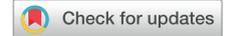


A regularly irregular wide QRS tachycardia: What is the mechanism?



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Introduction

The electrophysiological approach to supraventricular tachycardias has mainly been described for regular tachycardias.^{1,2} In case of cycle length (CL) alternans, entrainment maneuvers are not applicable. Therefore, criteria derived from regular tachycardias other than overdrive pacing should be used for confirming the correct diagnosis.

Case report

We report the case of a 46-year-old male patient admitted for paroxysmal atrial fibrillation ablation. The baseline electrocardiogram showed sinus rhythm with a wide QRS–type right bundle branch block. A wide QRS (of identical morphology), regularly irregular tachycardia without visible p wave occurred during the procedure (Figure 1).

One quadripolar catheter was positioned at the apex of the right ventricle and a second one at the coronary sinus, revealing a tachycardia with CL alternans and a 1:1 ventriculoatrial (VA) relationship (Figure 2A). A concentric atrial activation pattern was recorded at the coronary sinus following ventricular depolarization with a short and constant VA interval while interventricular (V-V) interval changes were preceding interatrial (A-A) interval changes (Figure 2B). Moreover, discontinuities in the atrioventricular node (AVN) conduction curve were observed (Figure A.1).

What is the most likely mechanism of this tachycardia?

- Atrial tachycardia
- Slow-fast atrioventricular nodal reentrant tachycardia (AVNRT)

KEYWORDS Supraventricular tachycardia; Cycle length alternans; Atrioventricular nodal reentrant tachycardia; Slow pathway; Electrophysiological study

(Heart Rhythm Case Reports 2023;9:506–508)

Funding Sources: This work was supported by the Arrhythmias Institute.
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KEY TEACHING POINTS

- The approach to supraventricular tachycardia diagnosis has mainly been described for tachycardias with a stable cycle length. However, extrapolation of criteria derived from regular tachycardias can also be performed with caution to regularly irregular tachycardias.
 - When there are variations in cycle length, if V-V interval changes precede and predict A-A interval changes, then a diagnosis of atrioventricular nodal reentrant tachycardia (AVNRT) can be made.
 - Cycle length alternans may be seen in AVNRT in case of anterograde conduction alternating between 2 slow pathways.
- Orthodromic reciprocating tachycardia (AVRT)
 - Junctional ectopic tachycardia (JET)
 - Dual atrioventricular nodal nonreentrant tachycardia (“double fire” tachycardia)

Discussion

The electrophysiological study using decremental atrial extrastimuli pacing during sinus rhythm demonstrated discontinuities in the AVN conduction curve, suggesting the presence of different anterograde AVN pathways (although a His recording was not available), a feature that has been implicated as the substrate for AVNRT. However, the presence of dual (or multiple) AVN pathways is not necessarily indicative of the existence of functional reentry and may also be seen in normal controls or in coexistence with other forms of supraventricular tachycardia.¹ Even orthodromic AVRT or atrial tachycardia with anterograde conduction alternating between fast and slow pathway could result in a regularly irregular rhythm. In our case, AVRT is excluded,

