Case Report

Atrial Tachycardia and Sinus Node Dysfunction as a Manifestation of a Novel SARS-CoV-2 Infection in a Child: A Rare Case

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ABSTRACT

Respiratory symptoms constitute one of the most significant manifestations of the coronavirus infection. SARS-CoV-2 (COVID-19) may lead to a life-threatening condition called "multisystem inflammatory syndrome in children (MIS-C)," which can affect many organs and systems, such as cardiovascular, respiratory, gastrointestinal, and renal systems. The condition might lead to severe and irreversible damage.

Myocarditis is one of the presentations of COVID-19 in children. Cardiac tissue inflammation could enhance the automaticity of cells and develop different arrhythmias.

Here, we report a pediatric case of MIS-C with cardiac involvement inducing atrial tachycardia and sinus node dysfunction. ***(Iranian Heart Journal 2024; 25(2): 96-101)***

KEYWORDS: SARS-CoV-2, COVID-19, Myocarditis, Atrial tachycardia, Sinus node dysfunction

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Multisystem inflammatory syndrome in children (MIS-C) with SARS-CoV-2 (COVID-19) infection may lead to a life-threatening condition. Common symptoms include gastroenteritis, rash, toxic shock syndrome, prolonged fever, hypotension, and cardiogenic shock.

Different types of cardiac involvements, such as myocarditis, are more likely to occur related to COVID-19. Myocardial involvement produces a higher rate of mortality and morbidity in patients with COVID-19.

The pathophysiology and diagnosis of myocarditis in MIS-C remains challenging. Acute myocarditis is characterized by cardiomyocyte injury and death owing to the infiltration of immune cells. Tumor necrosis factor-α, interleukin-6, interleukin-1β, and nitric oxide as the acute inflammatory mediators are released and activate innate immune cells, suggesting a cytokine storm associated with microvascular disease. [1]

However, the precise mechanism by which a virus may invade the heart still needs elucidation. Whether cardiac involvement is caused indirectly by inflammatory mediators

or directly by virus-mediated invasion, myocarditis could happen.

Cardiac arrhythmias and heart failure are the marked complications developed in children with acute myocarditis. All tachyarrhythmias and bradyarrhythmias could be induced by myocarditis.

Cardiovascular magnetic resonance (CMR) using the Lake Louise criteria (LLC) serves as a noninvasive and sensitive approach to characterizing myocardial injury and is also the modality of choice for diagnosing acute myocarditis. [2]

Case Report

A 2.5-year-old girl was referred to the emergency department owing to respiratory distress and tachypnea. The initial examination revealed fever (body temperature =39 ℃), tachycardia (heart rate =132 bpm), and tachypnea (respiratory rate =55 breaths per minute) with bilateral crackles on auscultation.

A chest X-ray illustrated bilateral pleural effusion (Fig. 1). A right chest tube was inserted, and the child was transferred to the pediatric ICU (Fig. 2).

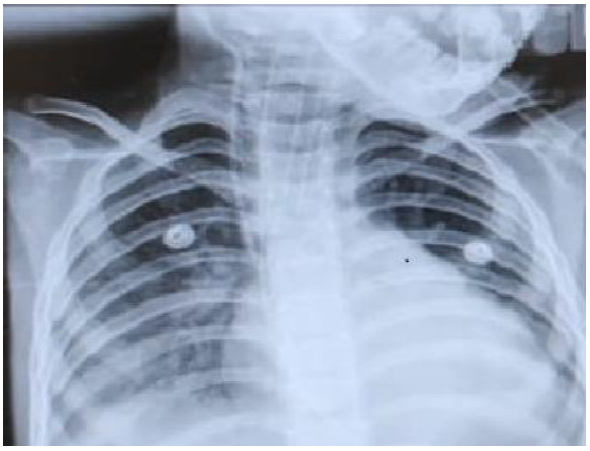

Figure 1: The chest X-ray shows bilateral pleural effusion with interstitial infiltration.

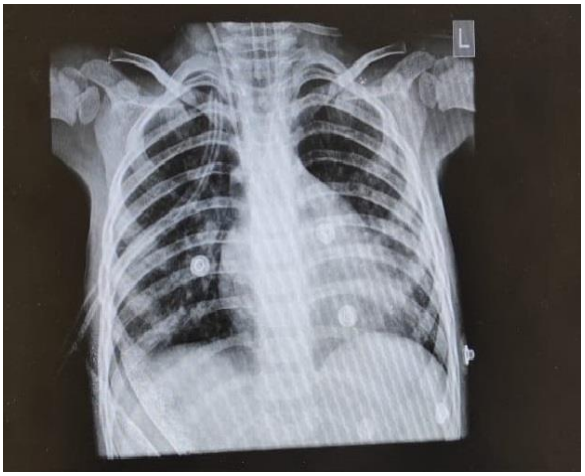

Figure 2: The chest X-ray after right chest tube insertion shows left ventricular and left atrial enlargement.

