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CASE REPORT

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To cool or not to cool: Targeted temperature management to prevent ventricular tachycardia associated with Brugada syndrome

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Key Clinical Message

A robust inflammatory and febrile response from acute viral illness such as with SARS-CoV-2 in patients with Brugada syndrome may lead to triggering of ventricular arrhythmias. The use of targeted temperature management (TTM) using cooling devices may mitigate the febrile triggering of ventricular arrhythmias in patients with Brugada syndrome.

Abstract

Brugada syndrome (BrS) is an autosomonal dominant genetic disorder, with a risk of ventricular tachycardia (VT). Triggers of VT in BrS include fevers. Here, we report a case of BrS secondary to SARSs-CoV-2 infection and the use of targeted temperature management (TTM) to decrease fever and prevent VT triggering.

KEYWORDS

Brugada syndrome, targeted temperature management

1 | INTRODUCTION

Brugada syndrome (BrS) is an autosomal dominant genetic disorder of loss of function mutation in the cardiac sodium channel, characterized by abnormal findings on the electrocardiogram (ECG) in conjunction with an increased risk of ventricular tachycardia (VT) and sudden cardiac death (SCD).[1] However, there is emerging data suggesting that BrS and the likelihood of developing VT and SCD may be due to inheritance of multiple BrS variants, or an oligogenic hypothesis.[2] Triggers of the ECG pattern and VT in BrS include fevers, drugs, and electrolyte abnormalities.[1] Mutant cardiac sodium channels demonstrate worsening biophysical properties of defective channels at higher temperatures leading to loss of function of sodium channel currents.[1] The most common presenting arrythmia with BrS is ventricular fibrillation or polymorphic ventricular tachycardia. We report a unique case of targeted temperature management (TTM) use in a patient with BrS with VT secondary to infection with SARS-CoV-2 as a way to decrease fevers and prevent triggering of VT.

2 | CASE REPORT

We report the case of a 23-year-old male with developmental delay and known history of BrS with an intracardiac defibrillator (ICD) who presented to the hospital

with chest pain and rhinorrhea. Upon presentation, he was febrile to 38.2°C, with a heart rate of 155 beats per minute, blood pressure was 134/110 mmHg, and his oxygen saturation was 98% on room air. Laboratory values on admission revealed a normal complete blood count, a normal basic metabolic panel, and an elevated c-reactive protein (CRP) of 19.1 mg/L, D-dimer of 163 ng/mL, and ferritin of 51 ng/mL. Upon polymerase chain reaction testing, SARS-CoV-2 was detected with a cycle threshold of 16.4. ECG revealed a Type 2 Brugada pattern (Figure 1). Interrogation of his ICD revealed 28 device shocks on the morning of admission, with each episode beginning with a premature ventricular contraction inciting polymorphic VT. His transthoracic echocardiogram (TTE) discovered a newly reduced ejection fraction of 25% with global hypokinesis. Persistent VT led to intubation in the emergency department, and sedation with fentanyl and propofol infusions were initiated. Persistent fevers led to external cooling via the Arctic Sun. In addition, amiodarone infusion was initiated and he was transferred to the cardiac intensive care unit (CICU). In the CICU, acetaminophen around the clock, remdesivir and dexamethasone were initiated as targeted COVID-19 therapies. However, persistent fevers despite acetaminophen led to TTM initiation via ArcticSun® external cooling device with a goal to maintain normothermia, preemptively to prevent further VT triggering. Repeat inflammatory markers revealed a CRP of 244 mg/L, D-dimer of 163 ng/mL, and ferritin of 338 ng/mL. Sedation was maintained with propofol and dexmedetomidine and intravenous magnesium was used to prevent shivering. After 5 days without VT, the patient's fever curve, Brugada pattern, and inflammatory markers improved. TTM was discontinued, COVD-19 therapies were completed, and he was extubated successfully. His cardiac function normalized on repeat TTE and he was discharged home with no antiarrhythmic therapies.

3 | DISCUSSION

We report a unique case of TTM in a patient with BrS with VT, as a way to prevent fever and further triggering of VT. Although mild to moderate hypothermia (target temperature of 32–34°C) has demonstrated survival benefit in patients successfully resuscitated after a cardiac arrest, it remains unknown if the benefits of TTM are related to the cooling or the prevention of post-return of spontaneous circulation (ROSC) fevers.[2,3] Indeed, active control of core body temperature is a crucial intervention for patients who achieve ROSC post-cardiac arrest as soon as possible and maintained for at least 72 h. When performing active temperature control, endovascular or surface methods to control temperature are used.[4] Observational studies have demonstrated improved outcomes among patients with moderate to severe hypoxic ischemic injury with TTM to 33°C.[5] However, the optimal temperature management post cardiac arrest has remained debated over the past 20 years. The benefits of hypothermia have been disproven and best available evidence suggests the avoidance of fever, to a target temperature of 36°C or normothermia.[6] In the CICU, given our patient's persistent fevers from COVID-19, and concern for VT triggering, we attempted TTM to 37°C using an external cooling device, the ArticSun®. Only two previous case reports have described the use of therapeutic hypothermia in patients with BrS as a way to decrease fevers and prevent further VT triggering.[7,8] In one case, active temperature control in a 27-year-old male with BrS and sustained VT was initiated with a target temperature of 33°C for 24 h.[7] In the other case, a 56-year-old male with BrS who had an out of hospital cardiac arrest (OHCA) had TTM initiated to a temperature of 34°C.[8] Although our patient did not have an OHCA, as his ICD was able to prevent sustained VT, we used TTM to prevent further fevers and VT. Notably, although TTM

