

# “Triangular QRS-ST-T waveform ECG pattern” during SARS-CoV-2 infection in a paediatric case with multiple comorbidities

## Brief Report

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### Abstract

Triangular QRS-ST-T waveform electrocardiography pattern, so-called “shark fin sign,” is a rare and highly mortal electrocardiography finding, which usually occurs in adult patients with coronary occlusion. Here, we reported the first paediatric case occurring in a striking “triangular waveform electrocardiography pattern” due to myocarditis during COVID-19 infection.

SARS-CoV-2 virus may lead to myocardial cell damage and electrocardiography abnormalities. It has been reported that cardiac involvement occurs in 0.6% of children during coronavirus infection, and 60–67% of paediatric cases with COVID-19 infection had abnormal electrocardiography findings.<sup>1,2</sup> The “triangular QRS-ST-T” waveform pattern electrocardiography is a rare and highly mortal electrocardiography finding, usually occurring in adult patients with coronary occlusion.<sup>3</sup> Here, we reported the first paediatric case occurring in a striking “triangular waveform electrocardiography pattern” due to myocarditis during COVID-19 infection.

### Case

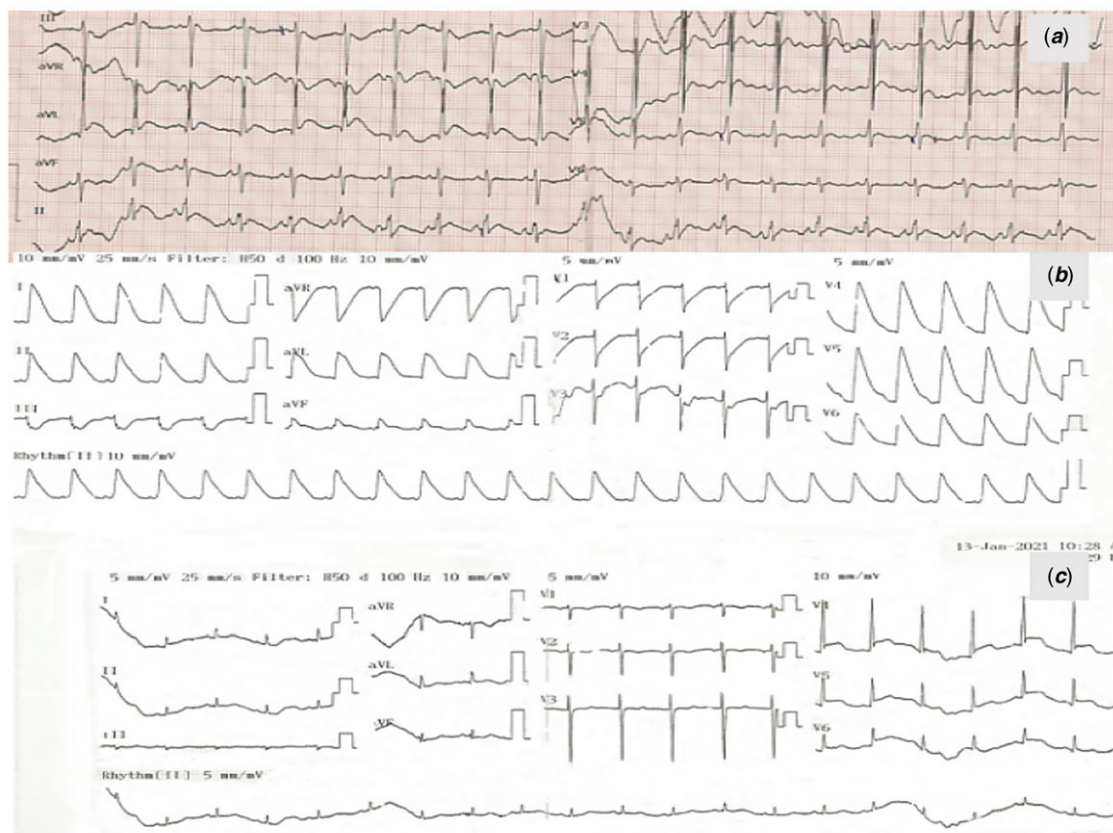
A 4-year-old girl was admitted with the complaint of vomiting and inability to pass stool for 4 days, and then, she was hospitalised with a diagnosis of ileus. She had been followed with diagnoses of compensated chronic renal failure (no dialysis). She also had a history of pre-existing dilated cardiomyopathy. The differential diagnosis of dilated cardiomyopathy in our case was made with laboratory, genetic, and metabolic tests 1 year ago. The aetiology of dilated cardiomyopathy was presumed to be idiopathic or secondary to renal failure and given diuretics, digoxin, and aspirin. Physical examination revealed a body temperature of 37.8°C, heart rate of 112 beats/minute, respiratory rate of 24 breaths/minute, blood pressure was normal, and an oxygen saturation of 98%. Her weight and height were under 3rd percentile. She had a positive nasopharyngeal PCR test for SARS-CoV-2. Before surgery, she had no respiratory or cardiovascular signs or symptoms, and echocardiographic examination showed mildly decreased left ventricular systolic function (EF: 52%) and dilated left ventricle (the left ventricle end-diastolic diameter: 37 mm, z score: +3.96). Meanwhile, electrocardiography showed normal sinus rhythm and normal QRS morphology (Fig 1a). After surgery for bridge ileus, she became hypotensive and had tachycardia. The arterial blood gas was metabolic alkalosis. Laboratory tests showed hypokalemia, severe hyponatremia, increased Troponin I, and brain natriuretic peptide levels. Erythrocyte sedimentation rate was normal, and there was mild elevation in C-reactive protein levels (Table 1). The surface electrocardiography showed a distinctive electrocardiography pattern, and there was a giant R wave (20 mV) and a steep down sloping ST segment which was concealing the T wave in anterolateral leads and left precordial derivation. The fusion of QRS-ST and T waves formed a triangular shape in left, anterior, inferior, and lateral leads. There was a deep (5 mm) ST depression in the right (V1–3, aVR) and inferior (DIII) leads (Fig 1b). Repeated echocardiography showed no more reduction in left ventricular systolic function (EF: 52%)