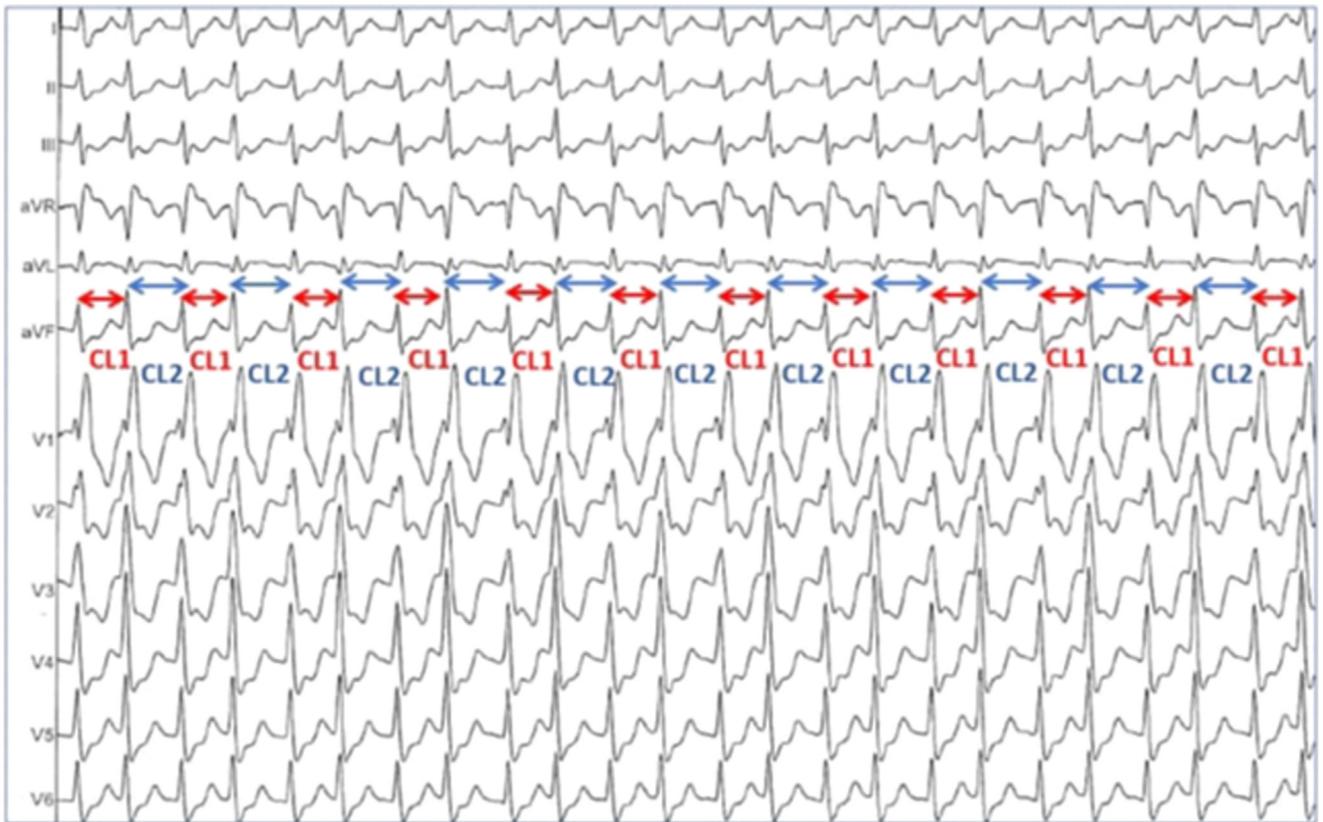


Figure 1 A 12-lead electrocardiogram of a wide QRS regularly irregular tachycardia.

as the VA interval was very short, with almost simultaneous atrial and ventricular electrograms. Moreover, a constant VA interval despite variations in CL indicates a linking of ventricular and atrial activation that would not be expected in atrial tachycardia.² When there are variations in CL, if V-V

interval changes precede and predict A-A interval changes, then a diagnosis of AVNRT can be made.¹

CL alternans <15% of the tachycardia CL may be seen in AVNRT.³ In our case, 2 discontinuities in the AV node conduction curve were observed, suggesting the presence

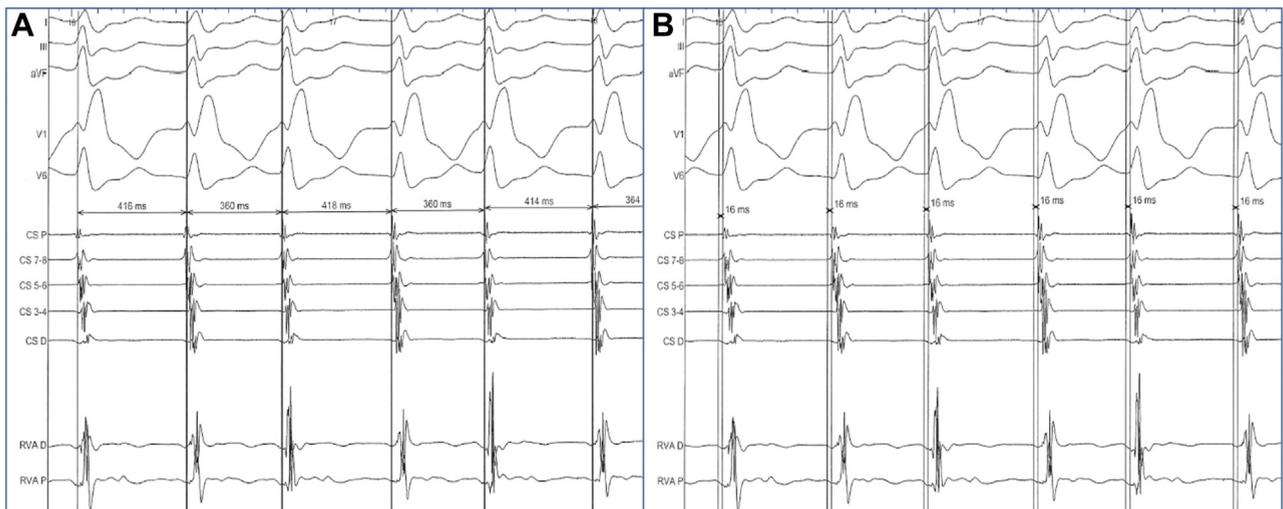


Figure 2 **A:** Intracardiac recordings reveal a tachycardia with cycle length alternans and a 1:1 ventriculoatrial (VA) relationship. **B:** A concentric atrial activation pattern is recorded at the coronary sinus following ventricular depolarization with a short and constant VA interval while interatrial interval changes preceding interatrial interval changes. CS D = distal coronary sinus; CS P = proximal coronary sinus; RVA = right ventricular apex.

