CLINICAL PROBLEM SOLVING

Short HV interval in absence of delta wave and normal PR interval—What is the mechanism?

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Introduction

Variants of accessory pathways (AP) can be concomitantly present as bystanders to atrioventricular pathways. Atriofascicular, nodofascicular (NF) / nodoventricular (NV), and fasciculoventricular pathways (FVP) can have subtle pre-excitation on surface electrocardiogram (ECG).[1,2] Accurate diagnosis by exploring electrophysiological properties is important to avoid unwarranted ablation. We encountered one such case after successful ablation of participating atrioventricular AP.

Case report

A 26-year-old male patient with structurally normal heart underwent electrophysiology study for a manifest right posterolateral (RPL) atrioventricular AP (Supplemental Figure 1) and orthodromic atrioventricular reentrant tachycardia. The HV interval during orthodromic reciprocating tachycardia was 26–28 ms. After ablation of AP the delta wave disappeared, but the HV interval remained short (26 ms). The PR interval was 150 ms. Interestingly, the local HV (5 ms) was shorter than surface HV (26 ms) (Figure 1). During decremental atrial pacing (-10 ms in every fourth beat), the AH (and PR interval) gradually prolonged without any appearance of delta wave. The HV interval remained the same until 400 ms of pacing cycle length, when he developed an abrupt but reproducible prolongation of the local HV from 5 ms to 30 ms (despite the surface HV remaining the same, 26 ms) (Figure 1). His 12-lead ECG during the atrial pacing is shown in Figure 2. What could be the possible mechanism?

- Another atrioventricular AP
- NF/NV pathway (manifest)
- FVP
- Atriofascicular pathway.

KEY TEACHING POINTS

- Fasciculoventricular pathways (FVP) can be an incidental finding during electrophysiology study. They may be present in addition to a pathological atrioventricular pathway participating in tachycardia. Actually they are a breach in the insulation near the right bundle branch.
- The PR interval can rarely be normal, although more often it is slightly short with subtle pre-excitation. The magnitude of pre-excitation is fixed during atrial pacing, as the pathway is completely infranodal.
- Ipsilateral bundle branch block, decremental FVP, and source-sink mismatch can lead to absence of subtle pre-excitation.

Discussion

As we proceed to discuss the case, we know that an atrioventricular AP is unlikely in the absence of delta wave and short PR interval even during atrial pacing. A manifest NV/NF pathway shows variation in pre-excitation too during atrial pacing, as they do not completely bypass the atrioventricular node, hence an unlikely possibility in this case. Atriofascicular pathways often reveal pre-excitation during right atrial pacing. Hence, an FVP becomes the most likely possibility, although it usually exhibits a fixed pre-excitation mimicking anteroseptal AP. Very rarely they masquerade as left-sided AP.[1] In the background of available findings we suspected an atypical FVP, which was validated as described below. It also had several unique findings to be considered.

First, there was no pre-excitation despite having local HV of 5 ms and surface HV of 26 ms. We speculated a few mechanisms:

