Narrow complex supraventricular tachycardia. What is the mechanism?

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Introduction

Electrophysiological evaluation of supraventricular tachycardia using various maneuvers is routinely performed before the attempted ablation.[1,2] A comprehensive knowledge about various maneuvers used during the electrophysiology study (EPS) is crucial for establishing the correct mechanism of the tachycardia before the ablation is performed.[3]

Case report

A 35-year-old man with a history of recurrent palpitations was seen in our arrhythmia clinic. The patient was having recurrent palpitations with rapid onset and offset. He had few visits to the emergency room; however, the tachycardia would terminate before arrival to the emergency room. The patient was offered EPS and was taken to the electrophysiology lab. His baseline electrocardiogram showed sinus rhythm without any preexcitation (Figure 1A). The tachycardia was incessant and easily inducible with minimal ventricular pacing (Figure 1B). The ventricular entrainment revealed a pseudo-VAAV response (Figure 1C and 1D). The postpacing interval − tachycardia cycle length (PPI-TCL) was 176 ms and Stim A − VA was 151 ms (Figure 2A and 2B). Atrial tachycardia was unlikely because the tachycardia was easily induced by ventricular pacing and pseudo-VAAV response to ventricular entrainment. Parahisian pacing was performed, and it revealed a nodal response (Figure 2C). These features were all suggestive of an atypical atrioventricular nodal reentrant tachycardia (AVNRT). However, no AH jump or nodal echo beats were observed during programmed electrical stimulation of the atrium, thus ruling out dual AV node physiology. A His-refractory premature ventricular contraction (PVC) was delivered and resulted in a delay in the next A, suggestive of retrogradely conducting decremental accessory pathway (AP) (Figure 3). The AP was mapped during the tachycardia to the right posteroseptal area near the floor of the coronary sinus ostium and was successfully ablated in sinus rhythm (Supplemental Figure S1). The tachycardia, which was incessant and easily inducible with ventricular pacing, could not be reinduced after ablation. The patient did not have any recurrence of palpitation on follow-up in the clinic.

KEY TEACHING POINTS

- His-refractory premature ventricular contraction during supraventricular tachycardia that results in delay of next A is usually suggestive of a decremental accessory pathway (AP)-mediated orthodromic reciprocating tachycardia.
- A nodal response can be seen in retrogradely conducting decremental pathway. It just implies the retrograde conduction is slow.
- A pseudo-VAAV response and a long postpacing interval – tachycardia cycle length only implies a slow retrograde conduction, and can be seen in both atypical atrioventricular nodal reentrant tachycardia and retrograde decremental AP.

Discussion

Supraventricular tachycardia (SVT) is a common tachyarrhythmia affecting 570,000 people each year. The patients are often young, although the disorder can present at any age. SVT can be the source of significant morbidity, including disabling symptoms and hospital visits.[1,2] While medications including AV nodal blocking agents and other antiarrhythmic drugs are reasonable treatments,