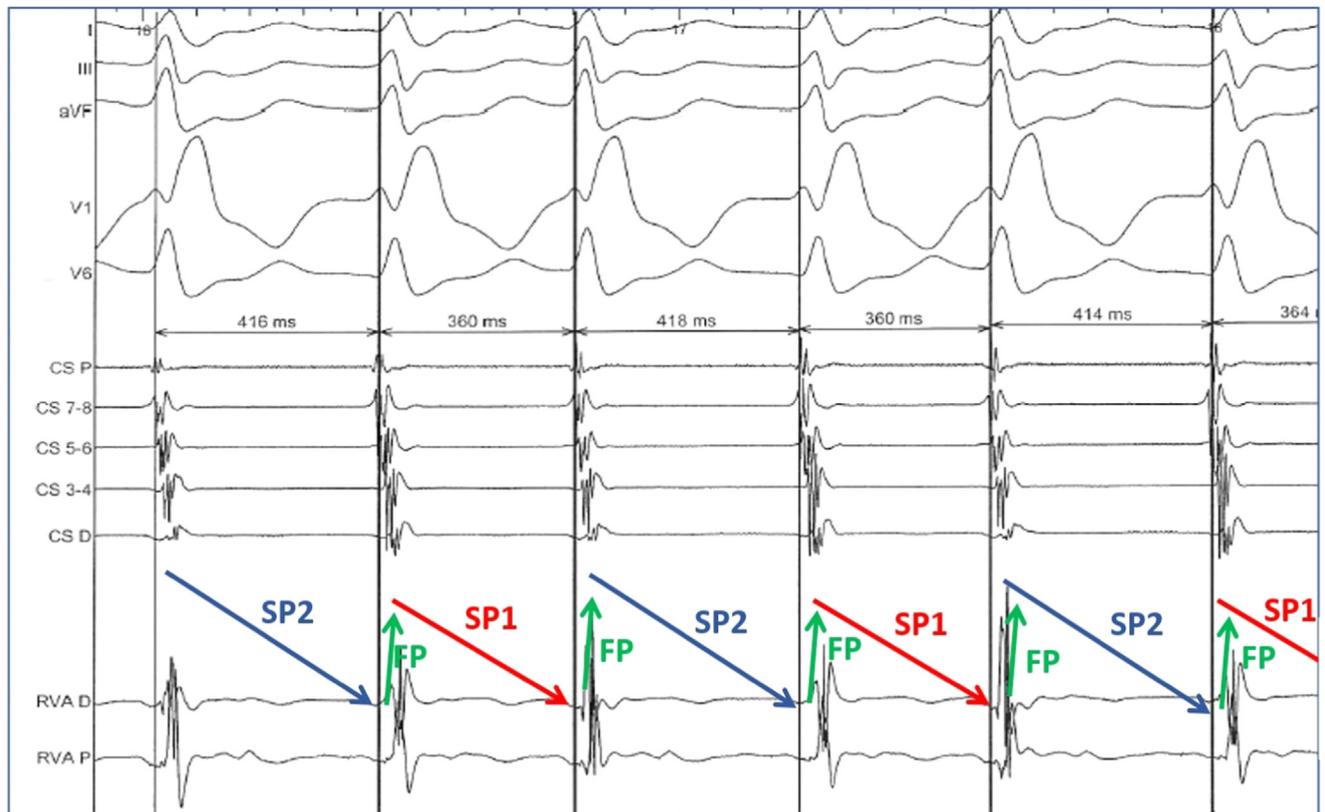


Figure 3 Atrioventricular nodal reentrant tachycardia with anterograde conduction alternating between 2 slow pathways. CS D = distal coronary sinus; CS P = proximal coronary sinus; FP = fast pathway; RVA = right ventricular apex; S = slow pathway.

of 2 slow pathways, although not all premature atrial impulses were conducted to the ventricles (Supplemental Figure 1). Interestingly, the incidence of multiple (more than 2) AVN pathways in patients with AVNRT was unexpectedly high, at about 40%, in a previous report.⁴

Our hypothesis was AVNRT with anterograde conduction alternating between 2 slow pathways (Figure 3). Notably, a regular AVNRT also occurred and pacing maneuvers confirmed the mechanism (Supplemental Figure 2). Radio-frequency ablation to the posterior septum to eliminate slow pathway function abolished both tachycardias (Supplemental Figure 3).

The rare phenomenon of double response was also observed before ablation (Supplemental Figure 4). Double fire tachycardia, owing to double anterograde conduction of 1 sinoatrial nodal activity via the slow and fast pathways, also has a regularly irregular pattern, but with a 1:2 atrioventricular relationship and a visible p wave.⁵

Finally, JET is uncommon in adults.³ The main mechanism for JET is enhanced automaticity from an ectopic focus in the AV junction. Although this tachycardia can be

occasionally irregular, CL alternans are not in accordance with the mechanism of abnormal automaticity.

Appendix Supplementary Data

Supplementary data associated with this article can be found in the online version at <https://doi.org/10.1016/j.hrcr.2023.05.004>.

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