

Challenges in Clinical Electrocardiography

Irregular Supraventricular Tachycardia

Edgar Argulian, MD, MPH; Eric Bader, MD; Patricia Chavez, MD; Emad F. Aziz, DO, MB, ChB

An 86-year-old woman with a known history of coronary artery disease and a prior percutaneous coronary intervention presented to the emergency department with several episodes of self-resolving chest discomfort occurring at rest. She denied any shortness of breath, palpitations, and diaphoresis. Her home medications included a β -blocker. Her blood pressure was 140/85 mm Hg, and she had an irregular heart rate of 125/min. **Figure 1** shows the initial electrocardiogram (ECG) obtained in the emergency department.

Question: Does the patient have atrial fibrillation (AF)?

ECG Description

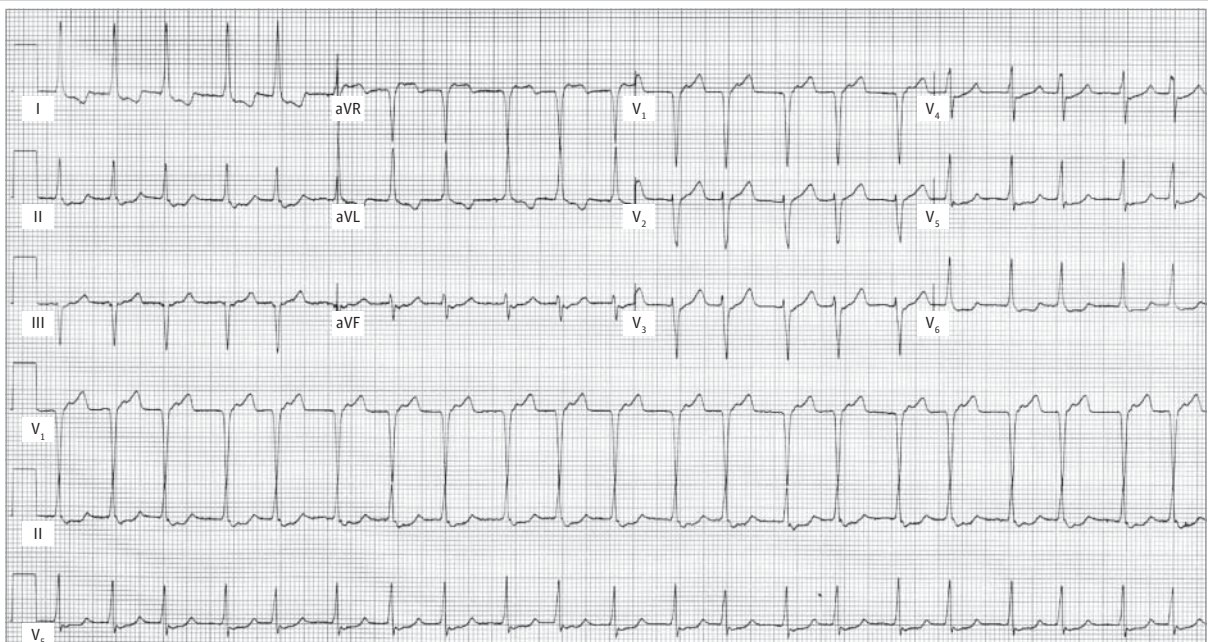
The initial ECG shows a narrow-complex irregular tachycardia at a rate of approximately 125/min. On careful inspection, distinct P waves can be seen at the end of each QRS complex in multiple leads. They appear to be negative (retrograde) in inferior leads (II, III, aVF), giving the impression of a reentrant tachycardia using the atrioventricular (AV) node. At the end of the strip, a regularly irregular pattern is seen (please note an alternation of short and long R-R intervals). On the basis of these findings, a form of AV nodal reentrant tachycardia (AVNRT) was considered as the most likely diagnosis. The pathophysiologic basis of AVNRT includes the presence of 2 electrically distinct pathways within the AV node (or the paranodal tissue), which are necessary to create a reentrant circuit: the "fast pathway" has rapid conduction and a relatively long refractory period, whereas the "slow pathway" has slow conduction but a relatively short refractory period. During normal sinus rhythm, the impulse

