ARRHYTHMIA OF THE MONTH

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An Irregular, Narrow QRS Complex Tachycardia With Ventriculoatrial Block: What is the Tachycardia Mechanism?

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Case Presentation

A 57-year-old woman underwent an electrophysiology procedure because of a 19-year history of recurrent palpitations. Typical AV nodal reentrant tachycardia that had a cycle length of 460 msec was induced by ventricular pacing. Slow pathway ablation was attempted using a combined anatomical and electrogram-guided approach. After an application of radiofrequency energy associated with junctional ectopy, the tachycardia shown in Figure 1 was recorded. What is the mechanism of this tachycardia?

Commentary

Figure 1 shows an irregular, narrow QRS complex tachycardia with an average cycle length of 300 msec, interrupted by one pause. The atrial electrograms have a constant cycle length of 580 msec, and there are approximately half as many atrial electrograms as there are QRS complexes. The causes of a narrow QRS complex tachycardia with fewer P waves than QRS complexes include AV nodal reentrant tachycardia with upper common pathway block, automatic junctional tachycardia with ventriculoatrial block, a reentrant tachycardia utilizing the normal conduction system for anterograde conduction, and a nodofascicular pathway for retrograde conduction, and intra-Hisian reentry. In each of these tachycardias, ventriculoatrial conduction results in a concentric pattern of atrial activation. These tachycardias theoretically may occur in association with complete ventriculoatrial block, in which case atrial activation would not be concentric. If this were the case, the atrial rhythm would be dissociated from the tachycardia.

In the present case, the high-right atrial electrogram precedes the low-right atrial septal electrogram, consistent with sinus rhythm. Furthermore, there is a fixed AV interval between each atrial electrogram and the first subsequent ventricular electrogram. These two observations rule out each of the four possible causes of narrow QRS complex tachycardia and ventriculoatrial block described above.

The P wave morphology is consistent with sinus rhythm, and the most likely explanation for this tachycardia is that each atrial depolarization gives rise to two ventricular depolarizations by conducting through the fast and slow AV nodal pathways (Fig. 2). This type of 1:2 AV conduction (or "double fire") is rare during sinus rhythm in patients who have dual AV nodal pathways since conduction through the slow pathway during sinus rhythm usually is not slow enough to allow recovery of excitability in the lower portion of the AV node, His-Purkinje system, and/or ventricle after depolarization through the fast pathway. It also is possible that conduction through the fast pathway results in concealed retrograde penetration of the slow pathway, preventing anterograde conduction through the slow

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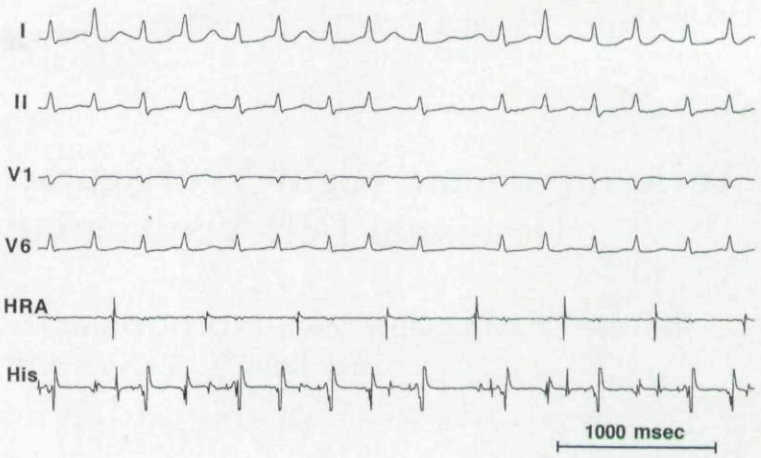

Figure 1. *A narrow QRS complex tachycardia with ventriculoatrial block. Shown are leads I, II, V1, and V6, and intracardiac electrograms recorded in the high-right atrium (HRA) and in the region of the His bundle (His). Note that there are approximately twice as many QRS complexes as atrial electrograms.*

pathway. In the present case, an application of radiofrequency energy presumably slowed conduction through the slow pathway to the extent that there was sufficient time for recovery of excitability distal to the slow pathway. The pause seen in Figure 1 is attributable to an episode of complete block in the slow pathway.

At the time that this rhythm was recorded, AV nodal reentrant tachycardia was still inducible by pacing. After an additional application of radiofrequency energy directed at the slow pathway, AV nodal reentrant tachycardia was no longer inducible and there were no further episodes of 1:2 AV conduction.

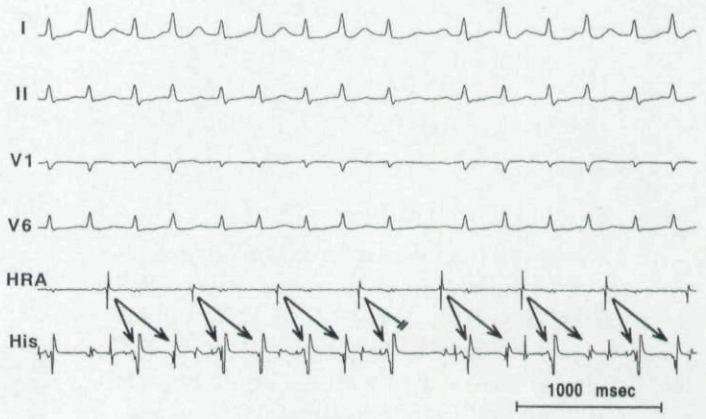

Figure 2. *The same tachycardia is shown in Figure 1, with arrows indicating simultaneous conduction through the fast and slow AV nodal pathways. There is one instance of complete block in the slow pathway, accounting for the pause.*