cardiac dysfunction within a short period following respiratory infection were considered to have a higher probability of developing post-infectious myocarditis. This approach helped establish a clinical correlation between the infectious episode and myocardial inflammation.

All clinical, laboratory, and instrumental data obtained during the study were systematically recorded and analyzed. Quantitative data were expressed as mean values with standard deviations, while qualitative indicators were presented as percentages. Comparative analysis was performed to evaluate differences between infants with suspected myocarditis and those without cardiac involvement. Statistical analysis was conducted using standard medical statistical methods, and a significance level of $p < 0.05$ was considered statistically significant.

The collected data served as the basis for developing a diagnostic algorithm aimed at facilitating the early detection of myocarditis in infants following acute respiratory infections. The algorithm integrates clinical symptoms, laboratory findings, and instrumental diagnostic indicators into a structured diagnostic pathway designed to assist pediatricians in identifying myocardial involvement at an early stage.

Results

The experimental analysis of clinical and diagnostic data obtained during the study revealed several significant features associated with the development of myocarditis in infants following acute respiratory infections. A total of 100 infants were examined, including 70 infants with a recent history of acute respiratory infection and suspected cardiovascular complications, and 30 infants without signs of cardiac involvement who served as the comparison group. The results of the study demonstrated that myocardial involvement in infants after respiratory infection is characterized by a combination of clinical symptoms, laboratory changes, and functional cardiac abnormalities.



Clinical observation showed that infants who developed signs of myocarditis after respiratory infection most frequently presented with nonspecific systemic manifestations. Tachycardia was one of the earliest and most frequently observed signs, detected in a significant proportion of infants with suspected myocardial involvement. Feeding difficulties and irritability were also common findings, reflecting the general deterioration of the infant's condition and possible circulatory insufficiency. In some cases, respiratory distress and lethargy were observed, which may indicate decreased cardiac output and impaired systemic circulation.

The distribution of the main clinical manifestations observed in infants with suspected post-infectious myocarditis is presented in **Table 1**.

Table 1. Clinical manifestations in infants with suspected myocarditis after acute respiratory infection

Clinical symptom	Number of infants (n=70)	Percentage (%)
Tachycardia	52	74.3%
Feeding difficulties	44	62.8%
Irritability	39	55.7%
Dyspnea	31	44.3%
Lethargy	27	38.6%

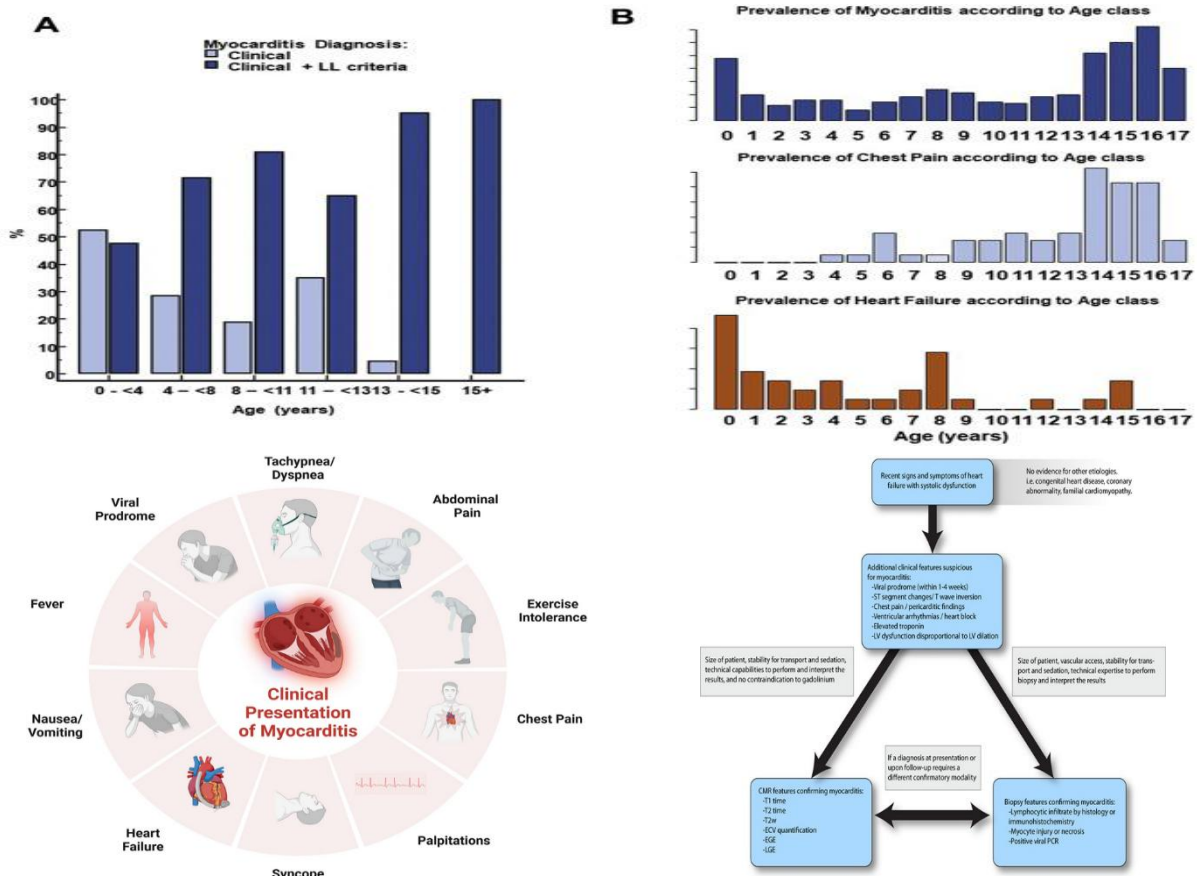
The data demonstrate that cardiovascular symptoms frequently accompany the post-infectious period following respiratory illness in infants and may represent early indicators of myocardial inflammation.