from atria conducts rapidly down the fast pathway and activates the ventricles, while the delayed conduction down the slow pathway finds the infranodal tissue refractory. A critically timed atrial premature beat can find the fast pathway refractory, while the slow pathway has already recovered. The antegrade conduction down the slow pathway will allow enough time for the fast pathway to recover and conduct retrograde; thus, a reentrant circuit of typical AVNRT is established presenting as *regular* narrow-complex tachycardia. In some patients, the AV node contains not just 2 but multiple pathways (ie, several slow pathways) and alternate antegrade conduction during the supraventricular tachycardia is possible creating an irregular rhythm (**Figure 2**). In our patient, the relationship between the R wave and following P wave (RP interval) remains constant owing to retrograde conduction using a single fast pathway. The R-R interval varies, and the clear alternation of short and long R-R intervals at the end of the ECG is due to alternating antegrade conduction through different slow pathways.

Clinical Course

The patient spontaneously converted to normal sinus rhythm with resolution of her chest discomfort. The subsequent ECG showed normal sinus rhythm with borderline prolongation of the PR interval (**Figure 3**). Please note that retrograde P waves after the QRS complexes are no longer present. Because of the symptomatic nature of the arrhythmia in a patient already treated with a β -blocker, an electrophysiologic study was pursued. This study confirmed the presence of multiple AV nodal pathways. A successful slow pathway

Figure 1. Irregular Narrow-Complex Tachycardia



modification procedure was performed, and the patient was discharged home, where she remains asymptomatic.

Discussion

The differential diagnosis for irregular narrow-complex tachycardia includes AF, atrial flutter with variable AV conduction, sinus tachycardia with atrial premature beats, and multifocal atrial tachycardia. While AF is a common diagnosis, careful consideration of other possibilities is necessary in order not to expose the patient to unnecessary treatments such as long-term anticoagulation. In this case,

the close inspection of the ECG revealing a P wave after each QRS complex and regularly irregular rhythm at the end of the strip, alerted the clinician to consider other possibilities. Atrioventricular nodal reentrant tachycardia is typically a regular narrow-complex short-RP tachycardia but very occasionally can be irregular. Previous studies show that up to 6% of patients have not just the 2 AV nodal pathways necessary to sustain the reentrant circuit (fast and slow) but multiple pathways.^{1,2} This can be demonstrated by multiple discontinuities in the anterograde AV nodal conduction during an electrophysiologic study.^{1,2} However, even in these patients, during AVNRT

Figure 2. Atrioventricular (AV) Nodal Reentrant Tachycardia Using the AV Node With More Than 2 Pathways

