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A Long RP Tachycardia: What is the Tachycardia Mechanism?

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Case Presentation

A 75-year-old man underwent an electrophysiologic procedure because of recurrent palpitations and documented tachycardia. At baseline, there was sinus rhythm with right bundle branch block. Programmed stimulation demonstrated anterograde dual AV nodal physiology. A regular, long RP tachycardia with a cycle length of 540 msec and inverted P waves in the inferior leads was induced by atrial overdrive pacing (Fig. 1). The QRS morphology and His-ventricular interval were identical during sinus rhythm and during tachycardia. Ventricular pacing at a cycle length of 520 msec during tachycardia accelerated the atrial cycle length to the pacing cycle length. The response upon cessation of pacing is shown in Figure 2. After infusion of isoproterenol, typical AV nodal reentrant tachycardia was induced. During slow pathway ablation, inadvertent temporary complete AV block occurred (Fig. 3). What is the mechanism of the long RP tachycardia?

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Commentary

The 12-lead ECG shown in Figure 1 shows a regular, wide QRS complex tachycardia with right bundle branch

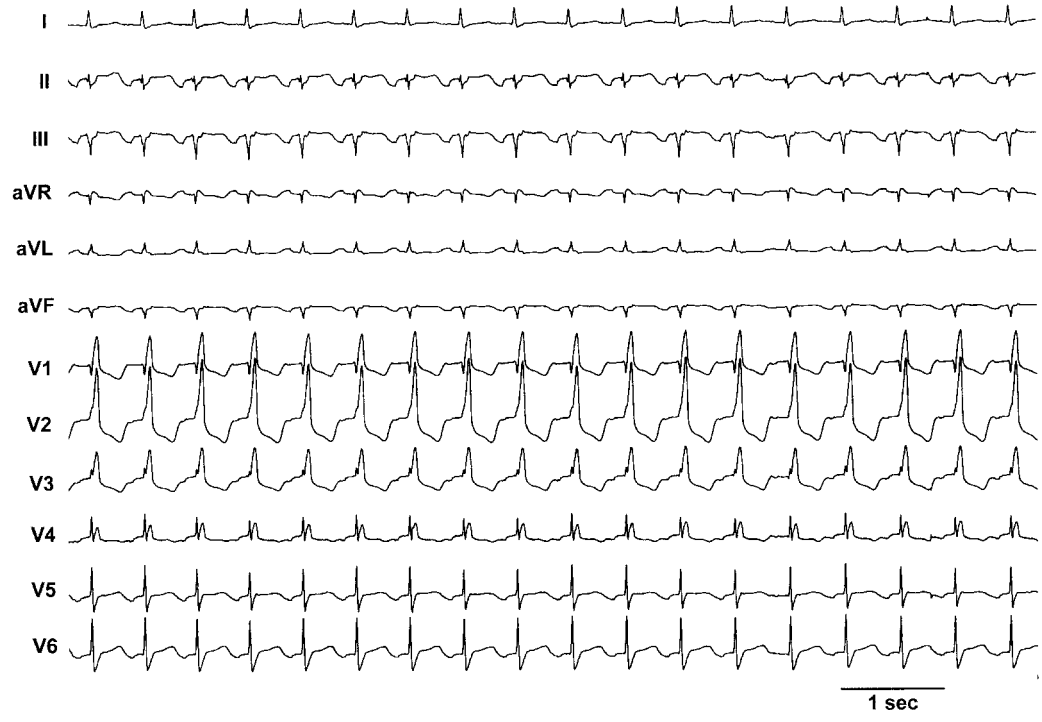

Figure 1. *Twelve-lead ECG of the wide QRS complex, long RP tachycardia.*

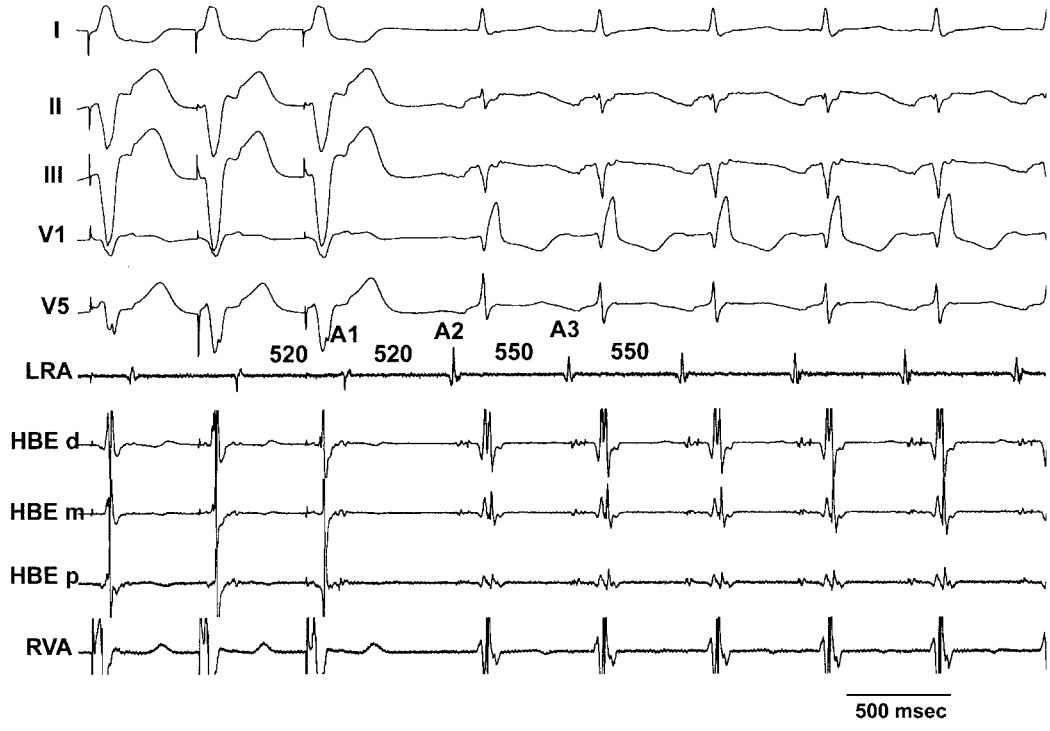

Figure 2. *Ventricular pacing at a cycle length of 520 msec during supraventricular tachycardia with a cycle length of 550 msec. Shown are leads I, II, III, V1, and V5, the lateral right atrial electrogram (LRA), the distal (d), middle (m), and proximal (p) His-bundle electrograms (HBE), and a right ventricular apex electrogram (RVA). The atrial electrograms immediately following ventricular pacing are denoted as A1, A2, and A3. The intervals displayed represent cycle lengths (in msec).*

