

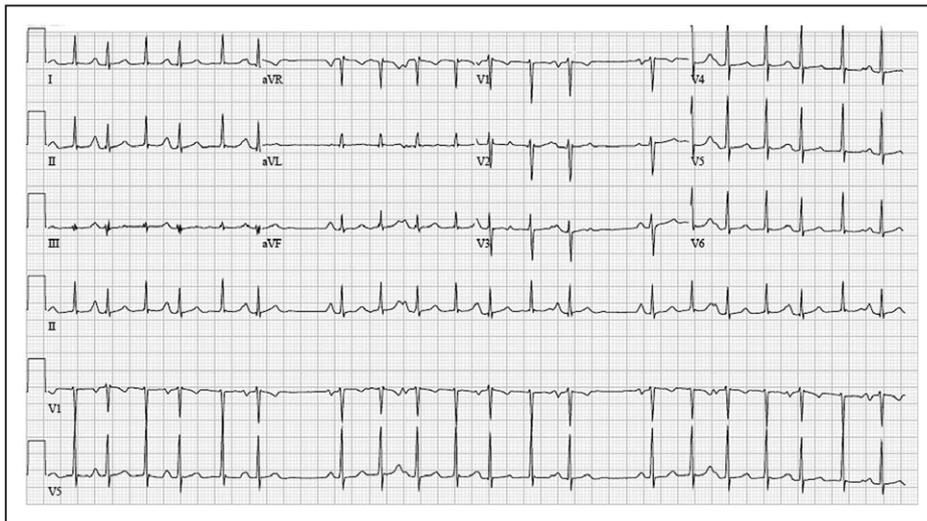
# Irregular Narrow Complex Tachycardia in a 29-Year-Old Woman

## ECG CHALLENGE

A 29-year-old woman without known medical illness was evaluated for incessant palpitations. She presented to an emergency department multiple times, where various diagnoses were made, including junctional tachycardia, atrial tachycardia, and atrial fibrillation. Therapy with propafenone, metoprolol, and rivaroxaban was initiated, but her symptoms continued. Echocardiography did not show evidence of structural heart disease. The patient was then referred to our hospital for further treatment and potential ablation for atrial fibrillation. At her clinic visit, a 12-lead ECG revealed an irregular narrow complex tachycardia with group beating pattern (Figure 1).

What is the rhythm shown in Figure 1?  
Please turn the page to read the diagnosis.

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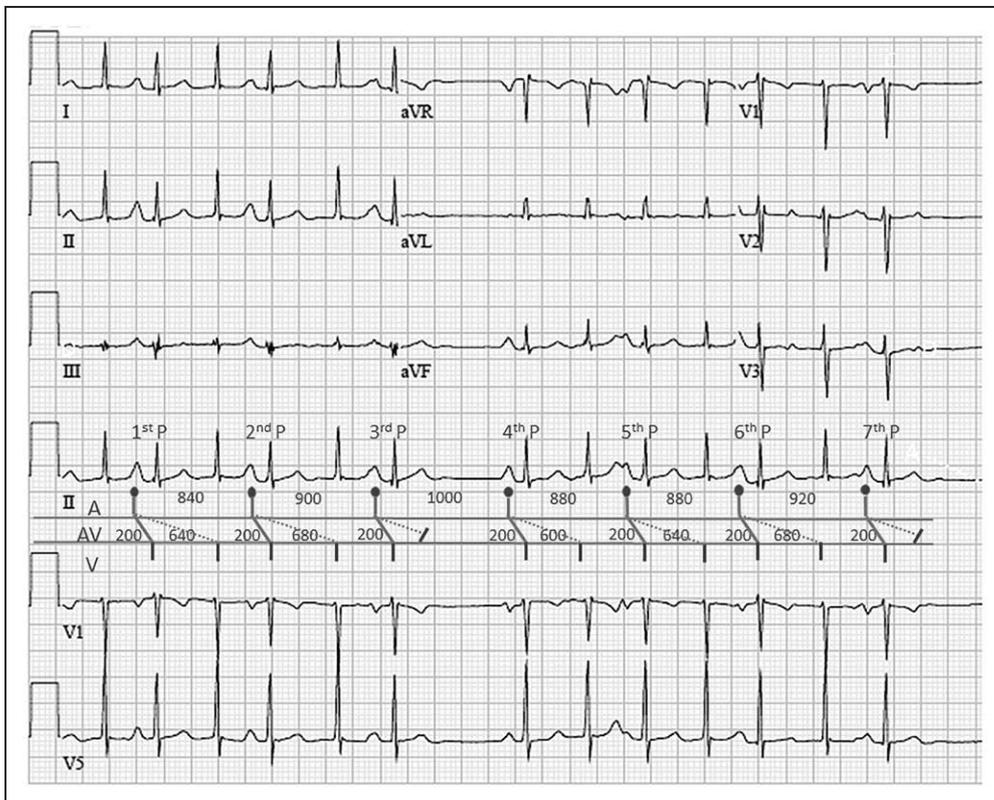