She underwent cardiopulmonary resuscitation and was intubated due to unstable hemodynamics and remained intubated for 11 days.

Two polymerase chain reaction tests for COVID-19 were performed: both were positive. Additionally, a lung high-resolution computed tomography scan confirmed the diagnosis of COVID-19 (Fig. 3).

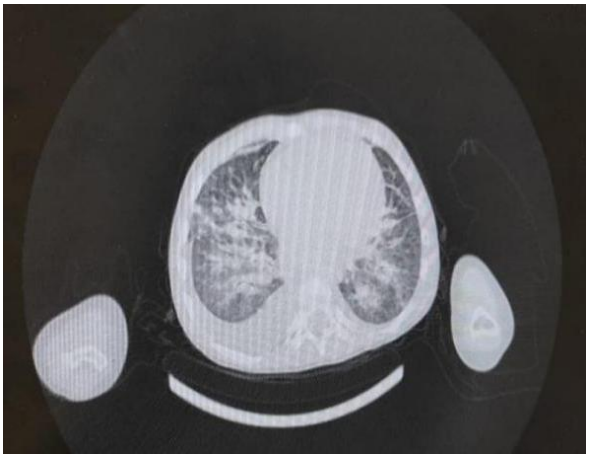

Figure 3: The lung high-resolution computed tomography scan shows increased peribronchovascular interstitial thickening with pleural effusion.

The child had frequent episodes of supraventricular tachycardia during hospitalization, and ECG showed a narrow QRS tachycardia resistant to the treatment, more in favor of long RP tachycardia (Fig.

4). An adenosine test was performed using adenosine injection (0.1 mg/kg/IV/stat), which caused a temporary atrioventricular node block without effects on atrial tachycardia, compatible with long RP tachycardia (Fig. 5). Of course, during reentrant tachycardia cases other than atrial tachycardia, adenosine terminates the arrhythmia, and there is no recurrence.

ECG indicated atrial tachycardia with left lower pulmonary vein origin. Because of poor heart function, amiodarone (5 mg/kg/loading and infusion with 5 μg/kg/min) was started.

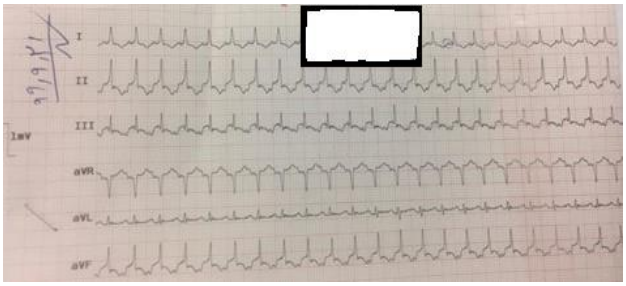

Figure 4: The ECG after pediatric ICU admission shows a narrow ORS complex and a long RP supraventricular tachycardia.

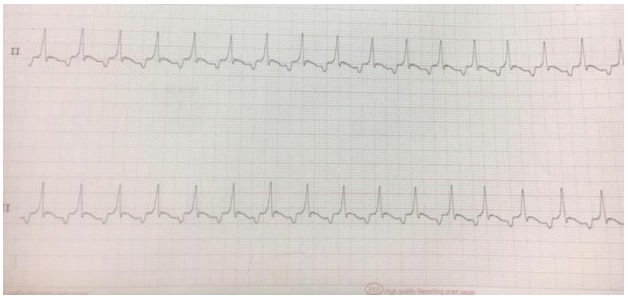

Figure 5: The ECG during the adenosine test shows a narrow ORS complex and a long RP supraventricular tachycardia with temporary atrioventricular node block in response to the adenosine administration.

The first echocardiographic examination revealed left ventricular dilation, left atrial dilation, moderate mitral regurgitation, normal coronary arteries, and decreased left ventricular function. With the diagnosis of myocarditis due to low heart function, the patient received dobutamine, which has minimal arrhythmogenic effects, furosemide, and spironolactone.

As the child's clinical symptoms improved, dobutamine was tapered off, and oral captopril (1 mg/kg/d), spironolactone (1 mg/kg/d), and furosemide (1 mg/kg/d) were continued. Because of the side effects of amiodarone, it was switched to carvedilol (0.05 mg/kg/dose twice). Following extubation, she exhibited significantly decreased muscle tone and impaired vision and speech. After 3 weeks of hospitalization, the patient was discharged from the pediatric ICU and transferred to the pediatric cardiology ward. She still had decreased muscle strength, limb edema, and impaired vision and speech. During the hospitalization, psychiatric and neurological consultations and physiotherapy were performed. The child's muscle force and speech power increased, and there was a gradual improvement in her vision. One month after the hospital admission, she still had transient tachycardia and bradycardia episodes, evidence of sinus node involvement (Fig. 6 & Fig. 7).