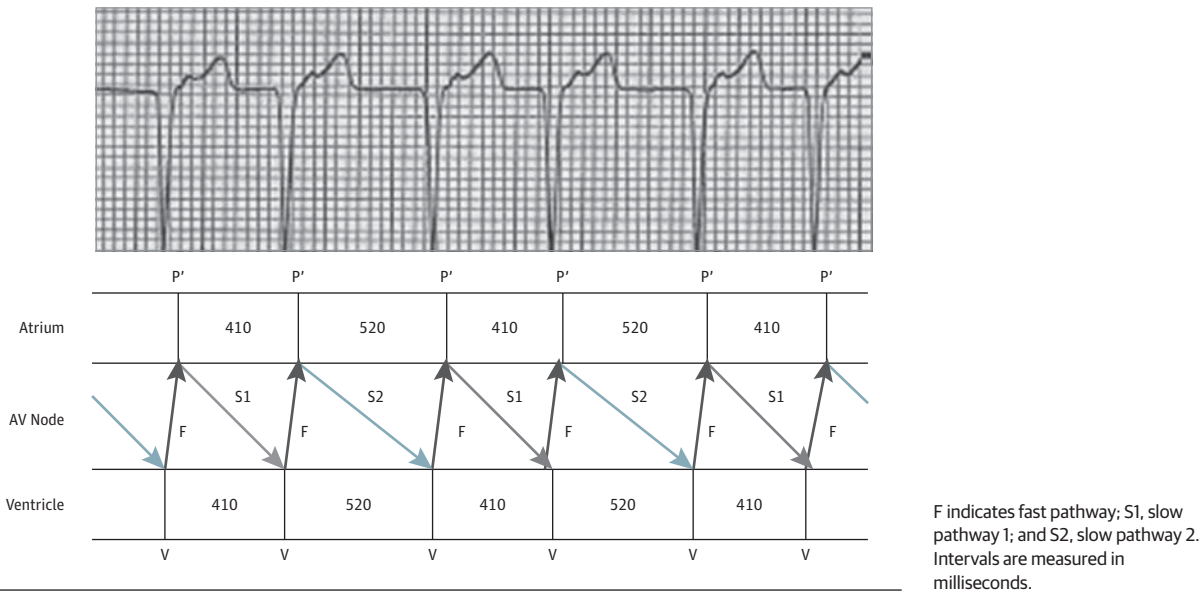
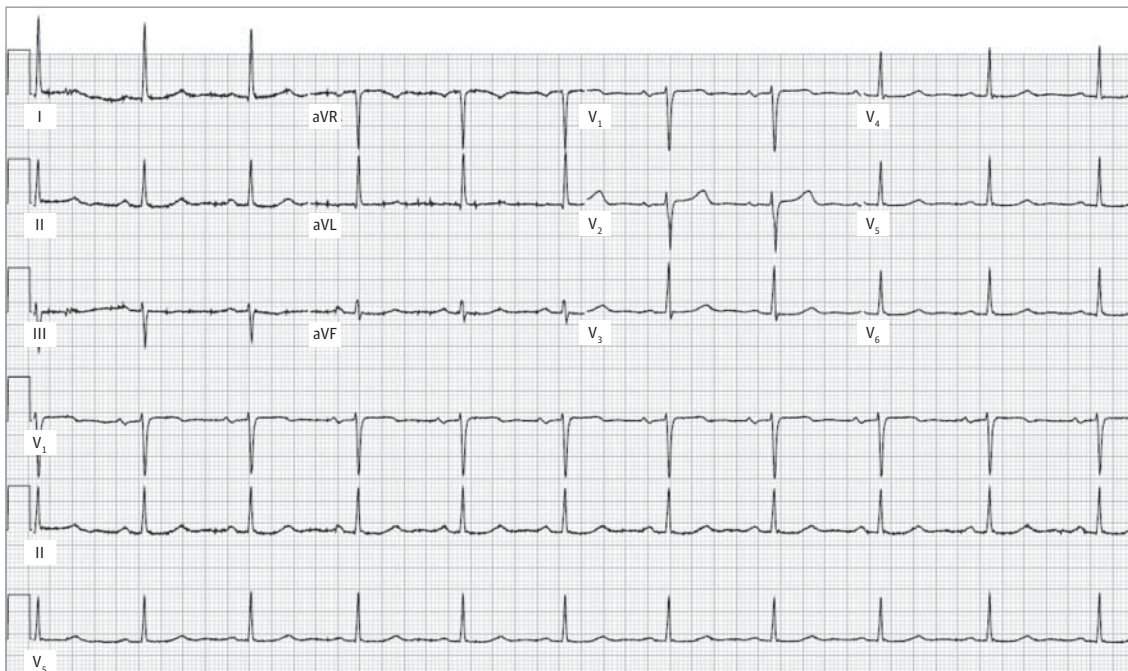


Figure 3. Electrocardiogram in Normal Sinus Rhythm



there is typically 1 conducting antegrade pathway creating a regular tachycardia. Previous reports describe irregular narrow-complex tachycardia due to different slow pathways involvement during AVNRT mimicking AF (named "pseudo-AF").^{3,4} According to those reports, this manifestation of AVNRT as an irregular tachycardia resulting from alternating conduction through different slow pathways (as was seen in our patient) is rare. When in doubt, transient AV nodal slowing using vagal maneuvers or intravenous adenosine can help to clarify the diagnosis of narrow-complex tachycardia: the macroreentrant arrhythmias using the AV node such as

AVNRT commonly break while some other arrhythmias like atrial flutter or AF can be unmasked.

Take-Home Points

- An irregular narrow-complex tachycardia is commonly AF but other possibilities should be carefully excluded in order not to expose the patient to unnecessary treatment.
- Some patients with AVNRT have multiple AV nodal pathways that can rarely result in irregular narrow-complex tachycardia mimicking AF.

ARTICLE INFORMATION

Author Affiliations: Division of Cardiology, St Luke's-Roosevelt Hospital Center, New York, New York.

Corresponding Author: Edgar Argulian, MD, MPH, Division of Cardiology, St Luke's-Roosevelt Hospital Center, Columbia University College of Physicians and Surgeons, 1111 Amsterdam Ave, New York, NY 10025 (eargulian@chpnet.org).

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