

Septal accessory pathway and the value of para-Hisian entrainment



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Introduction

Ventricular overdrive pacing from the right ventricular (RV) apex is used to establish the mechanism of supraventricular tachycardia (SVT) in the electrophysiology lab. The difference between the postpacing interval (PPI) and tachycardia cycle length (TCL) has been shown to differentiate atypical atrioventricular nodal reentrant tachycardia (AVNRT) from orthodromic reciprocating tachycardia (ORT) using a septal accessory pathway.¹ We present a case that illustrates the limitation of this diagnostic maneuver and shows the utility of para-Hisian entrainment for this purpose.

Case report

A 44-year-old man with history of palpitations and drug-refractory SVT was referred for an electrophysiology study. Two-dimensional echocardiography showed normal left ventricular systolic function and no evidence of structural heart disease. SVT was induced using programmed atrial stimulation with intravenous isoproterenol infusion at 2 mcg/min.

The SVT had a cycle length of 315 ms, concentric atrial activation in the coronary sinus, and a septal ventriculoatrial (VA) time of 180 ms. An intermittent left bundle branch block morphology was also noted during SVT. Overdrive pacing from the right ventricle demonstrated a pseudo-VA-atrioventricular (AV) response, ruling out atrial tachycardia. The difference between the PPI and TCL was 204 ms (Figure 1) and the corrected PPI-TCL (corrected for delta atrio-His interval) was 202 ms.² Ventricular premature depolarization delivered from the RV apex during His refractoriness did not perturb the tachycardia. Para-Hisian pacing in sinus rhythm demonstrated an AV node-AV node

KEY TEACHING POINTS

- Postpacing interval and tachycardia cycle length have been shown to differentiate atypical atrioventricular nodal reentrant tachycardia (AVNRT) from orthodromic reciprocating tachycardia (ORT) using a septal accessory pathway.
- However, this diagnostic maneuver has its limitations in slowly conducting accessory pathways.
- Our case illustrates the utility of para-Hisian entrainment to differentiate between atypical AVNRT and ORT via septal accessory pathway in difficult cases.

response. These findings were all suggestive of atypical AVNRT rather than ORT using a septal accessory pathway.

Para-Hisian entrainment was performed during tachycardia. A standard quadripolar catheter was placed at the His position and pacing was performed at low output for RV capture and high output for both RV and His capture (Figures 2 and 3). The Stim proximal coronary sinus interval during pacing was more than 90 ms, thereby excluding atrial capture.³ The retrograde atrial activation sequence was the same during RV and His/RV capture. The Δ SA interval (difference between the interval from stimulus to earliest retrograde atrial activation) during RV capture and His/RV capture was 7 ms. The “local” VA interval (interval between the ventricular and atrial electrograms at the site of earliest retrograde atrial activation) remained unchanged between RV and His/RV capture. The Δ SA interval being less than 40 ms with no change in the local VA time suggested participation of a septal accessory pathway in the tachycardia circuit.

The ablation catheter was then moved to the posteroseptum of the right ventricle. Ventricular overdrive pacing from the posteroseptum yielded PPI-TCL < 115 ms. Of

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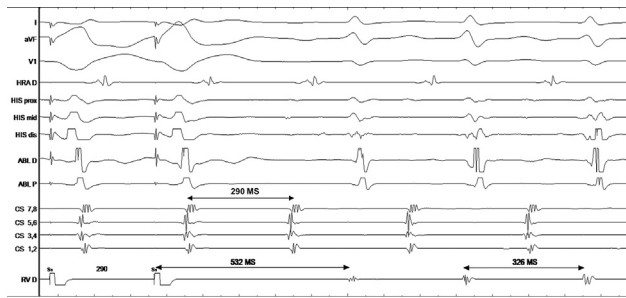


Figure 1 Entrainment from right ventricle (postpacing interval–tachycardia cycle length > 115 ms).

note, there was no change in the VA time or TCL with left-bundle aberrancy during tachycardia.

Electroanatomic mapping (CARTO3; Biosense Webster, Irvine, CA) of the right atrium during tachycardia revealed earliest atrial activation in the posteroseptal region. Radiofrequency ablation was performed using a standard 4-mm-tip nonirrigated ablation catheter (Biosense Webster Navistar). The tachycardia terminated with ablation at the posteroseptal site, and no recurrence was seen post ablation with programmed stimulation on and off isoproterenol infusion.

Discussion

The difference between PPI and TCL with ventricular overdrive pacing from the RV apex during SVT is a useful criterion to differentiate AVNRT from ORT using a septal accessory pathway.¹ However, this maneuver can be misleading in certain situations: (1) if the RV pacing site is not the true RV apex (that is, the myocardial site of insertion of the right bundle branch block); and (2) when the maneuver is applied to AV reentrant tachycardia (AVRT) using a slowly conducting concealed septal accessory pathway, as our case illustrates. This maneuver would have led us to the erroneous diagnosis of atypical AVNRT, even after correcting for the atrio-His interval.