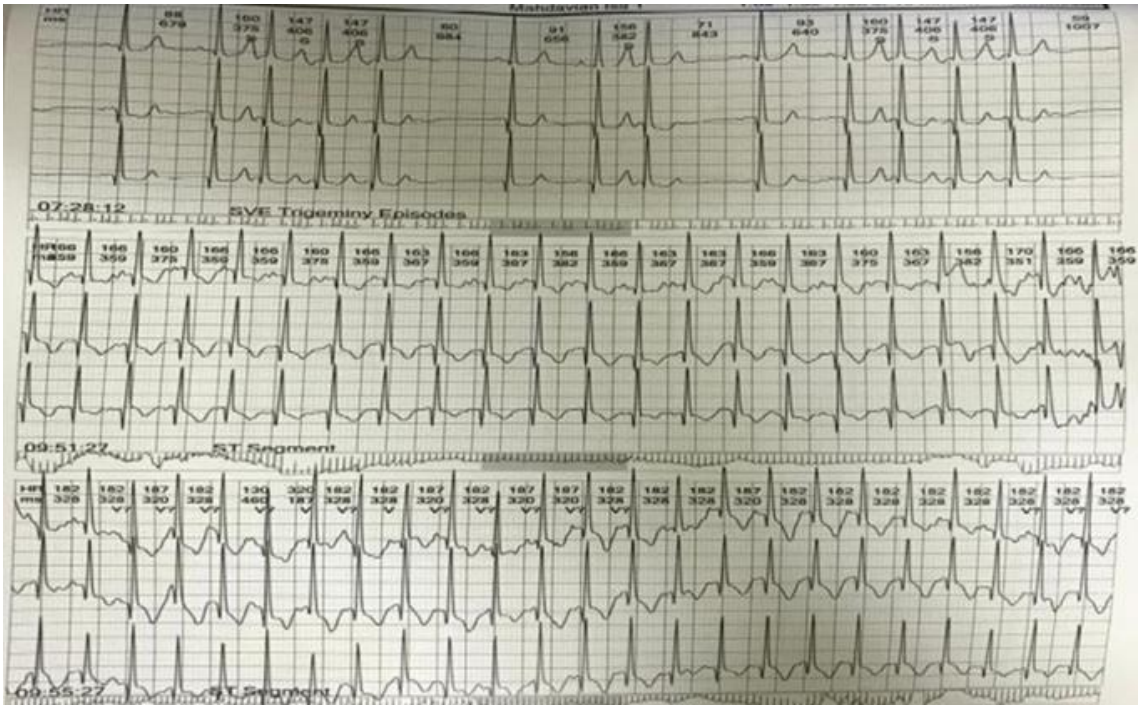

Figure 6: The ECG shows episodes of atrial tachycardia and bradycardia owing to sinus node dysfunction.

