ECG PUZZLER
A new 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.

INVERTED P WAVES
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Scenario: The patient is a 52-year-old woman who presents to her physician’s office with complaints of general malaise and a low-grade fever. The patient presented to an acute care clinic 3 weeks prior for a sore throat, which was diagnosed as strep throat (streptococcal pharyngitis). Appropriately, she was started on oral penicillin but admitted to not finishing the prescription since she “felt better after 4 days of taking the antibiotic.”

Examine this ECG and the following 9 features, and 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
   - Irregular-irregular

3. P waves
   - One P wave for every QRS complex
   - Too many
   - Missing
   - Inverted (opposite direction as QRS complex using lead II)

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

5. QRS complex duration in lead V₁
   - Normal (≤0.12 seconds)
   - Wide (>0.12 seconds)

6. QRS complex morphology in lead V₁
   - Negative and ≤0.12 seconds (normal)
   - Negative and >0.12 seconds (left bundle branch block)
   - Positive and >0.12 seconds (right bundle branch block)

7. ST segment
   - Normal
   - Elevated (≥2 mm)
   - Depressed (≥2 mm)

8. T Wave
   - Normal
   - Inverted

9. QTc
   - Normal for this heart rate
   - Lengthened (>0.47 seconds)
Interpretation: Nonparoxysmal junctional tachycardia at 65 bpm.

Rationale: Nonparoxysmal (gradual-onset) junctional tachycardia is a supraventricular rhythm with narrow QRS complexes and a regular rate, usually between 60-140 bpm. The distinguishing feature of this ECG is retrograde conduction of the atrium causing an inverted P wave, best observed in lead II. In this case, the P waves are also inverted in multiple leads (III, aVF, V3 through V6). Although lead V1, a commonly selected monitoring lead, is not helpful for observing retrograde P-wave conduction, the PR interval is short (0.10 seconds), which suggests a junctional rhythm.

The causes of nonparoxysmal junctional tachycardia include underlying heart disease such as inferior myocardial infarction, myocarditis as a result of rheumatic fever, or after open heart surgery. In addition, an important cause of nonparoxysmal junctional tachycardia is digitalis toxicity. Given this patient’s scenario, which included a recent streptococcal infection, myocarditis is a likely cause of this rhythm.

Nursing Actions to Consider

This ECG rhythm is regular, and cardiovascular status is not compromised. However, given the diagnosis of rheumatic fever causing the myocarditis, this patient should be admitted to the hospital for bed rest, anti-inflammatory agents, and antibiotic therapy.
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