Bennett and colleagues⁴ published a case series of 24 patients with AVRT utilizing concealed septal accessory pathways that frequently yielded RV entrainment criteria traditionally attributable to AVNRT. Based on their experience, they proposed an arbitrary VA/TCL cutoff value of 40% to define normally conducting and slowly conducting accessory pathways.

Para-Hisian pacing was introduced by Hirao and colleagues⁵ to identify the presence of a retrograde accessory pathway. This pacing technique is performed in sinus rhythm

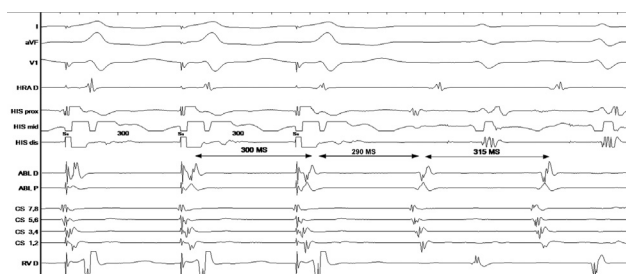


Figure 2 Para-Hisian entrainment with His/right ventricular capture.

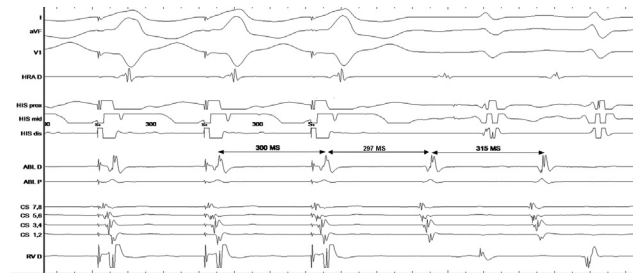


Figure 3 Para-Hisian entrainment with right ventricular only capture.

and cannot prove participation of the pathway during tachycardia. This is particularly true for slowly conducting accessory pathways where conduction up the pathway is often preempted by conduction up the AV node. Indeed, in their original description, two thirds of slowly conducting posteroseptal pathways demonstrated AV node response to para-Hisian pacing. To circumvent this shortcoming of para-Hisian pacing in sinus rhythm, we previously demonstrated para-Hisian entrainment as a maneuver to define the retrograde limb of conduction during SVT.⁶ Para-Hisian entrainment with a “run” of His/RV capture and RV capture during tachycardia ensures that there is no other competitive retrograde route of activation of the atria. A Δ SA interval < 40 ms with no change in retrograde atrial activation and similar local VA time can be used to identify an accessory pathway–accessory pathway response and differentiate AVNRT from orthodromic AVRT.

Conclusion

Para-Hisian entrainment determined that the mechanism of SVT in this case was orthodromic AVRT via a slowly conducting accessory pathway and not atypical AVNRT as suggested by initial maneuvers.

References

1. Michaud GF, Tada H, Chough S, Baker R, Wasmer K, Sticherling C, Oral H, Pelosi F Jr, Knight BP, Strickberger SA, Morady F. Differentiation of atypical atrioventricular node re-entrant tachycardia from orthodromic reciprocating tachycardia using a septal accessory pathway by the response to ventricular pacing. *J Am Coll Cardiol* 2001;38:1163–1167.
2. Gonzalez-Torrecilla E, Arenal A, Atienza F, Osca J, Garcia-Fernandez J, Puchol A, Sanchez A, Almendral J. First postpacing interval after tachycardia entrainment with correction for atrioventricular node delay: a simple maneuver for differential diagnosis of atrioventricular nodal reentrant tachycardias versus orthodromic reciprocating tachycardias. *Heart Rhythm* 2006;3:674–679.
3. Obeyesekere M, Leong-Sit P, Skanes A, Krahn A, Yee R, Gula LJ, Bennett M, Klein GJ. Determination of inadvertent atrial capture during para-Hisian pacing. *Circ Arrhythm Electrophysiol* 2011;4:510–514.
4. Bennett MT, Leong-Sit P, Gula LJ, Skanes AC, Yee R, Krahn AD, Hogg EC, Klein GJ. Entrainment for distinguishing atypical atrioventricular node reentrant tachycardia from atrioventricular reentrant tachycardia over septal accessory pathways with long-RP tachycardia. *Circ Arrhythm Electrophysiol* 2011;4:506–509.
5. Hirao K, Otomo K, Wang X, et al. Para-hisian pacing: a new method for differentiating retrograde conduction over an accessory AV pathway from conduction over the AV node. *Circulation* 1996;94:1027–1035.
6. Reddy V, Jongnarangsin K, Albert C, Sabbour H, Keane D, Mela T, McGovern B, Ruskin J. Para-Hisian entrainment: a novel pacing maneuver to differentiate orthodromic atrioventricular reentrant tachycardia from atrioventricular nodal reentrant tachycardia. *J Cardiovasc Electrophysiol* 2003;14:1321–1328.