

Electrocardiographic Ventricular Repolarization Variables in Children Diagnosed With COVID-19

Alper Akin¹, Velat Şen², Kamil Yılmaz², Fesih Aktar², Mehmet Türe¹, Çiğdem Mermutluoğlu³, Ayfer Gözü Pirinçioğlu²

¹Department of Pediatric Cardiology, Dicle University School of Medicine, Diyarbakır, Turkey

²Department of Pediatrics, Dicle University School of Medicine, Diyarbakır, Turkey

³Department of Infectious Disease and Clinical Microbiology, Dicle University School of Medicine, Diyarbakır, Turkey

Coronavirus disease 2019 (COVID-19) originated in China in 2019, and it quickly became a global pandemic within months, continues to be an important health problem. The outbreak was first encountered in our country in March 2020 and rapidly spread to thousands of people.¹ Although children as well as adults can become infected; it has been reported that children are less symptomatic or develop less severe symptoms.² However, most studies on the subject cover patients in the adult age group.

Cardiovascular symptoms of the infection frequently include myocardial injury, thromboembolic events, and arrhythmia.³ Although the underlying pathophysiology of myocardial injury that may cause arrhythmias or electrophysiological changes is not fully known, several theories have been proposed. It has been reported that COVID-19 can cause direct myocardial damage by binding to type 2 angiotensin converting-enzyme receptors. Another culprit is hypoxia. Causes such as the acute phase of severe disease and electrolyte unbalance have also been blamed.^{4,5}

There are various ECG parameters that are predictors of cardiac arrhythmias, especially ventricular arrhythmias. QT lengths, corrected QT (QTc), QT dispersion (QTd) and QTc dispersion (QTcd), Tp-e interval (time between peak and end of T wave from precordial leads), Tp-e dispersion and Tp-e/QT measurements are frequently used for this purpose. It was thought that QT, QTc, QTd, QTcd and Tp-e interval could be associated with cardiovascular disease and mortality.⁶ Ece et al.⁷ found that QTd, QTcd, Tp-e, Tp-e dispersion, Tp-e/QT ratio and Tp-e/QTc ratio were statistically higher in COVID-19 subjects than control subjects. They concluded that ventricular repolarization may also be impaired in asymptomatic children diagnosed with COVID-19. Yenerçay et al.⁸ showed that adult patients with COVID-19 had prolonged Tp-e interval, Tp-e / QT ratio and Tp-e / QTc ratio compared to normal healthy individuals.

The ECGs of the children hospitalized in our hospital diagnosed with COVID-19 were evaluated before any treatment had been initiated. This study included 55 patients between the ages of 0-18 who were diagnosed with COVID-19 as well as 55 age and gender-matched healthy children as the control group. The mean age of the patients was 104.5 (± 64.98) months, and 32 patients were male. There was no significant difference between the patient and control groups in terms of age, gender, body weight, body mass index, and heart rate. QT length, QTc, QTcd, Tp-e interval, Tp-e dispersion, and Tp-e/QT ratio values were measured and compared in 12-lead surface ECG of the patient and control. The patient group had significantly higher QTd, QTcd, Tp-e dispersion, and Tp-e/QT ratio values and significantly lower QTmin (shortest QT lengths) and QTcmin (shortest QTc) values compared to the control (Table 1). There was a positive correlation between Tpe/QT and C-reactive protein (CRP) ($r = +0.355$, $P = .008$). None of the patients had an electrolyte imbalance that could cause electrocardiographic changes nor elevated cardiac troponin levels. Furthermore, the mean oxygen saturation of our patients was within normal limits. Life-threatening arrhythmias were not observed in any patients.

Corresponding author:

Fesih Aktar

✉ fesihaktar@yahoo.com

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Table 1. Electrocardiographic Measurements in Patients with COVID-19 and Control Groups

Baseline Characteristics	Patients (n = 55)	Control (n = 55)	P
QT min (ms)	287 ± 37.12	306 ± 25.74	.003
QT max (ms)*	320 (300-352)	320 (320-340)	.824
QT dispersion (ms)*	28 (20-40)	20 (12-20)	.000
QTcmin (ms)	360 ± 29	373 ± 24	.012
QTcmax (ms)	407 ± 31	409 ± 25	.647
QTc dispersion (ms)	48.3 ± 24.4	36.7 ± 24.1	.014
Tp-e min (ms)	47.8 ± 11.4	52 ± 11.8	.081
Tp-e max (ms)	68.7 ± 17.7	68.8 ± 14.1	.112
Tp-e disp	20.7 ± 11.2	11.8 ± 10.7	.000
Tp-e/QT ratio	0.21 ± 0.05	0.19 ± 0.04	.045
Tpe/QTc ratio	0.16 ± 0.04	0.15 ± 0.03	.188

*Median (25% percentile-75% percentile).

QTmin, shortest QT distance; QTmax, longest QT distance; QTc, corrected QT; QTc min, shortest QTc distance; QTc max, longest QTc distance; Tp-e, peak-to-end interval of the T wave; Tp-e max, longest Tp-e distance; Tp-e min, shortest Tp-e distance.

Although it is reported that life-threatening heart rhythm disorders are less common among children diagnosed with COVID-19 compared to adults patients, the effects of the infection on electrocardiographic parameters are not yet fully known. Our study showed that ECG evaluation performed in children diagnosed with COVID-19 might increase the parameters showing the risk of ventricular arrhythmia. Therefore, especially all COVID-19 positive children who will be initiated with QT-prolonging medication should be closely followed up, and routine ECGs should be taken. In addition, long-term studies are needed to evaluate the relationship between these changes in ECG parameters with arrhythmia and cardiac events.

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