**Figure 1.** Twelve-lead electrocardiography shows narrow complex tachycardia with group beating pattern.

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**Key Words:** 1 to 2 atrioventricular conduction ■ atrioventricular nodal reentrant tachycardia ■ dual atrioventricular nonreentrant tachycardia

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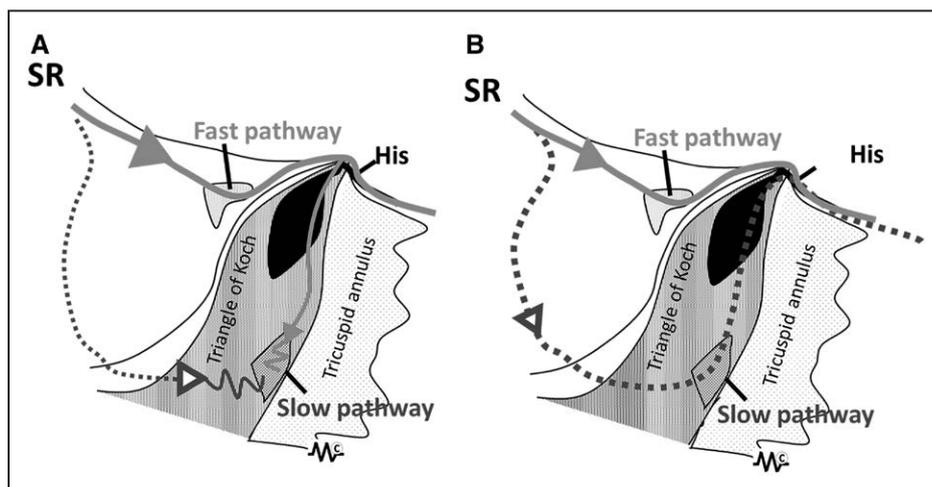
**Figure 2. Electrocardiography with ladder diagram demonstrating the dual atrioventricular nonreentrant tachycardia.**

One sinus beat (P, positive in II, III, and aVF and biphasic in V1) is followed by 2 QRS complexes through the fast pathway and slow pathway. PR interval during FP conduction stays constant at 200 milliseconds. Progressive prolongation of PR interval from 600 to 680 milliseconds during SP conduction is seen, followed by Wenckebach block. FP indicates fast pathway; and SP, slow pathway.

### RESPONSE TO ECG CHALLENGE

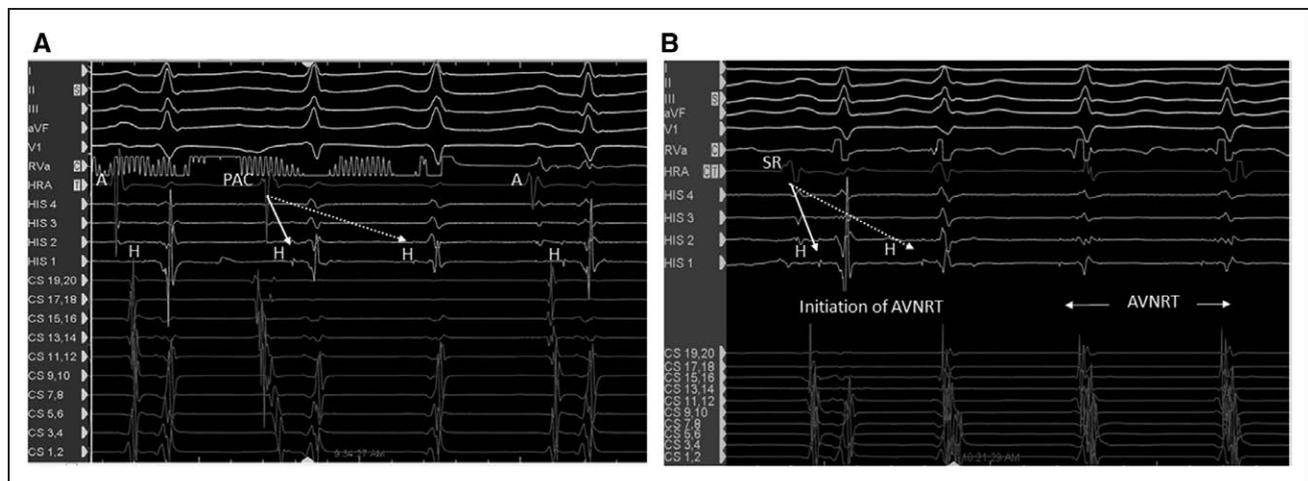
P waves arising from the sinus node are seen at a rate of 66 beats per minute. Each P wave is followed by 2 QRS complexes until the tachycardia terminates, followed by

