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IMAGING VIGNETTE

INTERMEDIATE

ECG CHALLENGE

Narrow Complex Tachycardia With Intermittent 2:1 Atrioventricular Relationship

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ABSTRACT

Narrow QRS complex tachycardia has a broad differential diagnosis. We present a series of rhythm strips with representative onset, transition from 2:1 AV conduction to 1:1 AV conduction, and offset of tachycardia. By analyzing these rhythm strips, we can identify the electrophysiologic mechanism and diagnosis. (**Level of Difficulty: Intermediate.**) (J Am Coll Cardiol Case Rep 2022;4:1418–1420) © 2022 Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

CASE

A 48-year-old woman with end-stage renal disease and heart failure with preserved ejection fraction presented with recurrent paroxysmal narrow complex tachycardia. She was symptomatic with chest pain and palpitations. Her tachycardia with representative onset, transition from 2:1 to 1:1 atrioventricular (AV) relationship, and offset was documented on telemetry rhythm strips (**Figures 1A to 1C**).

What is the mechanism of this patient's tachycardia?

A. Atrial tachycardia
B. Atrioventricular re-entry tachycardia
C. Atrioventricular nodal re-entry tachycardia
D. Atrial flutter

DISCUSSION

Narrow QRS complex tachycardia has a broad differential diagnosis, and subtle findings on the electrocardiogram can guide one to the correct diagnosis.[1] **Figure 1A** depicts the onset of narrow QRS complex supraventricular tachycardia (SVT) following a premature atrial complex and a prolonged PR interval. Inverted P waves at the end of QRS complexes are evident in lead II, and the P-wave itself is quite narrow, implying retrograde atrial activation from the septum, consistent with the location of the AV node. PP intervals are constant with an atrial rate of 136 beats/min, and RR intervals are constant with a ventricular rate of 68 beats/min, consistent with 2:1 AV relationship. **Figure 1B** depicts the transition of the tachycardia from a 2:1

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to a 1:1 AV relationship, with an identical P-wave configuration and PP intervals suggesting the same underlying mechanism of the tachycardia. The RP interval is less than one-half of the RR interval, consistent with short RP tachycardia.

Sinus tachycardia is excluded by the abrupt onset and termination and by the inverted P waves. Atrial fibrillation can be ruled out by the presence of regular P waves. Atrial flutter by definition does not have isoelectric intervals between P waves. Atrial tachycardia (and atrial flutter) is excluded by the termination of 1:1 SVT in **Figure 1B** with an atrial activation because it would be highly coincidental for the atrial tachycardia to terminate with the last atrial activation also becoming AV blocked.

ABBREVIATIONS AND ACRONYMS

AV = atrioventricular

AVNRT = atrioventricular nodal re-entry tachycardia

AVRT = atrioventricular re-entry tachycardia

SVT = supraventricular tachycardia

Orthodromic AV re-entry tachycardia (AVRT) is incompatible with a 2:1 AV block pattern. In AVRT, the atrium, AV node and infranodal conduction system, ventricle, and the accessory pathway are all participatory in the re-entry mechanism, and a block in any 1 of these components will terminate the tachycardia.

In AV nodal re-entry tachycardia (AVNRT), because retrograde conduction from the AV node to the atria for the re-entry circuit is above and independent of the bundle of His and the ventricles, a functional infranodal block can produce a 2:1 block similar to our case (**Figure 1D**). Man et al[2] performed experiments that showed the lack of a response to atropine and consistent conversion of 2:1 block to 1:1 conduction by a ventricular extrastimulus and concluded that a functional intra-Hisian block is most likely to produce 2:1 AV block in AVNRT.

The final diagnosis is AVNRT. The patient underwent an electrophysiology study that revealed dual AV nodal physiology with inducible sustained typical AVNRT, and 2:1 infranodal AV block was reproduced during atrial pacing at 400 milliseconds.

The correct answer is C, atrioventricular nodal re-entry tachycardia.

