JAMA Clinical Challenge

An Elderly Unresponsive Patient

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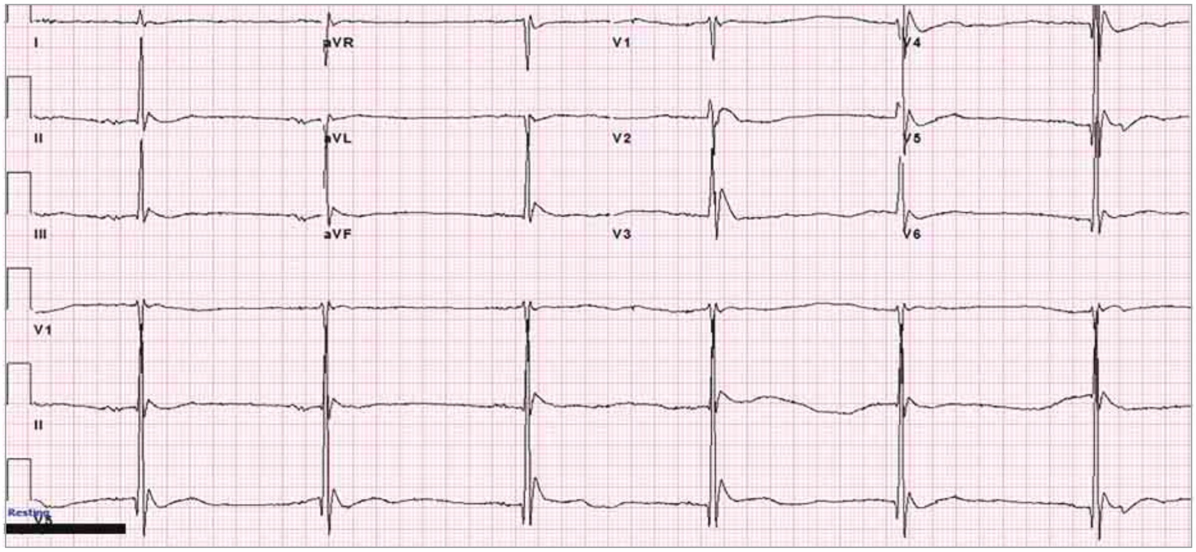

Figure 1. Initial electrocardiogram on presentation.

A 79-year-old man with a history of hypertension, stroke, and glaucoma was brought to the emergency department after being found unresponsive by a caregiver. He was cold to the touch; blood pressure was 85/55 mm Hg, heart rate was 36/min, respiratory rate was 14/min, and pulse oximetry was 100% on ambient air. Multiple temperature measurements, including a core temperature assessment via the rectal method, did not yield a detectable temperature. His chest examination was clear to bilateral auscultation. Chest radiographs and computed tomography of the head were negative for any acute pathology. Routine laboratory tests were ordered, and he was started on an intravenous fluid. His electrocardiogram (ECG) on presentation is shown in **Figure 1**.

+ **Quiz** at jama.com

WHAT WOULD YOU DO NEXT?

A. Order an emergency coronary angiogram

B. Order urgent temporary transvenous pacemaker placement

C. Order active rewarming

D. Order urgent hemodialysis

Diagnosis

Severe hypothermia

What to Do Next

C. Order active rewarming

The key to the correct diagnosis in this case is an ECG revealing severe sinus bradycardia with attenuated P waves (Figure 1) and classic Osborn waves pathognomonic of hypothermia (**Figure 2**, arrowhead). Recognizing this ECG pattern is important to avoid unnecessary interventions such as cardiac catheterization or placement of a temporary pacemaker before complete patient rewarming.

Discussion

Primary, unintentional hypothermia is a decrease in core temperature from environmental exposure.[1] Many medical conditions can also cause hypothermia, including trauma, hypothyroidism, hypopituitarism, hypoadrenalism, sepsis, neuromuscular disease, malnutrition, thiamine deficiency, hypoglycemia, ethanol abuse, and carbon monoxide intoxication.[1]

Hypothermia can cause several ECG changes including bradycardia, a decrease in the amplitude of P waves, prolonged PR and QT intervals, increased QRS duration, repolarization abnormalities (ST-segment depressions or elevations mimicking acute coronary syndrome), and a variety of arrhythmias.[1] However, Osborn waves are considered to be pathognomonic for hypothermia. These waves are characterized by a "delta" or "camel's hump" elevation in the terminal portion of the QRS deflection (Figure 2, arrowhead).[2-4] Hypothermia-induced prolongation of repolarization is not uniform throughout the myocardium, resulting in a voltage gradient generated between the epicardium and endocardium.[2] This voltage gradient causes a positive deviation of the J point, forming an Osborn wave. The amplitude of the Osborn wave often correlates with the severity of hypothermia. It is most prominent in leads V_3 or V_4 and occurs in 80% of patients with hypothermia.

The Osborn wave is not entirely specific to hypothermia and can also been seen in hypercalcemia, brain injury, subarachnoid hemorrhage, cardiopulmonary arrest from oversedation, vasospastic angina, and Brugada syndrome.[1,2] However, prompt recognition of Osborn waves is critical to avoid unnecessary cardiac catheterization, because current computer algorithms may misinterpret this ECG pattern as acute ischemic injury.

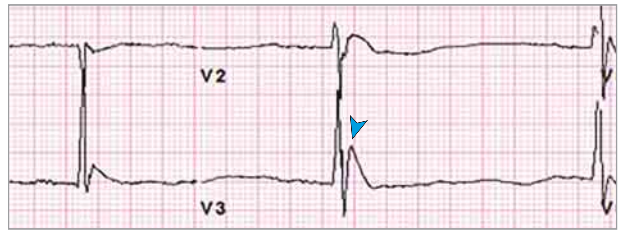

Figure 2. Osborn wave best seen in lead V_3 (arrowhead).

Sinus bradycardia is a physiological response to hypothermia, and there is usually sufficient oxygen delivery because the metabolic rate declines with hypothermia, resulting in lower oxygen requirements.[5,6] Therefore, cardiac pacing is typically not indicated unless bradycardia persists after rewarming. Furthermore, bradycardia is not vagally mediated, so it can be refractory to atropine.[1] Atrial fibrillation is the most common arrhythmia reported in these patients. This usually does not cause a rapid ventricular response and often resolves spontaneously with rewarming.[1]

Ventricular arrhythmias can also occur with hypothermia; however, management of ventricular tachycardia or ventricular fibrillation can be problematic, since these arrhythmias may be refractory to conventional therapy until the patient has been rewarmed.[1,7] There have been no human trials, but animal studies suggest that the application of standard advanced cardiac life support algorithms using epinephrine, amiodarone, and defibrillation increase the rates of return of spontaneous circulation.[7,8] Per American Heart Association guidelines, it is reasonable to use vasopressors and defibrillation according to standard advanced cardiac life support algorithms during rewarming.[7] Patients with severe accidental hypothermia and cardiac arrest may benefit from prolonged resuscitation and should not be considered dead before rewarming.[7]

Patient Outcome

The patient was actively rewarmed with a warmed saline infusion and warming blankets. His hypotension improved after intravenous administration of fluids. Once his body temperature normalized, the Osborn waves resolved, but PR and QT intervals remained prolonged. His workup during hospitalization led to a diagnosis of *Staphylococcus aureus* septicemia. His severe hypothermia was believed to be related to his sepsis, because no history of exposure to environmental cold were identified.

ARTICLE INFORMATION

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Submissions: We encourage authors to submit papers for consideration as a JAMA Clinical Challenge. Please contact Dr McDermott at mdm608@northwestern.edu.

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