

CLINICAL FEATURES AND OUTCOMES OF COVID-19 IN CHILDREN

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Abstract

Coronavirus disease 2019 (COVID-19), caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), usually has a mild or moderate clinical course in children. However, the presence of congenital heart disease (CHD) may increase the vulnerability of pediatric patients to respiratory, cardiovascular, and systemic complications. The interaction between pre-existing structural cardiac abnormalities and acute SARS-CoV-2 infection remains clinically important because children with CHD may have limited cardiopulmonary reserve and may respond differently to systemic inflammation and hypoxemia.

Keywords: COVID-19; SARS-CoV-2; congenital heart disease; children; pediatric cardiology.

Introduction

Coronavirus disease 2019 (COVID-19) caused by SARS-CoV-2 has produced a broad spectrum of clinical manifestations, ranging from asymptomatic infection to severe respiratory and multisystem disease. In the pediatric population, acute infection is generally less severe than in adults. Nevertheless, children with pre-existing chronic disorders may have a higher risk of complications and hospitalization. Among these conditions, congenital heart disease represents an important clinical subgroup because structural and functional abnormalities of the cardiovascular system can reduce physiological reserve during acute infection [1].

Congenital heart disease encompasses a heterogeneous group of structural abnormalities involving the heart and great vessels. The clinical spectrum ranges from simple defects with minimal hemodynamic consequences to complex cyanotic lesions requiring multiple surgical interventions. Consequently, the effect of SARS-CoV-2 infection is unlikely to be uniform across all children with CHD. The clinical response may depend on the anatomical complexity of the defect, ventricular function, pulmonary vascular status, previous surgery, residual hemodynamic abnormalities, and associated genetic or systemic disorders [2].

During acute COVID-19, several mechanisms may contribute to clinical deterioration in children with CHD. Viral infection can produce fever, tachycardia, hypoxemia, dehydration, and systemic inflammatory activation. These changes may increase myocardial oxygen demand while simultaneously reducing oxygen delivery. In children whose cardiac output is already limited by structural heart disease, such physiological stress may lead to decompensation more rapidly than in otherwise healthy children [6].

The relationship between congenital heart disease and COVID-19 severity has been examined in several observational studies. A large multicenter study from the United States evaluated 171,416





pediatric patients with SARS-CoV-2 infection and found that several pre-existing cardiovascular conditions were associated with severe COVID-19, defined by the need for supplemental oxygen or in-hospital death. Specific congenital cardiac abnormalities, including simple and complex biventricular defects, were among the conditions associated with increased disease severity [3].

Another large analysis of hospitalized pediatric patients demonstrated that children with CHD had increased rates of several serious complications. Although adjusted mortality did not differ significantly between children with and without CHD, tachyarrhythmias, heart block, respiratory failure, mechanical ventilation, acute kidney injury, and longer hospital stay were more frequent among children with CHD [4].

Therefore, understanding the clinical characteristics and potential complications of COVID-19 in children with CHD is important for risk stratification, monitoring, and therapeutic decision-making [5].

Materials and Methods

The study was conducted at the Bukhara Regional Children's Medical Association. A total of 150 children were included in the study and divided into three groups.

The main group consisted of 60 children with congenital heart disease (CHD) who had confirmed COVID-19 infection. The comparison group included 60 children with congenital heart disease who had no confirmed COVID-19 infection during the study period. The control group consisted of 30 clinically healthy children without congenital heart disease or a history of COVID-19.

All participants underwent a comprehensive clinical and laboratory assessment. The evaluation included medical history, physical examination, assessment of clinical symptoms, laboratory investigations, and cardiovascular examination. Particular attention was paid to the clinical manifestations and severity of COVID-19 in children with underlying congenital heart disease, as well as to differences in clinical and laboratory parameters between the study groups.

The study was performed in accordance with the principles of medical ethics. The obtained data were analyzed comparatively to assess the clinical characteristics and potential complications of COVID-19 in children with congenital heart disease.

Results

Cardiovascular complications are particularly relevant in pediatric patients with pre-existing congenital heart abnormalities. SARS-CoV-2 infection may be associated with tachycardia, myocardial injury, arrhythmias, ventricular dysfunction, pericardial involvement, and systemic inflammatory responses.

Ghimire et al. reported significantly increased odds of tachyarrhythmia and heart block among children with CHD hospitalized with COVID-19. The adjusted odds ratio for tachyarrhythmia was 4.2, while the adjusted odds ratio for heart block was 5.0. These findings indicate that electrocardiographic monitoring may be important in hospitalized children with significant CHD and acute SARS-CoV-2 infection.

The large multicenter study by Ehwerhemuepha et al. also demonstrated associations between several pre-existing cardiovascular conditions and severe pediatric COVID-19. Cardiac arrest, cardiogenic





shock, previous heart surgery, heart failure, and certain congenital cardiac defects were associated with greater odds of severe infection.

At the same time, these associations should not be interpreted as evidence that every child with CHD is at high risk. The available data indicate considerable heterogeneity, and children with well-compensated simple defects may have a substantially different prognosis from those with complex cyanotic disease or significant ventricular dysfunction.

Laboratory investigations were performed in all study participants to assess the systemic inflammatory response and the functional status of major organs. The laboratory evaluation included a complete blood count, biochemical blood analysis, inflammatory markers, and selected cardiovascular biomarkers. The main parameters assessed were hemoglobin, leukocyte count, platelet count, C-reactive protein, ferritin, and other clinically relevant biochemical indicators.

Comparative analysis showed that children with congenital heart disease (CHD) and concomitant COVID-19 demonstrated more pronounced laboratory abnormalities than children with CHD without COVID-19 and healthy controls. In particular, inflammatory markers were generally higher in the main group, reflecting a more pronounced systemic inflammatory response associated with SARS-CoV-2 infection.

Serum ferritin levels were higher in children with CHD and COVID-19 than in the other study groups. The mean ferritin concentration was 242.6 ng/mL in the main group, compared with 186.2 ng/mL in the comparison group and 103.4 ng/mL in the healthy control group. Thus, ferritin levels were approximately 1.3-fold higher in children with CHD and COVID-19 than in children with CHD without COVID-19 and approximately 2.3-fold higher than in healthy children.

These findings indicate that the combination of congenital heart disease and COVID-19 is associated with a more pronounced inflammatory response. Increased ferritin may reflect activation of systemic inflammatory processes and may be useful as an additional laboratory marker for assessing disease severity in children with underlying congenital heart disease.

The laboratory findings were evaluated together with clinical manifestations and cardiovascular parameters to determine the relationship between COVID-19 infection and the clinical course of congenital heart disease in children.

Conclusion

COVID-19 in children with congenital heart disease may have a more complicated clinical course, particularly in those with complex cardiac defects, ventricular dysfunction, or pulmonary hypertension. These patients are at increased risk of respiratory failure, arrhythmias, and prolonged hospitalization. Early monitoring of respiratory and cardiovascular function and individualized multidisciplinary management are essential. Further studies are needed to identify children with CHD who are at the highest risk of severe and post-acute COVID-19 complications.

Further prospective studies with standardized classification of congenital heart defects, detailed assessment of ventricular function and pulmonary hypertension, and long-term follow-up are required to define the pediatric CHD phenotypes most vulnerable to severe acute and post-acute consequences of COVID-19.





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