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KEY WORDS atrial tachycardia, atrioventricular nodal re-entry tachycardia, atrioventricular re-entry tachycardia, supraventricular tachycardia

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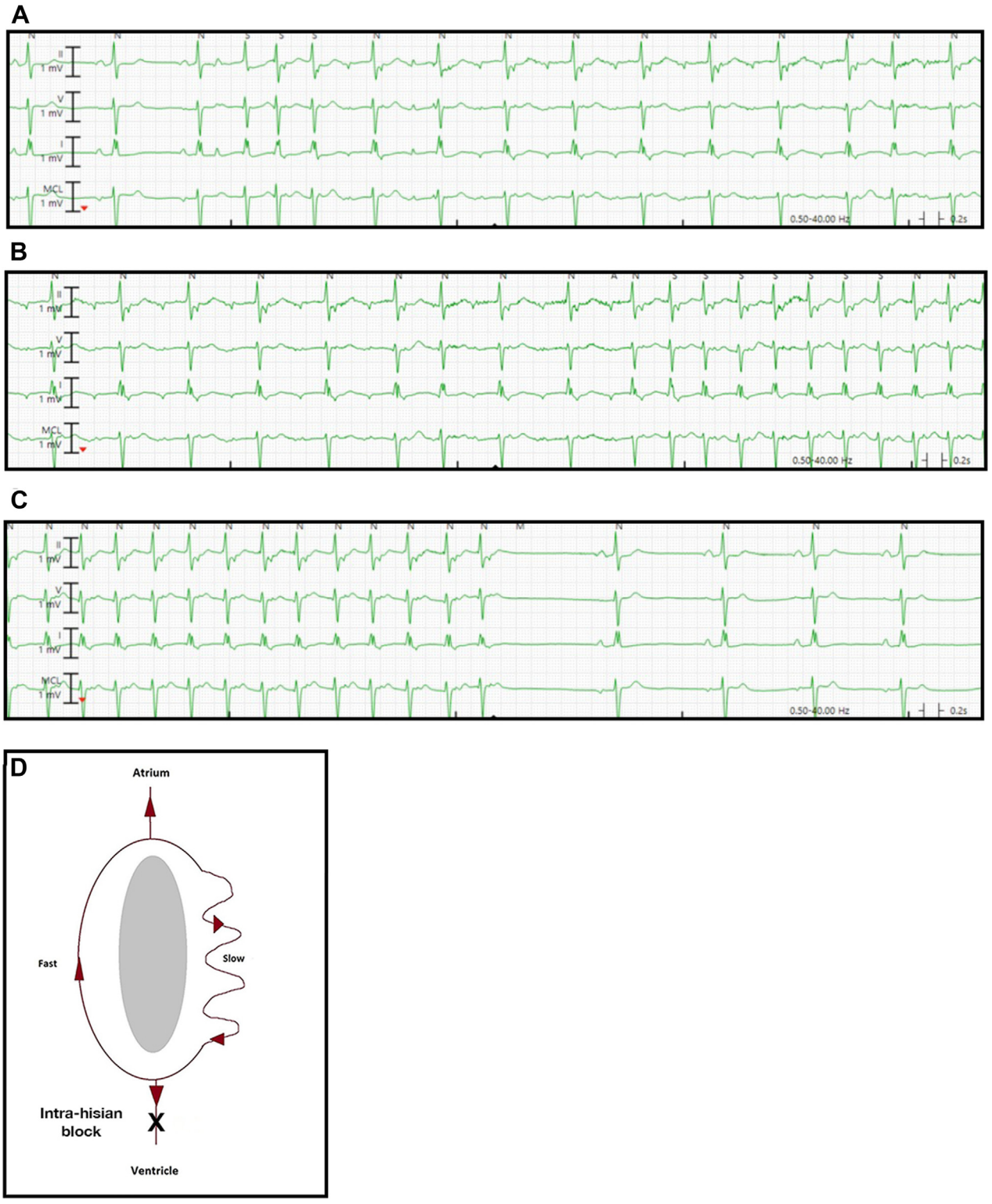
FIGURE 1 **Rhythm Strips and Illustration of Atrioventricular Nodal Re-Entry Tachycardia Circuit**



(A) Initiation of tachycardia. **(B)** The transition from a 2:1 to a 1:1 atrioventricular relationship. **(C)** Termination of tachycardia. **(D)** Diagrammatic illustration of the atrioventricular nodal re-entry tachycardia circuit. The entire re-entry circuit is above the level of and independent of the bundle of His, and intra-Hisian blocks, including 2:1 block as seen in our case, are compatible with atrioventricular nodal re-entry tachycardia.