ECG Puzzler

A regular feature of the American Journal of Critical Care, the ECG Puzzler addresses electrocardiogram (ECG) interpretation for clinical practice. To send an eLetter or to contribute to an online discussion about this article, visit www.ajconline.org and click “Respond to This Article” on either the full-text or PDF view of the article. We welcome letters regarding this feature.

ECG INTERPRETATION CONFOUNDERS

By Mary G. Carey, RN, CNS, PhD, Salah S. Al-Zaiti, RN, NP, Teri M. Kozik, RN, CNS, PhD, and Michele M. Pelter, RN, PhD

Scenario: A 45-year-old female executive arrived at the emergency room with complaints of substernal chest pressure and shortness of breath. She has no prior medical or surgical history, takes no medication, has a normal body mass index, and exercises regularly. Below is her 12-lead ECG obtained in the emergency room.

Interpretation Questions:

1. Is the ECG properly calibrated (10 mm) and are leads properly placed? ❑ Yes ❑ No ❑ NA
   If no, interpret cautiously.
2. Is this a sinus rhythm (one P wave preceding every QRS complex)? ❑ Yes ❑ No ❑ NA
   If no, check for number of P waves in relation to QRS complexes.
3. Is the heart rate (R-R interval) normal (60-100/min)? ❑ Yes ❑ No ❑ NA
   If no, check for supra-ventricular or ventricular arrhythmias.
4. Is the QRS complex narrow (duration < 110 milliseconds [ms] in V1)? ❑ Yes ❑ No ❑ NA
   If no, check for bundle branch blocks (BBBs), pacing, or ventricular arrhythmia.
5. Is the ST segment deviated (> 2 mm in V2-V3, or > 1 mm in other leads)? ❑ Yes ❑ No ❑ NA
   If yes, check for similar deviations in contiguous cardiac territories.
6. Is the T wave inverted in relation to the QRS (> 0.5 mV)? ❑ Yes ❑ No ❑ NA
   If yes, check for ST deviation or conduction abnormalities.
7. Is the QT interval lengthened (> 450 ms [women] or > 470 ms [men])? ❑ Yes ❑ No ❑ NA
   If yes, check for ventricular arrhythmias or left ventricular hypertrophy.
8. Is R or S wave amplitude enlarged (S wave V1 + R wave V5 > 35 mm)? ❑ Yes ❑ No ❑ NA
   If yes, check for axis deviation or other chamber hypertrophy criteria.

Mary G. Carey is associate director for clinical nursing research, Strong Memorial Hospital, Rochester, New York. Salah S. Al-Zaiti is a doctoral student at the School of Nursing at the State University of New York at Buffalo. Teri M. Kozik is supervisor of cardiac research at St. Joseph’s Medical Center, Stockton, California. Michele M. Pelter is an assistant professor at the Orvis School of Nursing, University of Nevada, Reno.

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Interpretation

The ECG shows normal sinus rhythm at 99/min plus lateral ST changes (T wave inversion in V5 and V6). Although not diagnostic, it may suggest myocardial ischemia. Limb lead reversal prevents interpretation of the limb leads.

Rationale

Lead reversal is frequent and has become more common as nonexperienced personnel replace trained ECG technicians. This type of lead reversal affects all of the limb leads but lead I can be used to identify this error by checking for the following: (1) inverted QRS complex; (2) a striking Q wave; (3) inverted T wave; and (4) a notable inverted P wave. However, the precordial leads should exhibit normal R wave progression, as seen in this scenario. If a previous ECG is available, these changes can be easily identified. Limb lead reversal is the most common frontal lead error and the only correction is to repeat the ECG. Unfortunately, this error was not detected in this patient prior to discharge so the ECG was not repeated.

Nursing Actions

The patient’s age, sex and physical fitness place her at low or intermediate risk for acute coronary syndrome (ACS). However, ACS accounts for almost 15 percent of patients who seek treatment in the emergency department; thus an evaluation that includes an initial history, physical exam, ECG, and serum biomarkers is warranted. Special consideration should be given to the fact that females can have atypical presentation and that subtle lateral wall changes may warrant further investigation. Also, the patient reports being an executive, which may suggest that she is having a cardiac event caused by chronic anxiety related to a high-demand career. Given this patient’s symptoms, elevated heart rate and the T-wave inversion seen in leads V5 and V6, a repeat ECG should be obtained immediately to assess the limb leads for possible ischemia.

Answers:

1. Yes, the ECG is properly calibrated. There is limb lead reversal of the left arm and right arm lead wire. Thus, the limb leads must be ignored and only the precordial leads can be analyzed.
2. Yes, the rhythm is sinus.
3. Yes, heart rate is regular at 99/min.
4. Yes, the QRS duration is narrow.
5. No, there is no diagnostic ST segment deviation.
6. Yes, there is T wave inversion in the precordial leads V5 and V6.
7. No, the QT interval is not lengthened.
8. No, there are no electrocardiographic signs of left ventricular hypertrophy.