

ECG TEACHING COMPETITION

BEGINNER

IMAGING VIGNETTE: ECG CHALLENGE

ST-Segment Elevation

One Sign, Many Shadows



Marco Bergonti, MD,^{a,b} Johan Saenen, MD, PhD,^b Hein Heidebuchel, MD, PhD,^{b,c} Andrea Sarkozy, MD, PhD^{b,c}

ABSTRACT

ST-segment elevation in patients sedated with propofol may be a sign of imminent malignant arrhythmias. Although propofol infusion syndrome-electrocardiographic abnormalities are usually described as Brugada-pattern, in unique cases nearly ubiquitous and extensive J-point and ST-segment elevation may be observed. These patients should undergo an ajmaline test following recovery. (**Level of Difficulty: Beginner.**) (J Am Coll Cardiol Case Rep 2021;3:1360-1362) © 2021 The Authors. Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

CASE

A 19-year-old female was admitted to the intensive care unit due to hemorrhagic stroke. Her medical history was unremarkable. Her family history was negative for cardiac diseases and sudden death. The electrocardiogram (ECG) on admission was normal. Propofol (4 mg/kg/h), norepinephrine, and external cooling therapies were administered to lower intracranial pressure (17 mm Hg). On day 7 of hospitalization, wide complex rhythm was noticed on the ECG monitor. The hemodynamic condition was stable, and electrolytes, pH, lactate, and kidney function were within normal range. Her ECG is shown in **Figure 1**.

WHAT IS THE DIAGNOSIS?

- A. ST-segment elevation myocardial infarction (STEMI)
- B. Takotsubo cardiomyopathy
- C. Intracranial-hypertension-driven ECG-abnormalities
- D. Hypothermia-induced ECG-abnormalities
- E. Propofol infusion syndrome (PRIS)
- F. Propofol-induced Brugada pattern in previously unrecognized Brugada syndrome

The correct answer is most likely E, but C and F and a combination of these cannot be excluded.

EXPLANATION

The ECG shows sinus tachycardia at a rate of 104 beats/min and narrow QRS complex fused with giant T-wave (shark fin pattern) (**Figure 1**). Diffuse J-point and ST-segment elevation are present throughout the precordial and limb leads with the exception of V₁, III, and aVR, where ST-segment depression is visible.

From the ^aUniversity of Milan, Cardiovascular Disease Fellowship Program, Milan, Italy; ^bDepartment of Cardiology, University Hospital Antwerp, Edegem, Belgium; and the ^cCardiovascular Research, University of Antwerp, Antwerp, Belgium. The authors attest they are in compliance with human studies committees and animal welfare regulations of the authors' institutions and Food and Drug Administration guidelines, including patient consent where appropriate. For more information, visit the [Author Center](#).

Manuscript received April 13, 2021; revised manuscript received May 4, 2021, accepted May 6, 2021.

The shark fin pattern is usually associated with a massive anterior STEMI. Although this diagnosis cannot be entirely ruled out solely on the basis of the ECG, the absence of contralateral ST-segment depression makes it very unlikely ([Supplemental Figure 1](#)).

Osborn waves are classically described as upwardly displaced J-points, followed by diffuse concave ST-segment elevations ([Supplemental Figure 1](#)). They develop simultaneously with cooling and resolve 12 to 24 hours after the restoration of normal temperature.

Intracranial hypertension is associated with giant, deeply inverted T waves and prolonged QT intervals ([Supplemental Figure 1](#)). However, cases of brain injury with concomitant diffuse ST-segment elevation have been described. ECG abnormalities usually resolve when the intracranial pressure is lowered to <10 mm Hg (1).

PRIS is a life-threatening condition associated with rhabdomyolysis and acidosis, and is sporadically (10%) accompanied by ECG abnormalities similar to a type I Brugada pattern. Severe head injury (along with young age and catecholamine administration) is a risk factor for PRIS, as these patients usually require a high dose of propofol (2). This phenotype is not necessarily related to inherited Na-channel disease. Additionally, acidosis and hyperkalemia, although frequently present, are not necessary for the development of ECG changes. ECG abnormalities often lead to malignant arrhythmias (3). If propofol is promptly withheld, the risk of ventricular arrhythmia is lower.