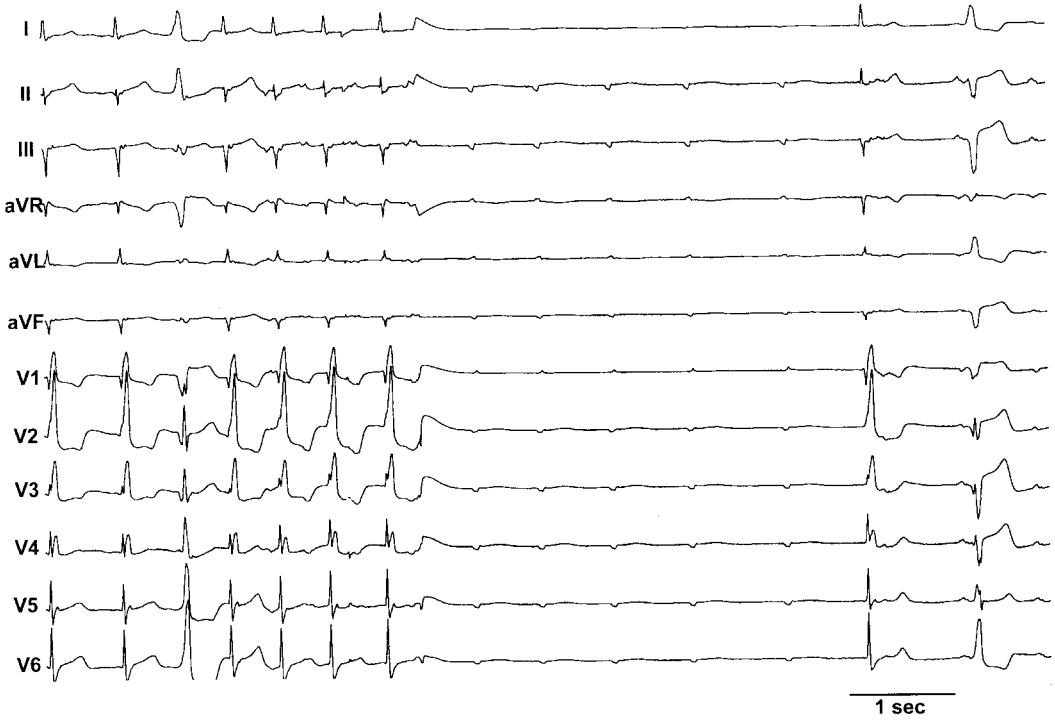

Figure 3. *Transient complete AV block during slow pathway radiofrequency ablation, with continuation of the atrial tachycardia. Radiofrequency ablation was performed during sinus rhythm. Complexes 1 to 7 represent junctional beats followed by complete AV block and atrial beats with the same P wave morphology and cycle length (550 msec) as during the tachycardia. The atrial cycle length prolongs and the tachycardia terminates, followed by a junctional and a fusion beat.*

block morphology and a long RP interval. The differential diagnosis at this point includes atypical (fast-slow) AV nodal reentrant tachycardia, orthodromic reciprocating tachycardia, and atrial tachycardia with an underlying bundle branch block. Ventricular tachycardia was excluded by the identical His-ventricular interval and QRS morphology during sinus rhythm and during tachycardia. The eccentric atrial activation sequence during tachycardia excludes atypical AV nodal reentrant tachycardia (Fig. 2).

Transient overdrive pacing of the right ventricle during tachycardia at a cycle length 10 to 60 msec shorter than the tachycardia cycle length often is helpful in identifying the mechanism of paroxysmal supraventricular tachycardias, provided VA conduction is present at this cycle length.[1] If the atrial rate accelerates to the ventricular pacing rate without termination of the tachycardia and the electrogram sequence immediately after the last paced ventricular complex shows an "atrial-atrial-ventricular" (A-A-V) response, a diagnosis of an atrial tachycardia can be established.

In Figure 2, the recording from the lateral right atrium upon cessation of ventricular pacing shows two atrial electrograms (A1 and A2). When determining if the response is A-V or A-A-V, the atrial electrogram that is counted first is the one that is the result of VA conduction from the last paced ventricular complex. In Figure 2, A1 and A2 are separated by an interval equal to the pacing cycle length. Therefore, the last atrial electrogram that appears to result from VA conduction is A2.

However, this case illustrates the importance of also analyzing the atrial activation sequence during ventricular pacing. The atrial activation sequence of A2 is the same as in the following beat A3 (lateral right atrial activation before septal atrial activation), and differs from the preceding beat A1 (lateral right atrial activation after septal atrial activation), indicating that A2 does not belong to the last paced ventricular complex, but is the first beat of the tachycardia. Consequently, this is an A-A-V response demonstrating that the tachycardia is atrial. The different atrial activation sequence during ventricular pacing and during tachycardia alone rules out atypical AV nodal reentrant tachycardia and orthodromic reciprocating tachycardia. The A-A interval immediately after ventricular pacing in Figure 2 probably is equal to the ventricular pacing cycle length because of spontaneous variation in the atrial tachycardia cycle length.

The only other possible explanation for an A-A-V response in Figure 2 is simultaneous retrograde conduction over the AV node and a slowly conducting right-sided accessory pathway that initiates orthodromic reciprocating tachycardia. However, it would be unlikely that the difference in VA conduction times between the AV node and an accessory pathway would equal the pacing cycle length. Continuation of the tachycardia in the presence of AV block excluded orthodromic reciprocating tachycardia (Fig. 3).

Reference

1. Knight BP, Zivin A, Souza J, Flemming M, Pelosi F, Goyal R, Man KC, Strickberger SA, Morady F: A technique for the rapid diagnosis of atrial tachycardia in the electrophysiology laboratory. J Am Coll Cardiol 1999;33:775-781.