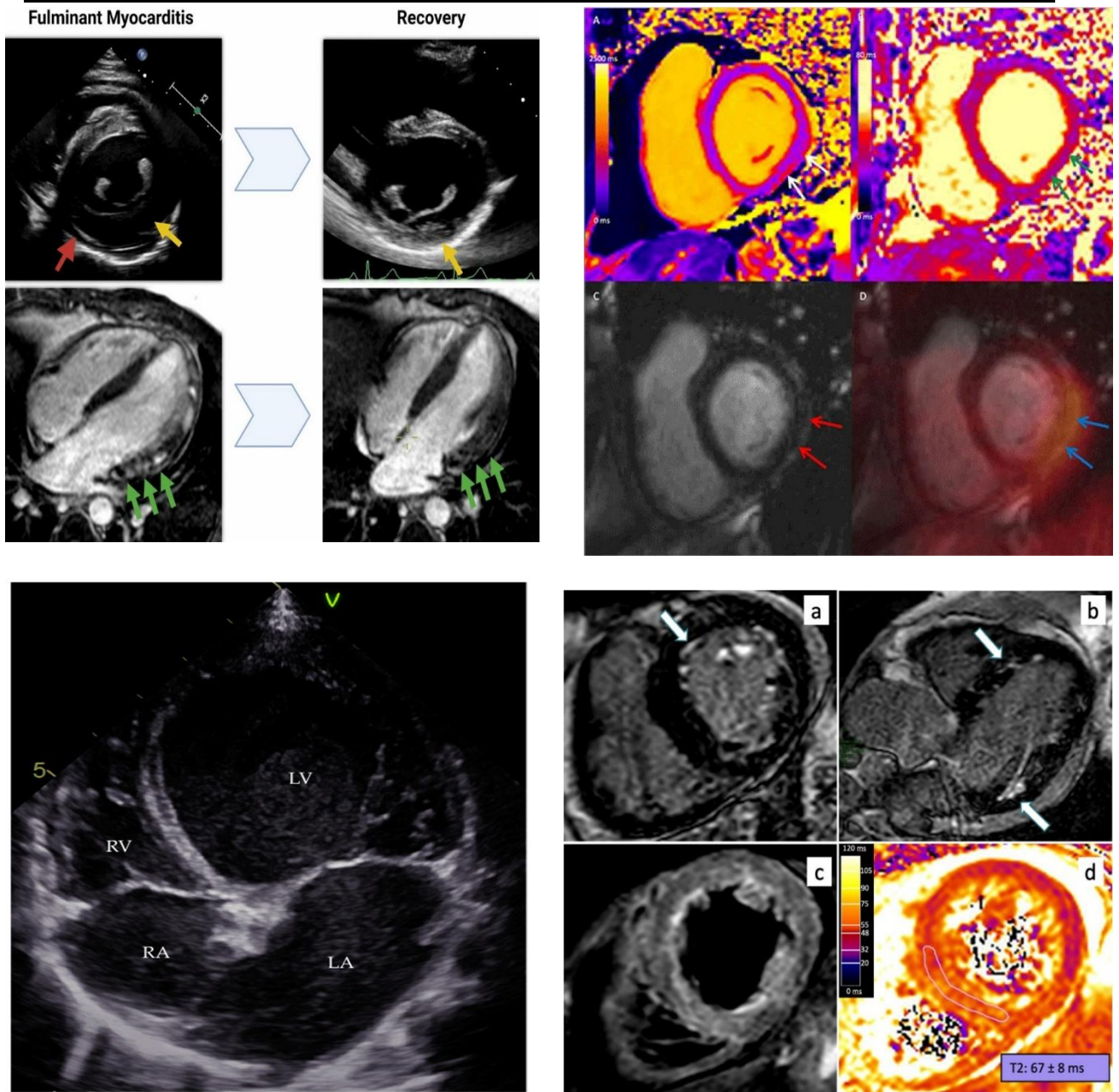
Laboratory investigations performed during the experimental study revealed moderate inflammatory changes in a number of infants with suspected myocarditis. Elevated leukocyte counts and increased inflammatory indicators were observed in patients with more pronounced clinical symptoms. These findings suggest the presence of systemic inflammatory processes that may contribute to myocardial damage following respiratory infection.