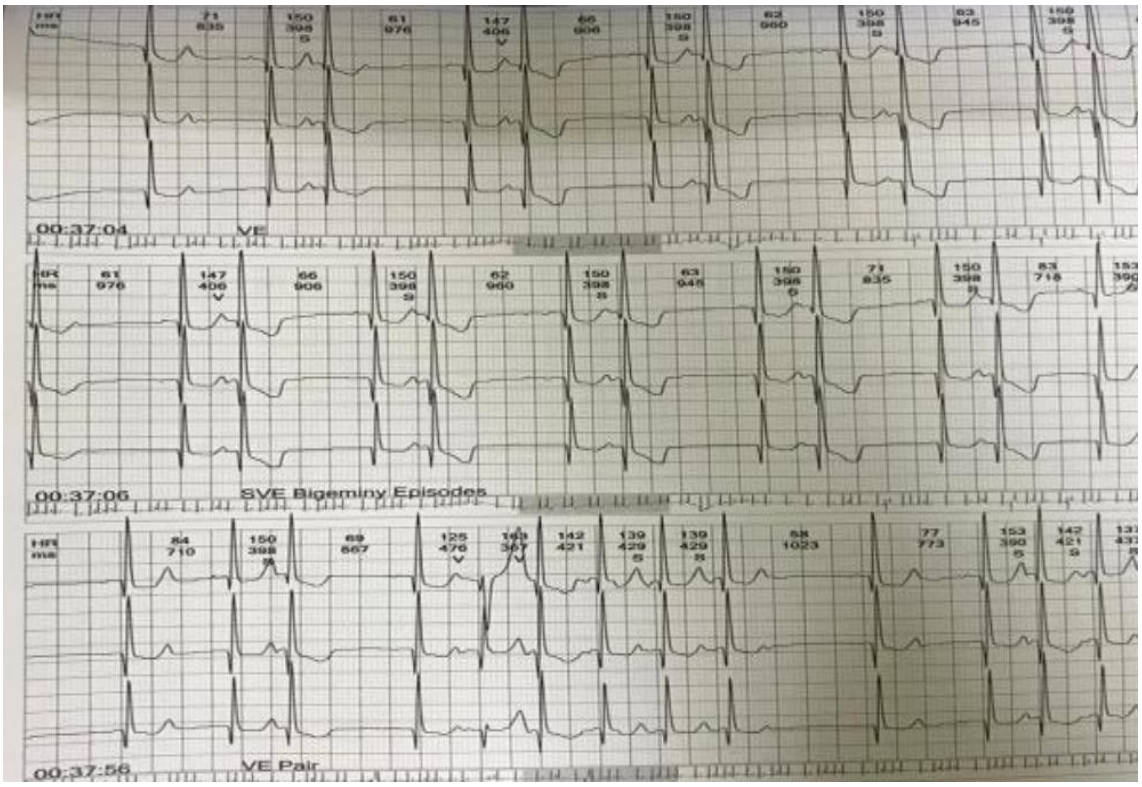

Figure 7: The ECG shows episodes of atrial tachycardia and bradycardia owing to sinus node dysfunction.

Three months later, a follow-up echocardiographic examination showed left ventricular dilation, left atrial dilation, and low left ventricular function (ejection fraction =35.5%), in favor of dilated cardiomyopathy. Nonetheless, another follow-up echocardiographic examination 12 months afterward revealed mild left ventricular dilation, mild left atrial dilation, and improved left ventricular function (ejection fraction =62%), with no significant arrhythmias. Next, a CMR test was performed to assess the COVID-19–induced dilated cardiomyopathy. The results indicated regular wall thickness in the ventricles, mild impairment in the feature-tracking values of the mid-cavity segments, a slight increase in the volumes of the ventricles, normal function of the ventricles, regular volumes of the atria, no pericardial effusion, and no pericardial fibrosis.

In summary, the CMR findings demonstrated a well-recovered previous acute myocarditis and normal heart. Therefore, we tapered the medications after a 1-year follow-up.

DISCUSSION

In general, children with COVID-19 do not develop serious problems as often as adults do. An uncommon, albeit serious, complication of COVID-19 called “MIS-C” can cause severe heart damage, cardiogenic shock, or death. [3]

Cardiovascular complications, notably arrhythmias, comprise the most significant manifestations of MIS-C in children with COVID-19 infection and can be associated with poor prognosis if not diagnosed and treated early.

Some children with MIS-C can present with abnormal heart rhythms and stiffened heart muscles, preventing regular heart relaxing and beating, which could lead to diastolic dysfunction and cardiac dysrhythmia. [4]

In patients with COVID-19 infection, tachycardia is the most common ECG abnormality. Nevertheless, the condition is usually self-limiting, with an approximate incidence rate of 72%. It should be noted that persistent dysrhythmia is rare. [5]

We herein presented a rare but interesting case of a patient with MIS-C initially presenting with cardiac involvement in the form of myocarditis, cardiac dysfunction, and atrial tachycardia. Subsequently, over the course of a few weeks and possibly through the immune response, the child also experienced sinus node dysfunction. Previous research has shown the high overlap rate of atrial arrhythmias and sinus node dysfunction. [6]

We treated the patient’s atrial tachycardia with amiodarone considering the possibility of myocarditis and ventricular dysfunction because amiodarone improves the prognosis in cases of myocarditis. [7]

After the initial control of the arrhythmia and the improvement of the patient’s clinical condition, and due to the long-term side effects of amiodarone, we changed the medication to carvedilol.

Carvedilol can affect left ventricular remodeling, systolic function, and symptomatic status. Additionally, carvedilol is a beneficial adjunctive treatment for patients with chronic heart failure who are already on amiodarone. [8]

Still, in this case, due to the viral background and the acute process and episodes of bradycardia, we recommended that amiodarone be tapered and carvedilol be continued, which fortunately conferred an acceptable result. Follow-up echocardiography demonstrated normal sinus rhythm and acceptable ejection fraction.

CONCLUSIONS

Myocarditis is one of the presentations of COVID-19 in children. Cardiac tissue

inflammation could enhance the automaticity of cells and develop different arrhythmias.

Conflict of Interest

The authors declare no conflicts of interest.

Acknowledgments

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Patient Permission/Consent Statement

The patient's parents provided informed consent for the publication of this report, and the procedure was performed in accordance with the center's ethical policy.

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