The coronary CT angiography showed normal coronary anatomy. The bacterial, serological, and multiple viral PCR tests were negative.

She was diagnosed with septic shock associated with intra-abdominal infection and managed with fluid, electrolyte replacement, and wide-spectrum antibiotics. Positive inotropic drugs (adrenalin and milrinone) were consecutively given to her according to haemodynamic findings, and we aimed to keep the patients warm and dry and to normalise the arterial blood pressures. Meanwhile, considering possible myocarditis, a total of 2 grams per kg of intravenous immunoglobulin and low-molecular-weight heparin (2000 IU) and methylprednisolone were started. Lopinavir was added as an antiviral drug on day 3. On day 4, electrocardiography revealed disappearances of triangular waveform pattern electrocardiography, but mildly elevated ST segment in the anterolateral leads (Fig 1c).

**Table 1.** Laboratory data of our cases were displayed.

Test	Reference range	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
Haemoglobin, gram/dl	12.0–16.0	8.8	8.2	6.5	9.7	7.1	8.5	7.3	7.6	9.1	8.6
Leukocyte, BIN/mm <sup>3</sup>	4.86–13.18	11.21	8.09	5.75	9.39	8.64	6.73	10.22	7.74	4.27	6.3
Platelets, BIN/mm <sup>3</sup>	150–450	429	338	237	454	161	170	201	176	200	182
Lymphocytes, BIN/mm <sup>3</sup>	1.3–3.5	3.85	2.85	2.7	4.26	3.17	2.06	4.24	3.56	1.72	2.22
Creatinine, mg/dl	0.5–1.1	1.1	0.81	0.99	1.35	1.26	1.3	1.23	1.21	1.46	1.61
Na mEq/L	136–145	136	138	147	160	160	154	153	148	143	135
K mEq/L	3.5–5.1	3.2	3.8	4.03	3.03	3.7	4.1	4.6	3.8	4.6	4.4
Ca mg/dl	8.7–10.4	9.6	8.8	8.4	10.7	8.6	8.8	7.9	8.9	9.9	10.8
Arterial blood gas											
pH	7.35–7.45	7.41	7.42	7.39	7.5	7.43	7.41	7.45	7.37	7.37	7.37
pCO <sub>2</sub> , mmHg	35–45	39	39	37	29	32.6	30	31	32	41	40
HCO <sub>3</sub> , mmol/L	22–28	24	25	22	22.6	22	18	21	19	22	22
Lactic acid, mmol/L	0.50–2.20	0.91	0.77	1.09	0.95	1.3	0.67	1.28	1.15	1.06	0.86
Troponin I, ng/L	2.5–39.59	63.65	93.62	43.2	1231.1	750.7	463	450	252	197	86
D-dimer, mg/L	0–0.55	0.24		6.51	8.69	21.6	16.2	17.9	4.4	3.6	4.5
Brain natriuretic peptide, pg/ml	0–100	644.6				>5000		>5000		>5000	1365
Sedimentation, mm/saat	0–20	6			2			41			23
C-reactive protein, mg/dl	0–0.5	2.56	4.89	2.64	1.06	1.13	1.5	2.15	12.7	11.6	10.8
Procalcitonin, ng/ml	0–0.1	<0.01				61.2		14.5		3.6	0.36