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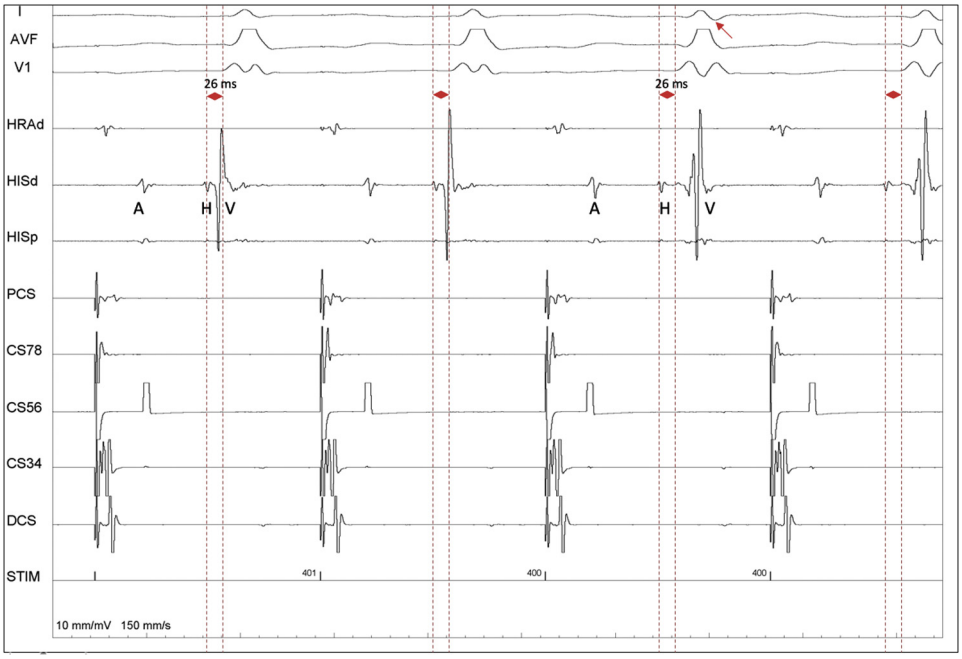

Figure 1 Electrocardiogram and intracardiac electrogram after manifest accessory pathway ablation showing short HV interval without any delta wave. During decremental atrial pacing the local HV prolongs at a pacing cycle length of 400 ms simultaneously during development of complete right bundle branch block.

(1) It could be owing to a source-sink mismatch at the FVP insertion site. This can nullify the small amount of pre-excitation irrespective of right bundle branch block (RBBB). O'Leary and colleagues[2] described lower delta amplitude in FVP than atrioventricular pathways. Our case might be falling at the lowest end of the spectrum where the delta is minimal to be clinically evident.
(2) This could be owing to incomplete RBBB, which partially neutralized the ventricular pre-excitation via the FVP except at the local site. The amount of local

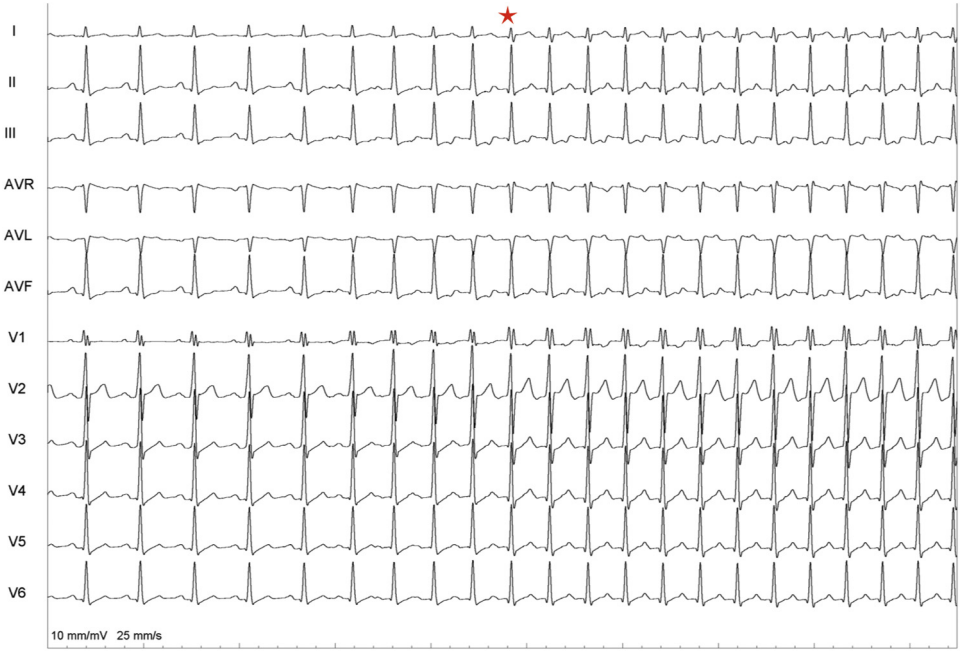

Figure 2 The 12-lead electrocardiogram during the same pacing protocol. The red star denotes the transition described in Figure 1.