Finally, propofol infusion has been described to provoke ECG abnormalities and malignant ventricular arrhythmias in patients with Brugada syndrome (3).

ABBREVIATIONS AND ACRONYMS

ECG = electrocardiogram

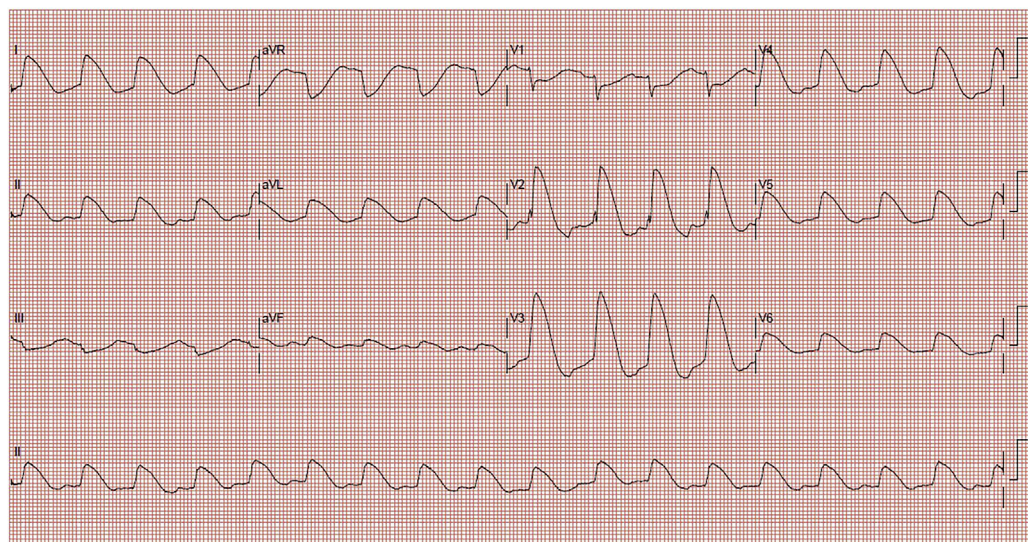
PRIS = propofol infusion syndrome

STEMI = ST-segment elevation myocardial infarction

HOSPITAL COURSE

In this case, hemodynamic conditions remained stable, and malignant arrhythmia was not recorded during her hospitalization. The patient's echocardiogram and troponin concentration remained normal. Raising body temperature did not resolve the ECG abnormalities. Propofol was withdrawn a few hours after the index ECG. Electrocardiogram abnormalities slowly normalized after 40 hours ([Supplemental Figure 2](#)). Results of a genetic test for Brugada syndrome were negative. Unfortunately, the patient refused Ajmaline testing.

FIGURE 1 12-Lead Electrocardiogram Recorded on the 7th Day of Hospitalization



CONCLUSIONS

Whether the extensive ECG abnormalities were caused by Brugada syndrome, PRIS, brain injury, or a combination of these conditions is hard to tell. The fact that they resolved after propofol withdrawal makes the authors favor PRIS, possibly predisposed by an underlying Brugada syndrome.

ADDRESS FOR CORRESPONDENCE: Dr. Marco Bergonti, University of Milan, Cardiovascular Disease Fellowship Program, Via Parea 4, 20138 Milan, Italy. E-mail: bergmar21@gmail.com. Twitter: [@mbergonti](https://twitter.com/mbergonti).

REFERENCES

1. Hersch C. Electrocardiographic changes in head injuries. *Circulation*. 1961;23:853-860.
2. Kam PCA, Cardone D. Propofol infusion syndrome. *Anaesthesia*. 2007;62:690-701.
3. Junttila MJ, Gonzalez M, Lizotte E, et al. Induced Brugada-type electrocardiogram, a sign for imminent malignant arrhythmias. *Circulation*. 2008;117:1890-1893.

APPENDIX For supplemental figures, please see the online version of this article.

KEY WORDS Brugada pattern, ECG, J-wave, shark fin pattern, ST-segment elevation