Received: 16 March 2022 | Revised: 26 July 2022 | Accepted: 2 August 2022

DOI: 10.1002/emp2.12810

JACEP OPEN
JOURNAL OF THE AMERICAN COLLEGE OF EMERGENCY PHYSICIANS OPEN
A GLOBAL JOURNAL OF EMERGENCY MEDICINE
WILEY

CASE REPORT

Pediatrics

Brugada pattern in adolescent with acute myocarditis due to SARS-CoV-2

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Funding and support: By *JACEP* Open policy, all authors are required to disclose any and all commercial, financial, and other relationships in any way related to the subject of this article as per ICMJE conflict of interest guidelines (see www.icmje.org). The authors have stated that no such relationships exist.

Abstract

Brugada syndrome is a genetic disorder characterized by abnormal findings on electrocardiogram (ECG) that can precipitate ventricular tachyarrhythmias and sudden cardiac death. Most clinical manifestations of Brugada syndrome are related to life-threatening tachyarrhythmias, such as ventricular fibrillation or polymorphic ventricular tachycardia, but Brugada syndrome can also present with syncope or less likely palpitations. Our case is of a previously healthy 17-year-old visiting from Puerto Rico who presented to the emergency department (ED) with a syncopal episode preceded by sore throat, dizziness, and lightheadedness without palpitations. The ED evaluation found a normal complete blood count and basic metabolic panel. The patient tested positive for COVID-19 by polymerase chain reaction. An ECG was performed that showed the Brugada pattern, which was later confirmed by cardiology. Although Brugada syndrome and pattern are well known to the medical population, the findings of Brugada pattern in the setting of COVID-19 is not well described. Recognition and treatment are important, as Brugada syndrome can lead to life-threatening arrhythmias and sudden cardiac death.

KEYWORDS
Brugada, COVID-19, COVID-19 myocarditis, myocarditis, syncope

1 | INTRODUCTION

Brugada syndrome is an autosomal dominant genetic disorder with inherited channelopathy. Characteristic findings on electrocardiogram (ECG) are ST-segment elevation in precordial leads (V1-V3). Patients who have characteristic ECG findings but are asymptomatic are said to have Brugada pattern, whereas those with ECG findings and clinical symptoms, such as unexplained syncope, sudden cardiac death, or nocturnal agonal respirations, are diagnosed with Brugada syndrome.[1] The prevalence of Brugada syndrome ranges from 1 in 5000 to 1 in 2000 and is thought to be responsible for 4%–12% of sudden cardiac death in children and young athletes.[2] There are a variety of factors that may precipitate the ECG and clinical findings of Brugada syndrome, such as cardiac sodium channelopathies, right ventricular abnormalities, autonomic tone, fever, and use of certain medications and recreational drugs. Fever is a trigger for both induction of Brugada pattern as well as severe complications, such as death, with 1 study showing that febrile patients were 20 times more likely to have Brugada pattern than the afebrile population.[3] As we know, COVID-19 infections commonly cause fevers as well as associated vascular inflammation, acute myocardial injury, myocarditis, and arrhythmias.[4]

Supervising Editor: Matthew Hansen, MD, MCR.

