A regular feature of the *American Journal of Critical Care,* the ECG Puzzler addresses ECG interpretation for clinical practice. We welcome letters to the Editors regarding this feature.

ECG Changes During Induced Hypothermia After Cardiac Arrest

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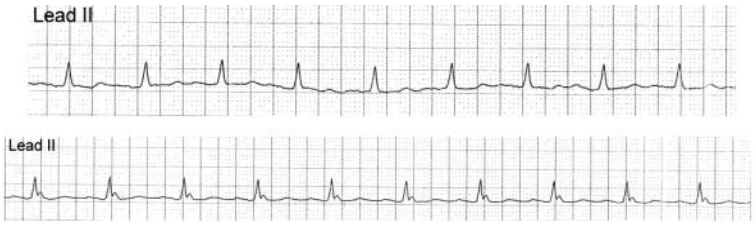
Scenario: These ECG strips are from a 56-year-old man brought to the emergency department after sudden cardiac arrest (SCA). Approximately 7 minutes had elapsed before life support was provided. His initial rhythm was ventricular fibrillation, which returned to sinus rhythm after defibrillation. The patient received routine post-SCA treatment and hypothermia was induced to improve cerebral resuscitation. The top strip was obtained in the emergency department before hypothermia was induced (core temperature, 37.2ºC). The bottom strip was obtained in the intensive care unit after several hours of induced hypothermia therapy (core temperature, 33°C).



For every ECG, we recommend you systematically examine the following 9 features (check all that apply):

1. Rate
- ❏ Normal (60-90 beats per minute)
- ❏ Bradycardia (<60 beats per minute)
- ❏ Tachycardia (>90 beats per minute)

2. Rhythm
- ❏ Regular
- ❏ Irregular
- ❏ Irregular-regular

3. P waves
- ❏ One P wave for every QRS complex
- ❏ Fewer P waves than QRS complexes
- ❏ More P waves than QRS complexes
- ❏ Cannot determine

4. PR interval
- ❏ Normal (≤0.20 seconds)
- ❏ Short (<0.08 seconds)
- ❏ Lengthened (>0.47 seconds)

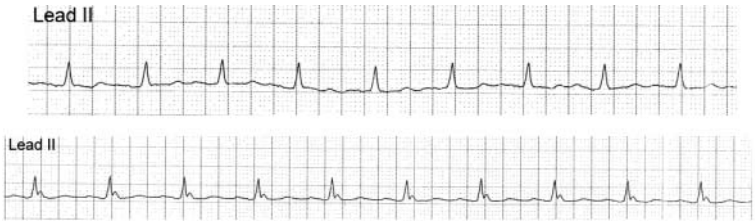
5. QRS complex duration
- ❏ Normal (≤0.12 seconds)
- ❏ Wide (>0.12 seconds)

6. QRS complex direction lead V_1
- ❏ Negative and ≤0.12 seconds (normal)
- ❏ Negative and >0.12 seconds
- ❏ Positive and >0.12 seconds
- ❏ Not applicable

7. ST segments
- ❏ Normal
- ❏ Elevated (≥2 mm)
- ❏ Depressed (≥2 mm)
- ❏ Elevation/depression 2 contiguous (side by side) leads (≥1 mm)

8. T wave
- ❏ Normal
- ❏ Inverted

9. QTc
- ❏ Normal
- ❏ Lengthened (>0.47 seconds)



ANSWERS

1. Rate

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❑ Bradycardia (<60 beats per minute)
❑ Tachycardia (>90 beats per minute)

2. Rhythm

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❑ Irregular-regular

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❑ Fewer P waves than QRS complexes
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❑ Negative and ≤0.12 seconds (normal)
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7. ST segments

☒ Normal
❑ Elevated (≥2 mm)
❑ Depressed (≥2 mm)
❑ Elevation/depression 2 contiguous (side by side) leads (≥1 mm)

8. T wave

☒ Normal
❑ Inverted

9. QTc

☒ Normal
❑ Lengthened (>0.47 seconds)

Interpretation: The top strip shows sinus rhythm with a first-degree atrioventricular block and lengthened QT interval. The bottom strip shows sinus rhythm with first-degree atrioventricular block with J waves indicating hypothermia and lengthened QT interval.

Rationale

A J wave is clearly seen in the bottom strip between the QRS complex and the early portion of the ST segment. Hypothermic J waves, also called Osborne waves after the scientist who described their presence in hypothermia, appear as core body temperature decreases. Nonhypothermic J waves can occur in patients with electrolyte disturbances, cerebral brain injury, Prinzmetal angina, myocardial ischemia, ventricular fibrillation, and Brugada syndrome. Prolongation of the PR interval and QTc are often seen in hypothermia. In this example, the J waves are most likely the result of induced hypothermia. As the J wave increases in height, the T wave may flatten out or even become inverted, which may make measuring the QT interval difficult. Hypothermic J waves are reversible, but can persist for 12 to 24 hours after core temperature is restored.

Nursing Actions

Recent guidelines from the American Heart Association state that induced hypothermia (32°C to 34°C) should be used in adult patients because it mitigates brain damage significantly after SCA. Therefore, nurses working with patients treated with induced hypothermia should be aware of the possible ECG changes that may occur. Although the association of hypothermic J waves and arrhythmias is uncertain, patients should be monitored carefully. Because acute ischemia can be a cause of SCA, this patient also should be monitored closely for changes in the ST segment suggestive of ischemia. In ischemia one would expect the ST-segment changes to occur in specific leads that correspond to the occluded artery, whereas the J waves would be visible in multiple ECG leads.