J-waves in hypothermia

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A 53-year-old man with a history of alcohol abuse was brought in by ambulance. He had been found on a park bench, after lying there for about eight hours. The temperature outside was 15°C. Initial assessment showed that the patient had an irregular heart rate of 30 beats/min, respiration rate of 14 breaths/min and a core body temperature of 31°C (87.8°F). Laboratory workup showed a serum potassium level of 2.9 (normal 3.5–5.0) mmol/L, ketoacidosis (pH = 7.29) and blood alcohol level of 57.5 mmol/L (0.24%) (upper limit for driving in Poland is 0.02%). On admission, the patient's electrocardiogram (ECG) showed irregular bradycardia, probably atrial fibrillation, with wide QRS complexes and prominent J-waves with the highest amplitude recorded in precordial leads V4–V5 (Figure 1). After active external and internal rewarming, our patient recovered uneventfully with complete resolution of his ECG changes within 24 hours of admission.

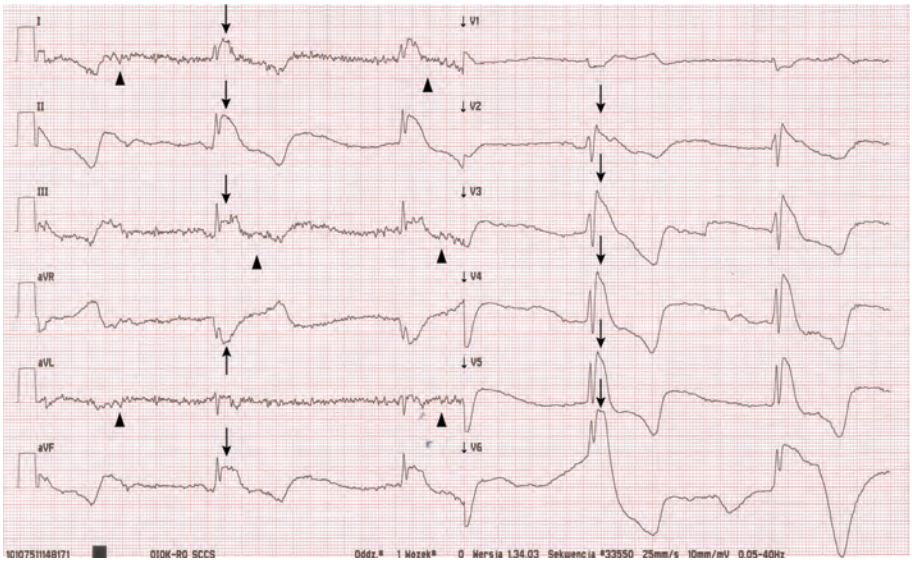

Figure 1: Twelve-lead electrocardiogram of a 53-year-old man, recorded at a body temperature of 31°C (87.8°F), showing irregular bradycardia, probably atrial fibrillation with slow ventricular response, wide QRS complexes with prominent J-waves seen in leads I, II, III, aVL, aVF, and V2–V6 (arrows) with the highest amplitude recorded in precordial leads V4–V5 (14 mm amplitude) and prolonged QT intervals. These markedly elevated deflections are consistent with giant-sized Osborn waves. Shivering artifacts were present in limb leads (I, III, and aVL in particular) (arrowheads).

J-waves, also known as Osborn waves, are related to an exaggerated outward potassium current leading to repolarization abnormalities that are more pronounced under hypothermic conditions. They have been observed at core body temperatures as high as 35°C, and below 30°C, they are detectable in 80% of patients.[1] Larger waves, seen at lower temperatures, signify an increased risk of ventricular arrhythmia, particularly when they exceed 2 mm.[2,3] That said, even mild hypothermia has been correlated with an early repolarization pattern and the development of incessant malignant ventricular arrhythmias.[4] However, mortality in hypothermia appears to be related to the seriousness of the underlying pathology rather than the amplitude of the J-wave. Other ECG manifestations of hypothermia include prolongation of PQ, QRS and QT intervals, bradycardia, and atrial and ventricular arrhythmia. Osborn waves can also occur in nonhypothermic conditions (Appendix 1, available at www.cmaj.ca/lookup/suppl/doi:10.1503/cmaj.170968/-/DC1) and thus are not pathognomonic of hypothermia.[5] Alcohol does not cause Osborn waves, although as in our patient, it may facilitate hypothermia.

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