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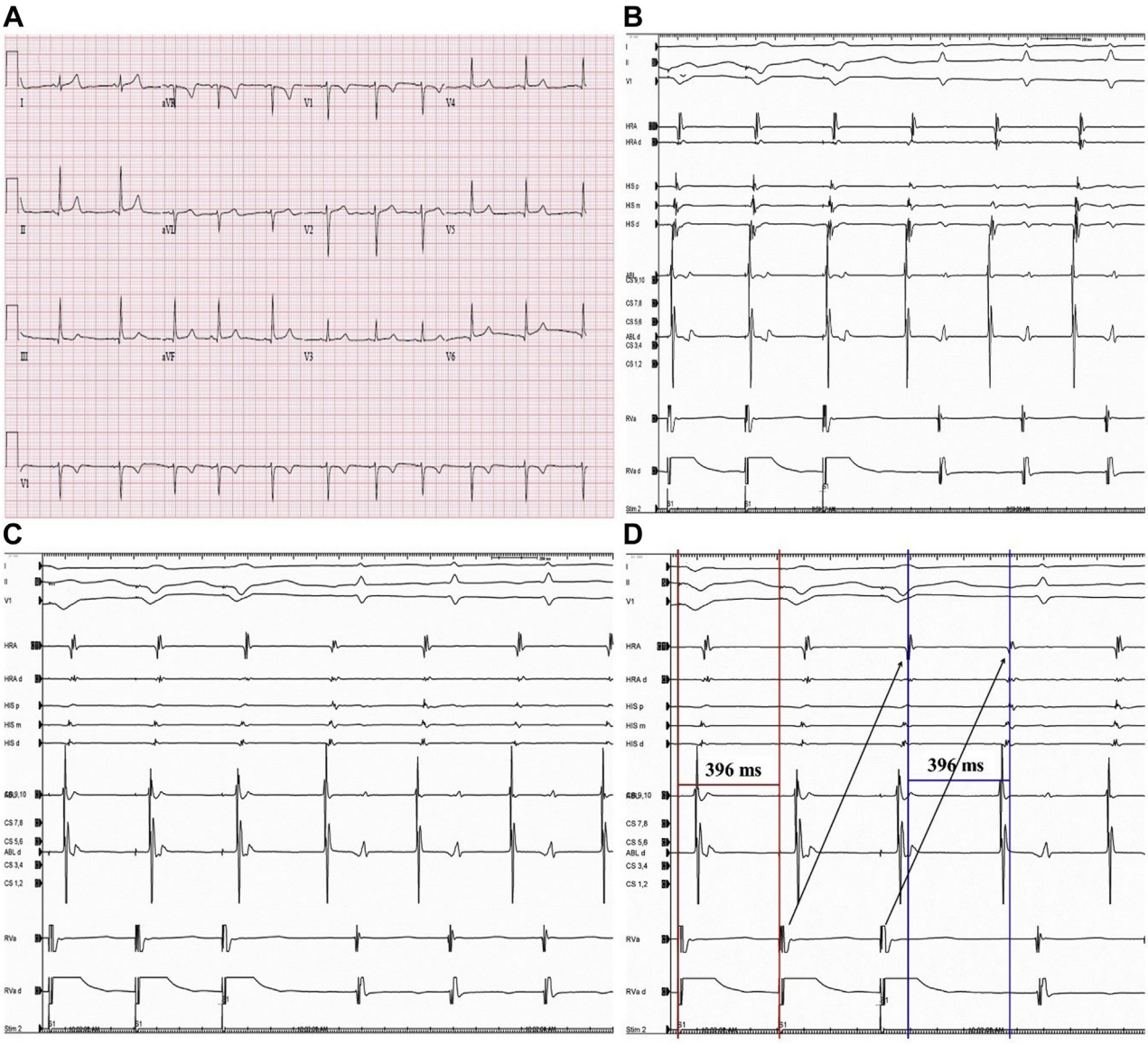

Figure 1 **A:** Baseline electrocardiogram showing sinus rhythm without any preexcitation. **B:** Tachycardia was easily inducible with ventricular pacing. **C:** Ventricular entrainment shows VAAV response, which was found to be pseudo-VAAV response (**D**).

radiofrequency ablation (RFA) has revolutionized the management of SVT. The vast majority of SVT are 1 of 3 types of arrhythmia: AVNRT (responsible for approximately 65% of cases), atrioventricular reciprocating tachycardia (responsible for approximately 30% of cases), and atrial tachycardia (responsible for approximately 5%–10% of cases). RFA can be an effective treatment for SVT, with cure rates ranging from >70% for atrial tachycardia to over 95% for atrioventricular reciprocating tachycardia and AVNRT. Before radiofrequency ablation is attempted, an EPS is performed to correctly diagnose the mechanism of the SVT. It is important to recognize that, as with most diagnostic tests, no single observation or maneuver used during EPS is 100% sensitive or specific. Therefore, it is important to obtain data from multiple observations and maneuvers to verify the diagnosis before proceeding with ablation.[3–5]

One of the maneuvers used during EP evaluation of SVT is delivering a His-refractory PVC during tachycardia. If a His-refractory PVC advances the atrial activation, it must do so through an AP because a PVC cannot conduct to the atrium through the his purkinjee system (HPS) when it is refractory. A PVC that terminates the tachycardia without conducting to the atrium must be causing it by a block in the AP, thus proving the presence and participation of the AP in the tachycardia.[6] When a His-refractory PVC delays the next A the maneuver not only proves the presence of an AP but its involvement too. It is also suggestive of a retrogradely decremental AP.[6]

In our patient, all maneuvers, including parahisian pacing (nodal response) and ventricular entrainment (pseudo-VAAV, long PPI-TCL, and Stim A − VA), were suggestive of atypical AVNRT; however, only the His-refractory PVC maneuver revealed a proper diagnosis of the tachycardia.