Instrumental diagnostic examinations also revealed functional abnormalities in the cardiovascular system. Electrocardiographic assessment detected sinus

tachycardia and minor conduction disturbances in several infants. Echocardiographic examination identified mild changes in myocardial contractility and slight dilation of cardiac chambers in some cases, which may indicate early myocardial dysfunction associated with inflammatory processes. The comparative analysis between infants with suspected myocarditis and those in the control group demonstrated statistically significant differences in several clinical and diagnostic parameters. Infants with myocardial involvement showed higher frequencies of tachycardia, feeding intolerance, and inflammatory laboratory indicators. These differences confirm the relationship between respiratory infections and the development of myocardial inflammatory changes in early childhood.

The experimental findings also allowed evaluation of the frequency of different diagnostic indicators associated with myocardial involvement. The distribution of the major diagnostic indicators identified during the study is illustrated in the following diagram.





Discussion

The findings of the present study demonstrate that myocarditis may develop as a significant complication in infants following acute respiratory infections. The results indicate that myocardial involvement in early childhood is frequently associated with nonspecific clinical manifestations, which makes early diagnosis



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particularly challenging in pediatric practice. The identification of tachycardia, feeding difficulties, irritability, and respiratory distress among the examined infants confirms that cardiovascular complications may occur during the post-infectious period after respiratory illness.

One of the most important findings of this study is the high frequency of tachycardia among infants with suspected myocarditis. Tachycardia is often considered one of the earliest indicators of myocardial dysfunction in pediatric patients. In infants, the heart rate normally varies depending on age and physiological conditions; however, persistent tachycardia following respiratory infection may indicate inflammatory damage to myocardial tissue. This observation is consistent with previous clinical studies that emphasize tachycardia as a sensitive marker of early myocardial involvement in children with infectious diseases.

Feeding difficulties and irritability were also frequently observed among infants with suspected myocardial inflammation. These symptoms may reflect reduced cardiac output and impaired systemic circulation. In infants, inadequate cardiac function may lead to decreased tissue perfusion and reduced oxygen delivery, which may manifest as fatigue during feeding, poor appetite, and general irritability. These clinical manifestations often appear before more severe signs of cardiac insufficiency develop.

Laboratory findings obtained in the study also support the presence of inflammatory processes associated with myocardial damage. Elevated leukocyte counts and inflammatory markers were observed in infants with more pronounced clinical symptoms. These changes indicate the activation of immune responses during infectious and inflammatory processes. Viral infections are considered one of the major etiological factors responsible for the development of myocarditis in infants. Respiratory viruses may directly damage myocardial cells or trigger immune-mediated inflammatory reactions that affect cardiac tissue.

Instrumental diagnostic methods provided important additional information about cardiac function in infants with suspected myocarditis. Electrocardiographic examination revealed abnormalities in heart rhythm and electrical conduction in several patients. Sinus tachycardia and minor conduction



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disturbances were the most frequently observed findings. These electrocardiographic changes are commonly associated with inflammatory processes affecting myocardial tissue and may serve as early diagnostic indicators of myocarditis.