reinitiation of tachycardia with the same pattern. The double ventricular response to a single atrial activation, called 1 to 2 atrioventricular conduction or dual ventricular response, occurs when activation from each sinus beat



**Figure 3. Depiction of dual atrioventricular nonreentrant tachycardia.**

**A**, During normal conduction, atrial activation proceeds anterograde through the fast pathway to activate the atrioventricular (AV) node and ventricle. Retrograde concealed conduction into the slow pathway prevents repeat activation of the ventricle by anterograde conduction down the slow pathway. **B**, Rarely, anterograde conduction in the fast pathway can be followed by anterograde conduction down the slow pathway, resulting in 2 QRS complexes for each atrial activation. This occurs because of a lack of retrograde concealment into the slow pathway. SR indicates sinus rhythm. Copyright © 2017 Mayo Foundation for Medical Education and Research.



**Figure 4. Intracardiac tracings from electrophysiology study.**

**A**, 1 to 2 atrioventricular conduction during sinus rhythm. Note the presence of 2 His (H) signals and QRS complexes after 1 sinus beat. **B**, Initiation of reentrant AVNRT with 1 to 2 AV conduction after a sinus complex. A indicates atrial signal; AVNRT, AV nodal reentrant tachycardia; CS, coronary sinus; PAC, premature atrial contraction; and SR, sinus rhythm.

first proceeds down the fast pathway (FP) to create a QRS complex with a short PR interval, followed by activation down the slow pathway (SP) to create another QRS complex with a longer PR interval<sup>1</sup> (Figure 2). This repeats itself for each sinus beat, leading to a nonreentrant tachycardia named dual atrioventricular nonreentrant tachycardia.<sup>2,3</sup> The occurrence of 1 to 2 atrioventricular conduction during sinus rhythm requires the absence of retrograde concealment into the SP by antegrade activation down the FP (Figure 3). It also requires slow enough conduction down the SP to allow recovery of the His-Purkinje system to produce another QRS complex. Also notable is the occurrence of Wenckebach phenomenon in the SP, such that there is progressive prolongation of the PR interval for the second QRS complex (arising from SP conduction), followed by block leading to temporary termination of the tachycardia.<sup>1</sup> In Figure 2, the PR interval associated with SP conduction progressively prolongs from 600 to 680 milliseconds after the 4th, 5th, and 6th sinus beats, followed by complete block in the SP after the 7th sinus beat.

Differential diagnosis for this ECG includes single junctional extrasystole after each sinus beat. However, the repetitive group beating pattern makes this less likely. The presence of regular sinus rhythm with no other apparent atrial activity excludes other common causes of irregular narrow complex tachycardia, such as atrial fibrillation, atrial flutter, and multifocal atrial tachycardia.

The patient underwent an electrophysiology study that confirmed the presence of dual atrioventricular nodal physiology and 1 to 2 atrioventricular conduction during sinus rhythm and with premature atrial contraction (Figure 4A). In addition, 1 to 2 atrioventricular conduction resulted in induction of typical atrioventricular nodal reentrant tachycardia (AVNRT), an unusual form of AVNRT initiation (Figure 4B). AVNRT is most commonly initiated by a premature atrial contraction that encounters a refractory FP, resulting in conduction

down the SP. If conduction in the SP is slow enough, then the FP repolarizes and can conduct in the retrograde direction, thus initiating a reentrant rhythm. In this case, however, the 1 to 2 atrioventricular conduction results in conduction down the FP, followed by the SP to produce 2 QRS complexes. The FP recovers refractoriness by the time that SP conduction is completed, resulting in its retrograde activation to initiate AVNRT. AVNRT is a reentrant tachycardia, unlike dual atrioventricular nonreentrant tachycardia. Radiofrequency ablation of the SP in the triangle of Koch resulted in elimination of both forms of tachycardia. The patient did not have recurrent tachycardia 6 months after the ablation.

## DISCLOSURES

None.

## AFFILIATION

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## FOOTNOTES

*Circulation* is available at <http://circ.ahajournals.org>.

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