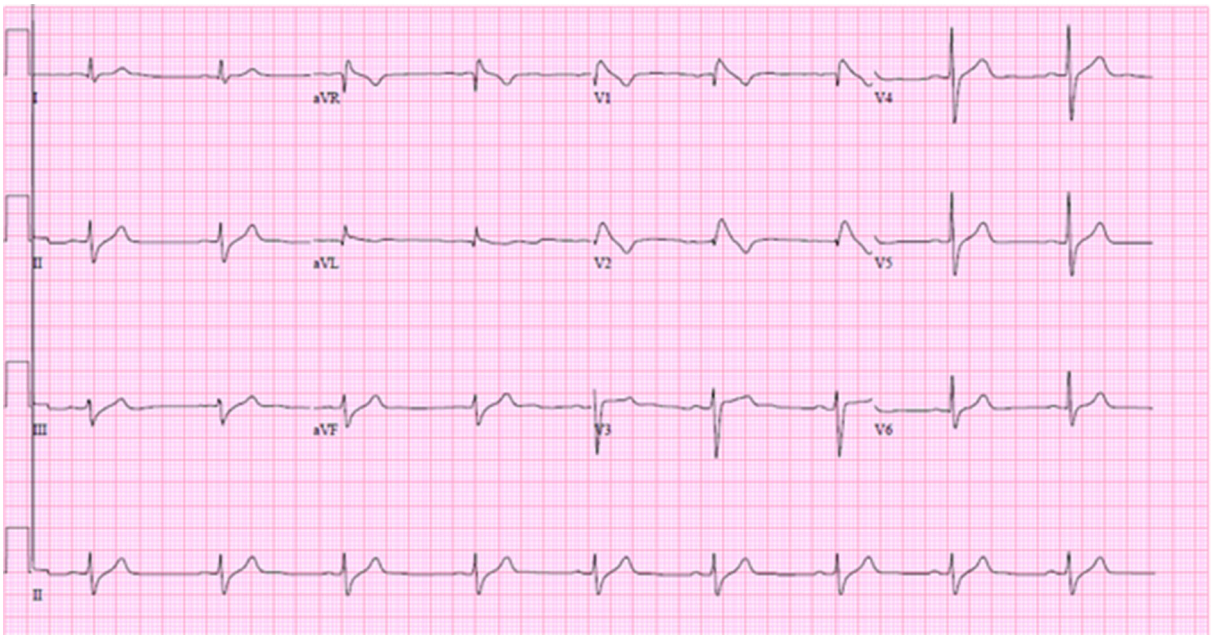

FIGURE 1 Patient's initial ECG during the workup in the emergency department shows Type 1, or "coved," Brugada pattern. This is seen as ST-segment elevation that descends with an upward convexity to an inverted T wave. Abbreviation: ECG, electrocardiogram

2 | CASE PRESENTATION

A 17-year-old male presented to the pediatric emergency department after a syncopal episode at home. Interestingly, he was seen by cardiology in Puerto Rico 1 year before for hypotension and per the family, had a normal ECG and echocardiogram at that time. Otherwise, he had been a healthy and active adolescent male, not taking any medications or recreational drugs.

On the morning of presentation, he developed a sore throat, but otherwise had no symptoms. While talking on the phone, he developed dizziness, lightheadedness with associated blurry vision and nausea. Subsequently, he lost consciousness for 5–10 minutes without seizure activity, according to the parents. The family poured water on the patient and he regained consciousness. 9-1-1 was called, and he was brought to the ED. Upon arrival, his vital signs were normal: Temperature 97.5°F, heart rate 67, and blood pressure 101/64 and he had a normal physical examination. Initial ECG was performed (Figure 1) soon after arrival. Serum blood work was within normal limits, apart from his respiratory swab, which was positive for COVID-19. The patient became febrile in the ED and was treated with acetaminophen. Cardiology was consulted given concern for incomplete right-bundle branch versus Brugada pattern on his ECG, and they recommended admission to the pediatric intensive care unite (ICU) for telemetry and close monitoring. Our patient had no further episodes of dizziness or syncope while inpatient. He had no further episodes of fever. He had daily ECGs and all but 2 showed Brugada pattern. He had a cardiac magnetic resonance imaging (MRI; Figure 2), which showed delayed enhancement in the inferoseptal region (showed by arrow) indicative of myocarditis. He was given intravenous immunoglobulin and prednisone as treatment for COVID-19-induced myocarditis. He was subsequently discharged home with a 30-day event monitor with

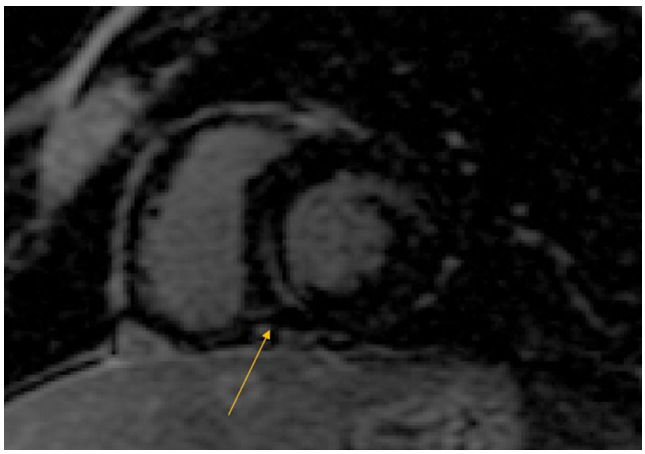

FIGURE 2 Patient's cardiac magnetic resonance imaging performed during his admission in the pediatric ICU, which shows delayed enhancement in the inferoseptal region. Abbreviation: ICU, intensive care unit