**Figure 1.** (a) ECG recorded before COVID-19 disease showed that there were no significant ST changes. (b) The ECG recorded on day 2 after surgery for ileus revealed a huge triangular QRS-ST-T waveform in the anterolateral and inferior leads. (c) On day 4, the surface ECG revealed disappearances of triangular waveform pattern ECG.

## Discussion

The myocardial involvement during COVID-19 disease has been frequently reported in children with multisystem inflammatory syndrome.<sup>4</sup> However, there are a few reports concerning children with pre-existing dilated cardiomyopathy and experienced acute myocarditis during the acute phase of COVID-19 disease.<sup>5</sup>

Adult patients with cardiovascular disease have a higher risk of myocardial injury and mortality during COVID-19 disease.<sup>6</sup> However, there are no sufficient data to support the association between heart disease and severe COVID-19 in children. The frequency of comorbid disease in paediatric COVID-19 studies was between 25 and 35.6%<sup>7,8</sup> and was shown to be an independent risk factor for admission to the paediatric ICU.

The most common electrocardiography findings in COVID-19 infection are QTc prolongation, low QRS amplitudes, transient T-wave inversion, and non-specific ST segment elevation in paediatric series.<sup>1,2</sup> Arrhythmias including ventricular, supraventricular tachycardia<sup>1</sup>, or high-grade atrioventricular block have been reported in paediatric children with multisystem inflammatory syndrome cases.

Triangular QRS-ST-T waveform electrocardiography pattern, so-called “shark fin sign,” is defined as a unique, giant wave (amplitude  $\geq 1$  mV) resulting from the fusion of the QRS complex and the ST segment. In this electrocardiography pattern, QRS complexes show “triangular” morphology with the positive polarity in the leads.<sup>3</sup>

Cipriani et al observed the triangular waveform electrocardiography pattern in 1.4% of adult cases with ST elevated myocardial infarction.<sup>3</sup> This electrocardiography pattern is usually associated with a large area of transmural myocardial ischemia and predicts ventricular fibrillation, cardiogenic shock, and mortality.

Triangular waveform electrocardiography pattern is very rarely occurs in pericarditis<sup>9</sup>, ibuprofen intoxication and hyperkalemia.<sup>3</sup> Symanski et al speculated that the triangular waveform pattern is a result of the dramatic slowing of transmural electrical conduction, due to biochemical and ion concentration changes (potassium loss, fall in pH, calcium overload, and sodium channels inactivation) during acute myocardial ischemia. Our case had mild hypokalemia and metabolic alkalosis when her electrocardiography pattern occurred. However, the elevated cardiac biomarker levels and remarkably ST elevation persisted, even after correction of her electrolyte disturbance.

In our case, coronary angiography excluded the coronary occlusion due to thrombosis or any other cause (air or lipid embolisation) and congenital or acquired coronary abnormalities or CHD (including patent foramen ovale). There was no laboratory evidence of atherosclerotic heart disease. There was a possibility of myocardial injury or ischemia during surgery. However, she had no myocardial ischemia findings in electrocardiography or increased cardiac enzyme levels post-operative on the first day. Abnormal electrocardiography findings and increased cardiac biomarkers levels occurred on day 2 after surgery, so we excluded myocardial ischemia during surgery. Except sepsis and possible

COVID-19 myocarditis, there was no reason to explain electrocardiography abnormalities and increased cardiac biomarker levels.

Distinctive echocardiographic features of Takotsubo syndrome have been described in adult cases with COVID-19 infection and one paediatric case with children with multisystem inflammatory syndrome in literature;<sup>10</sup> however, echocardiographic findings were not compatible with Takotsubo cardiomyopathy in our case.

## Conclusion

In this report, we presented the first paediatric case to have a distinctive triangular waveform electrocardiography pattern associated with myocarditis in the acute phase of COVID-19 infection. Although triangular waveform electrocardiography pattern is mostly associated with poor prognosis, the medical treatment provided success in our case even with her multiple comorbidities.

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**Ethical standards.** Written informed consent was obtained from the patient.

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