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.ajcconline.org and click “Respond to This Article” on either the full-text or PDF view of the article. We welcome letters regarding this feature.

ADENOSINE DURING ARRHYTHMIA

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Scenario: A 60-year-old man was admitted with exacerbated chronic obstructive pulmonary disease attributed to community-acquired right lower lobe pneumonia. His medical history was significant due to hypertension, diabetes, and a 40 pack/year history of smoking tobacco. His treatment included noninvasive ventilation, antibiotics, intravenous steroids, and aerosolized bronchodilators. On the second day he developed asymptomatic tachycardia at 160/min (A). A carotid sinus massage was attempted with no response, so intravenous adenosine (6 mg) was administered. This led to ventricular standstill with low voltage sawtooth waves (B). The patient reported flushing and increased shortness of breath, but the ventricles spontaneously recovered and the cardiac rhythm reverted to the narrow complex tachycardia (C).

For every ECG, we recommend that readers 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 (<0.11 seconds)
   - Lengthened (>0.20 seconds)
   - Cannot determine

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

6. QRS complex direction lead V1
   - Negative and ≤0.12 seconds (normal)
   - Negative and >0.12 seconds
   - Positive and >0.12 seconds
   - Cannot determine

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. QT
   - Normal
   - Lengthened (>0.47 seconds)

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Interpretation

(A) Narrow complex supraventricular tachycardia (SVT) at 150/min; (B) ventricular standstill with sawtooth pattern (F waves) indicative of atrial activity, with 2 escape beats; (C) atrial flutter of more than 150/min with a high and varied degree of atrioventricular block, causing irregularity.

Rationale

Panel A shows SVT, evidenced by a rapid, regular, narrow complex tachycardia. Administration of adenosine exposed the etiology of the tachycardia by exhibiting the flutter waves seen in panel B; that is atrial flutter. Adenosine is a class 5 antiarrhythmic agent that produces transient block in the atrioventricular node. This effect is mediated by interaction with A1 receptors (reducing cyclic adenosine monophosphate) present on myocytes, thereby activating potassium channels, which increases K+ efflux, causing cell hyperpolarization. Adenosine also indirectly reduces calcium influx into the cells by antagonizing catecholamine-stimulated adenylate cyclase. It has diagnostic (as demonstrated here) and therapeutic effects in termination of paroxysmal supraventricular tachycardia (PSVT). Common side effects are chest pain, flushing, hypotension, and palpitations. Transient ventricular standstill, as in this case, is a rare complication.

Nursing Actions

Managing SVT requires assessing the regularity of the rhythm and characterizing atrial activity (identification of P waves) if possible. Regular tachycardia without P waves suggests PSVT, atrial tachycardia, or atrial flutter. Because adenosine has a half-life of only a few seconds, this medication should be administered by rapid intravenous push followed by a normal saline flush. Because of the short half-life, intravenous administration close to the heart is preferred. Careful monitoring of the patient’s vital signs and ECG are required.

Prior to adenosine administration, there should be communication with all staff, physicians, and monitor technicians to avoid inappropriate treatment. It is also important to educate the patient about possible side effects, because these can be distressing. Absolute contraindications to adenosine include heart blocks, ventricular tachycardia, and atrial fibrillation. Bronchial asthma is a relative contraindication.
Adenosine During Arrhythmia
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