Echocardiographic examination also revealed functional changes in the myocardium in a number of infants included in the study. Mild decreases in myocardial contractility and slight dilation of cardiac chambers were detected in some cases. These findings may reflect early stages of myocardial dysfunction resulting from inflammatory damage to cardiac muscle cells. Echocardiography is widely recognized as one of the most valuable noninvasive diagnostic tools for evaluating cardiac function in pediatric patients and plays a crucial role in the early detection of myocarditis.

The results of the present study are consistent with findings reported in international pediatric cardiology research, which indicate that respiratory infections represent one of the most common triggers of myocarditis in infants and young children. Viral pathogens, particularly enteroviruses and respiratory syncytial virus, are frequently associated with myocardial inflammation following respiratory illness. The inflammatory response triggered by these pathogens may lead to damage of myocardial cells and subsequent impairment of cardiac function.

Another important aspect highlighted by this study is the importance of comprehensive diagnostic evaluation in infants with recent respiratory infections. Because the clinical symptoms of myocarditis may overlap with those of respiratory diseases, careful monitoring of cardiovascular signs is essential. Early recognition of cardiac involvement allows clinicians to initiate timely therapeutic interventions and prevent the progression of myocardial damage.

The integration of clinical observation with laboratory and instrumental diagnostic methods significantly improves the ability to detect myocarditis during the early stages of the disease. A systematic diagnostic approach that includes evaluation of symptoms, laboratory indicators of inflammation, electrocardiography, and echocardiography may enhance diagnostic accuracy and facilitate early treatment.



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Furthermore, early detection of myocarditis is particularly important in infants because cardiovascular complications may progress rapidly in this age group. Infants have limited physiological reserves, and deterioration of cardiac function may occur quickly if myocardial inflammation remains undiagnosed. Therefore, timely diagnosis and appropriate clinical management are essential for preventing severe outcomes such as heart failure or cardiomyopathy.

Overall, the findings of this study emphasize the importance of early recognition of myocardial involvement in infants recovering from acute respiratory infections. Increased awareness among pediatricians regarding potential cardiovascular complications may contribute to improved clinical outcomes and better long-term cardiovascular health in affected children.

Conclusion

The results of the present study demonstrate that myocarditis may develop as a serious cardiovascular complication in infants following acute respiratory infections. Due to the anatomical and physiological characteristics of early childhood, infants are particularly vulnerable to inflammatory processes that may affect the myocardium after infectious diseases. Early recognition of myocardial involvement is therefore essential for preventing severe cardiac complications and improving clinical outcomes.

The study revealed that several clinical symptoms may serve as early indicators of myocardial involvement in infants after respiratory infection. Tachycardia, feeding difficulties, irritability, respiratory distress, and lethargy were among the most frequently observed manifestations in infants with suspected myocarditis. These symptoms often appear during the recovery period following acute respiratory illness and may initially be overlooked because of their nonspecific nature.

Laboratory investigations confirmed the presence of inflammatory responses in many infants with suspected myocarditis. Elevated leukocyte counts and other inflammatory markers were observed in patients with more pronounced clinical manifestations. These findings indicate that systemic inflammatory processes



associated with respiratory infections may contribute to myocardial damage in infants.

Instrumental diagnostic methods also played a crucial role in identifying early functional changes in the cardiovascular system. Electrocardiographic examination allowed detection of rhythm disturbances and electrical conduction abnormalities, while echocardiographic assessment revealed mild impairments in myocardial contractility in some infants. These diagnostic techniques provide valuable information that assists clinicians in confirming myocardial involvement and evaluating the severity of cardiac dysfunction.

The integration of clinical observation, laboratory investigations, and instrumental diagnostic methods significantly improves the early detection of myocarditis in infants following acute respiratory infections. Early diagnosis allows timely therapeutic intervention, which may prevent the progression of myocardial inflammation and reduce the risk of long-term cardiovascular complications.

In conclusion, careful monitoring of infants recovering from acute respiratory infections is essential for the early identification of potential cardiac complications. Comprehensive clinical evaluation combined with appropriate diagnostic methods may contribute to improved management of post-infectious myocarditis and enhance the overall cardiovascular health of infants.

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