plans to return to Puerto Rico and follow up with his primary cardiologist. After discharge, our patient's genetic testing returned with a mutation in the cardiac sodium channel gene SCN5a, unlikely to cause Brugada syndrome as per cardiology. Our cardiology team states that Brugada is usually a multi-hit disease requiring more than 1 genetic mutation to cause the disease.

3 | DISCUSSION

An interesting aspect of this case is the relatively benign chief complaint. This patient presented for syncope without any history of intercurrent febrile illness. Furthermore, the Brugada pattern was

witnessed on ECG before he developed his first fever. It is unclear if his syncope was a result of the Brugada pattern or a vasovagal event. During our initial evaluation of the patient in the ED, we found he did not have a family history of cardiac disease and had a normal cardiac examination (including ECG and echocardiogram) 1 year before presentation.

In the literature, there are numerous case reports of adults with COVID-19 who are found to have Brugada pattern or syndrome.[5–7] To our knowledge, there are only 2 published cases of COVID-19 related Brugada pattern in pediatric patients. De Nigris et al described a 7-year-old who presented with 7 days of abdominal pain and fever, diagnosed with multisystem inflammatory syndrome in children with positive anti-SARS-COV-2 immunoglobulin G antibodies at time of admission. The patient had Brugada pattern seen on admission ECG and developed atrial ectopic tachycardia during admission requiring synchronized cardioversion followed by pharmacological therapy with sotalol. He was admitted for 20 days with no recurrence of arrhythmias.[8] Choi et al, described a 19-year-old patient, admitted for hypoxemia requiring intubation and fevers who was found on day 3 to be in Brugada pattern. This individual's Brugada pattern resolved by day 10 during hospitalization without recurrence.[9] In contrast to these 2 patients, our patient remained hemodynamically stable without respiratory compromise during admission. He also continued to have Brugada pattern on the day of discharge in the absence of subsequent fevers.

During evaluation in a patient with concerns for Brugada pattern or syndrome, 2 distinct ECG findings are seen. Our patient had the typical "coved" pattern, or Type 1, which has an elevated ST segment that descends with an upward convexity to an inverted T wave (which can be seen in V1 and V2 in the ECG). If there is doubt, the right precordial leads can also be moved to a more superior position, between the second and third intercostal space, which can increase sensitivity of the ECG.[1] If Brugada pattern is seen and confirmed on ECG, further imaging, including echocardiogram, cardiac MRI, as in our patient, or stress test, should be performed to further evaluate underlying cardiac structural abnormalities.

Treatment for Brugada syndrome in patients with loss of consciousness and Brugada pattern on ECG that does not resolve with antipyretics, as seen in our patient, can require placement of an implantable cardioverter defibrillator.[10] Our patient did not require implantable cardioverter defibrillator placement or medication initiation for Brugada during admission or at discharge likely secondary to the theory of Brugada being a multi-hit disease process and our patient only had 1 variance of unknown significance. Further treatment will be under the guidance of his cardiology team in Puerto Rico.

4 | CONCLUSION

Although there are numerous findings in the adult literature of COVID-19-induced Brugada pattern or syndrome, there are fewer reported pediatric cases. Obtaining an ECG in a patient with syncope is common practice, particularly looking for arrhythmias. If Brugada syndrome goes unrecognized, it can lead to severe and often fatal ventricular arrythmias particularly in the setting of fever or certain medications and drugs. With COVID-19 being declared a global pandemic by the World Health Organization, and with the predominant symptom being fever, early detection and treatment of any individual with Brugada are of the utmost importance.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

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How to cite this article: Bergamo D, Nelson C. Brugada pattern in adolescent with acute myocarditis due to SARS-CoV-2. *JACEP Open*. 2022;3:e12810. https://doi.org/10.1002/emp2.12810