Editorial

**Arrhythmic issues in pediatric patients with COVID-19**

Ji-Eun Ban, MD., PhD *

Department of Pediatrics, Ewha Womans University Medical Center, Seoul, Republic of Korea

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*Corresponding Author: Ji-Eun Ban, MD, PhD

Department of Pediatrics, Ewha Womans University Medical Center
1071, Anyangcheon-ro, Yangcheon-gu, Seoul, 07985, Republic of Korea
TEL: +82-2-2650-2663, FAX: +82-2-2653-3718
E-mail: jeban@naver.com
Key message

Pediatric patients with COVID-19 tend to have less life-threatening arrhythmias, including premature atrial or ventricular beats, and conduction disturbance such as first-degree atrioventricular blocks.

Life-threatening tachyarrhythmias and bradyarrhythmias such as nonsustained or sustained ventricular tachycardia, atrial tachycardia, atrial fibrillation and complete atrioventricular block developed in the serious condition of myocarditis or MIS-C with COVID-19 infection.

Awareness of ongoing clinical state, arrhythmic risk assessment, and adequate management of cardiac arrhythmias are crucial in MIS-C.
In the era of COVID-19, most studies demonstrated pediatric patients generally have mild symptoms from SAR-CoV-2 infection. However, after the European report of a child with a severe Kawasaki-like disease and COVID-19, the term of multisystem inflammatory syndrome in children (MIS-C) has been introduced.

According to World Health Organization (WHO), MIS-C is defined as (1) children and adolescents 0-19 years presenting with fever, laboratory evidence of inflammation, and evidence of clinically severe illness requiring hospitalization with multisystem organ involvement; (2) in the absence of alternative diagnoses; and (3) with a temporal association with COVID-19 demonstrated by a positive current or recent SARS-CoV-2 reverse transcription-polymerase chain reaction (RT-PCR), serology, or antigen test or known COVID-19 exposure within the 4 weeks prior to symptom onset.

COVID-19 associated MIS-C presented with cardiac involvement such as shock, elevated troponin, elevated pro-brain natriuretic peptide, coronary artery involvement, ventricle dysfunction, and arrhythmia. Recent review of cardiac manifestations in MIS-C reports myocarditis in 44%, coronary artery dilation or aneurysms in 6–24%, and arrhythmias in 7–60%.

Compared to arrhythmias in adult patients, pediatric patients with COVID-19 tend to have less life-threatening arrhythmias, including premature atrial or ventricular beats, and conduction disturbance such as first-degree atrioventricular (AV) blocks. The most frequent ECG finding are low QRS amplitude, non-specific ST segment changes and T wave abnormalities. PR prolongation and first-degree AV block are also common in MIS-C patients. The incidence of life-threatening arrhythmia associated COVID-19 in pediatric population is much low which was mainly demonstrated with a few case reports or case series.

Patients with COVID-19 infection may be at risk of certain tachyarrhythmia and bradyarrhythmia.
In this issue of the Clinical and Experimental Pediatrics, Song et al. summarized the literatures reporting the COVID-19 pediatric patients with life-threatening tachyarrhythmias and bradyarrhythmias. According to this review, nonsustained or sustained ventricular tachycardia (VT), atrial tachycardia (AT), atrial fibrillation (AF) developed in the serious condition of myocarditis or MIS-C with COVID-19 infection. These arrhythmias could deteriorate the clinical condition and increase the risk of death. Regarding bradyarrhythmia, complete AV block developed mostly in MIS-C patients. The incidence of complete AV block was as low as 2-5% and most of cases recovered to normal sinus rhythm. Some patients required the permanent pacemaker implantation.

The possible mechanism of arrhythmias is associated with myocardial injury or ischemia. The pathophysiology of myocardial injury is related to a direct SARS-CoV-2 viral infection via type 2 angiotensin converting enzyme (ACE) receptors on myocardial cell surface.

In comparison with adults, children might be less susceptible to COVID-19 infection because of a reduced function of ACE type 2 receptors. In addition, pediatric patients are rarely taking ACE inhibitors and angiotensin II receptor blockers. This is why children are less affective than adult patients. A second mechanism of arrhythmias may be related to hypoxia. Hypoxia induce oxygen free radical and destroy myocardial cell membranes leading to myocardial cell injury. Third, inflammation play a important role in myocardial injury. Intracellular cytokines levels were higher in COVID-19 and arrhythmia patients.

And the presence of electrolyte disturbances, QT prolonging drugs, and underlying cardiac condition such as hear failure or congenital heart disease are associated with arrhythmias in COVID-19 patients.

Regarding repolarization abnormalities, recent study demonstrated corrected QT interval and QT dispersion were statistically higher in COVID-19 children than the control group. The ventricular repolarization was impaired even in asymptomatic children with COVID-19.
Although the prevalence of life-threatening arrhythmias is low in pediatric patients with COVID-19, awareness of ongoing clinical state, arrhythmic risk assessment, and adequate management of cardiac arrhythmias are crucial in MIS-C.

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