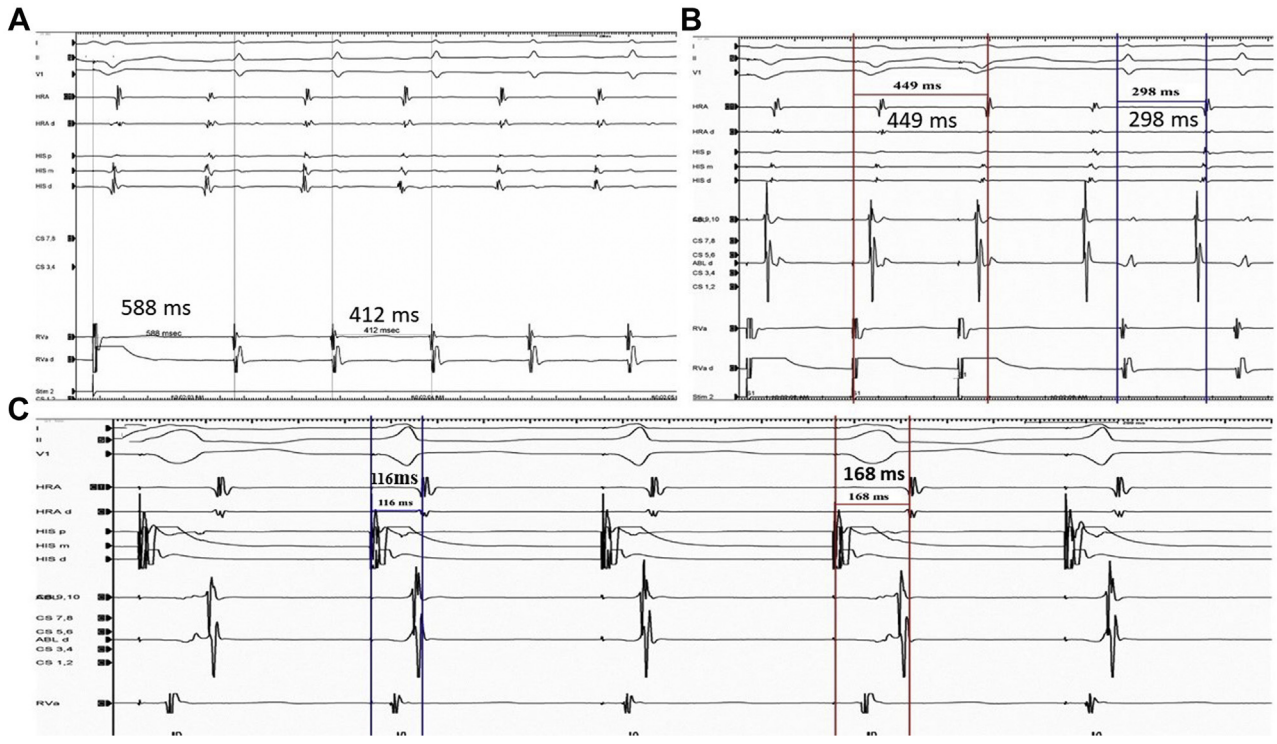

Figure 2 **A:** Postpacing interval (588 ms) and tachycardia cycle length (412 ms) difference of 176 ms. **B:** Stim A (449 ms) and VA (298 ms) difference of 151 ms. **C:** Parahisian pacing revealing Stim A of 116 ms during His capture and Stim A of 168 ms during the loss of His capture.

There are certain pitfalls inherent to the His-refractory PVC maneuver. If the site from where the PVC is delivered is away from the AP, the atrium may not be advanced despite the presence of an AP. The other factors that may affect the response to this maneuver include the ability of the PVC to penetrate the tachycardia circuit, which would further depend on the conduction time from the ventricular stimulation site to the AP and the local ventricular refractory period. In our patient, we saw a nodal response to parahisian pacing (Figure 2C). Thus, a nodal response can be seen in patients

Figure 3 Late-coupled premature ventricular contraction delivered during tachycardia demonstrates delay in the next A,suggestive of decremental accessory pathway.

with decremental retrograde conduction over an AP. This response simply implies either the retrograde conduction is slow (which can be seen in both AVNRT and retrograde decremental AP) or the pacing site is away from the tachycardia circuit (AVNRT) or culprit AP. We saw a pseudo-VAAV response during ventricular pacing. This response also demonstrates that the retrograde conduction during tachycardia is slow and can be seen in atypical AVNRT as well as retrograde decremental AP. A long PPI-TCL difference also implies that either the retrograde conduction is slow (atypical AVNRT and orthodromic reciprocating tachycardia using decremental AP) or the pacing site is away from the circuit (AVNRT).

As was previously alluded to, during electrophysiological evaluation of SVT, one should use multiple pacing maneuvers and pay attention to various tachycardia features rather than relying on a single maneuver for establishing the mechanism of the tachycardia. None of these maneuvers has 100% specificity and sensitivity.

Conclusion

A nodal response during parahisian pacing and a "pseudo-VAAV response with a long PPI-TCL and a long Stim A −VA" during ventricular entrainment of an SVT can be seen in retrogradely conducting decremental pathway. In this situation, a His-refractory PVC is a powerful maneuver, and a delay in the next atrial signal is suggestive of a decremental AP even when the other maneuvers suggest otherwise.

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Ethics Approval: Our institution (Johns Hopkins University) does not require ethical approval for reporting individual cases or case series.

Informed Consent: Verbal informed consent was obtained from the patient(s) for their anonymized information.

Appendix

Supplementary data

Supplementary data associated with this article can be found in the online version at https://doi.org/10.1016/j.hrcr.2021.04.011.

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