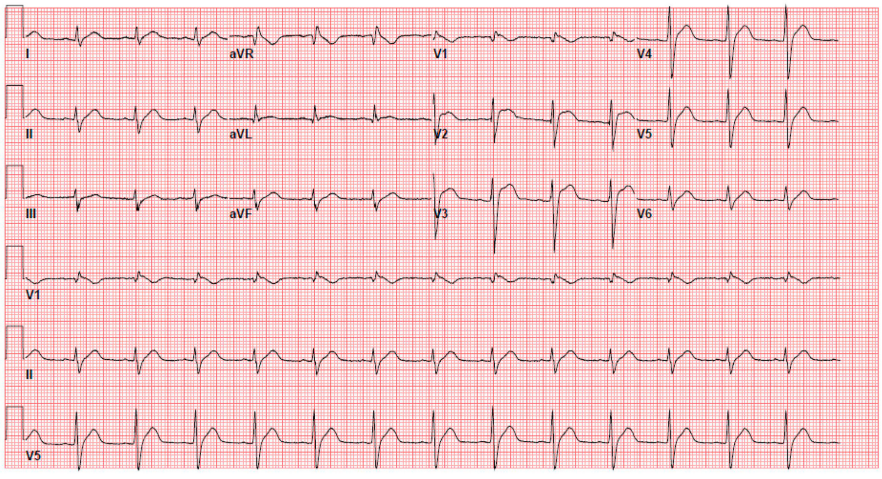

FIGURE 1 ECG on admission: Atrial fibrillation with left axis deviation and >2 mm of saddleback shaped ST elevation present in lead V2 consistent with Type 2 Brugada pattern.

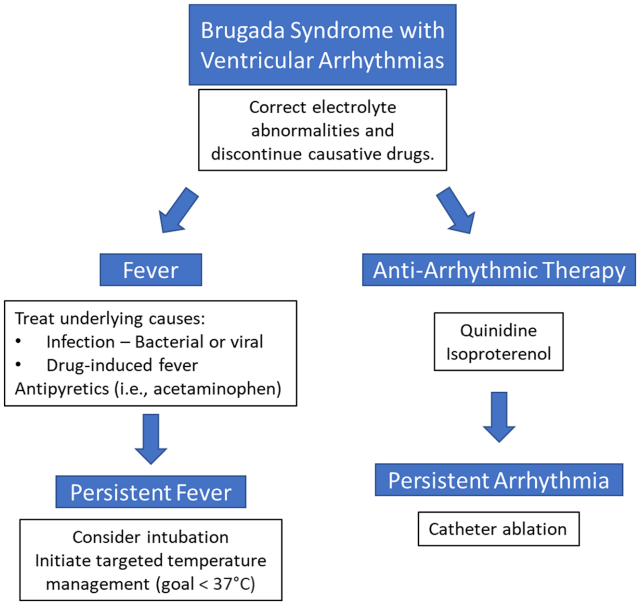

FIGURE 2 Proposed algorithm for treatment of persistent fever in patients with Brugada syndrome.

is often used for 24–72 h post OHCA, our patient continued TTM for 5 days, while other therapies targeting COVID-19 were used. The water bath temperature dropping to <37.5°C was used as a "fever-equivalent" and thus TTM was maintained, to prevent a fever and further VT triggering. Shivering may be common when inducing hypothermic temperature control. Thus, sedation and neuromuscular blockade are often required to facilitate cooling. Sedation management may be complex in patients with BrS. Propofol, a GABA-A agonist and NMDA antagonist, may precipitate Brugada pattern, based on case reports, due to sodium channel inhibition in cardiac myocytes at high doses.[9,10] Midazolam, a GABA-A agonist and dexmedetomidine, a central alpha 2a agonist are generally safe to use in patients with BrS.

In conclusion, this case highlights the robust inflammatory and febrile response from acute viral illness from COVID-19, specifically in patients with underlying arrythmias such as BrS. Surface cooling methods, including ice packs, cooling blankets, and gel-adhesive pads, can reduce the core body temperature ≥1°C/h. We propose an algorithm for patients with BrS that present with fever as the trigger for arrhythmia. (Figure 2).

AUTHOR CONTRIBUTIONS

Nicholas J. Kiefer: Conceptualization; data curation; formal analysis; investigation; writing – original draft; writing – review and editing. **Tania Ahuja:** Conceptualization; data curation; formal analysis; investigation; methodology; project administration; resources; supervision; validation; visualization; writing – original draft; writing – review and editing. **Alexandra Caballero:** Writing – review and editing. **Raymond Anthony Pashun:** Investigation; supervision; validation; writing – review and editing.

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None.

CONFLICT OF INTEREST STATEMENT

All authors have nothing to disclose. All of the authors have no conflict of interest. This case report was presented in poster form at the American Heart Association (AHA) Meeting in Chicago, IL from November 5–7, 2022.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

CONSENT

Written informed consent was obtained from the patient to publish this report in accordance with the journal's patient consent policy.

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