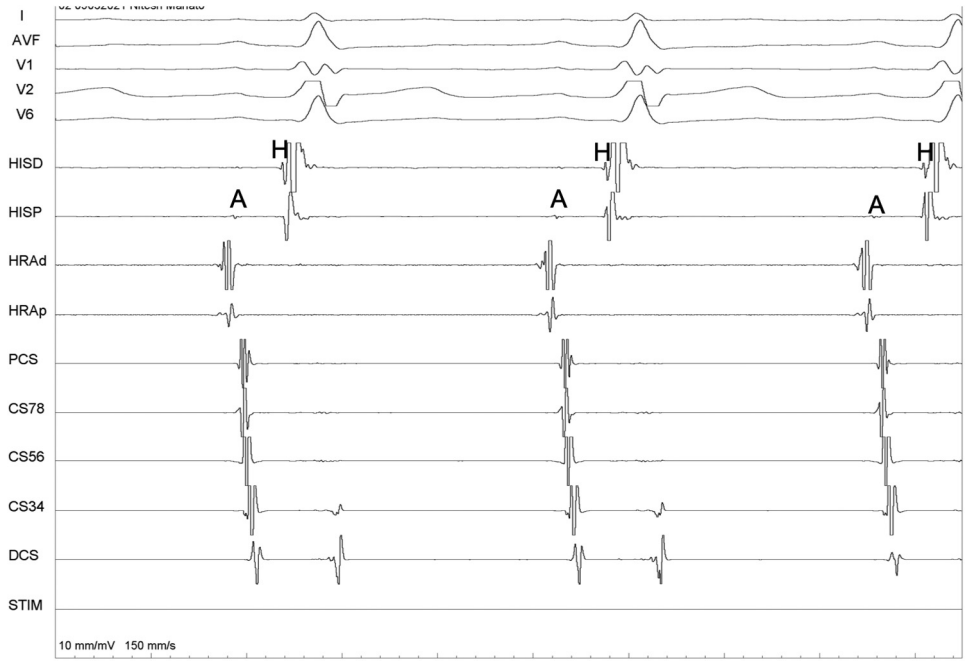

Figure 3 The HV became shorter (nearly 0 ms) when the catheter was slightly pushed in, closer to the right bundle region.

pre-excitation by the FVP was possibly balanced by rapid conduction on the opposite side via intact left bundle. Hence no pre-excitation was evident on ECG.

(3) This can also happen if the FVP has decremental properties.[3] However, the index case did not reveal any decremental property during programmed stimulation.

Second, during atrial pacing the surface HV remained the same (did not turn negative) with development of rate-dependent complete RBBB and prolongation of AH. This again proves that the pathway is infranodal and 1 end of the AP inserts proximal to the right bundle (RB), hence making FVP the most likely substrate. Moreover, the VA conduction was concentric and decremental during right ventricular (RV) pacing, showing a VA Wenckebach of 430 ms. This reconfirmed the successful abolition of the bidirectionally conducting AP at the RPL region.

Third, if an RV catheter is placed at the apex it might offer some useful insights. Recording of a late ventricular-electrogram (compared to His/RB) would have supported a diagnosis of FVP. However, it was not available in our case.

Fourth, when the His bundle catheter was pushed toward the ventricular side, the local HV further shortened (0 ms) (Figure 3). This confirms insulation breach exactly near the RB region.

Fifth, adenosine administration could have added valuable insights to the underlying mechanism but was contraindicated owing to the patient's pre-existing bronchial asthma.

Finally, after a drive train of atrial pacing, a few junctional beats were noted that had the same morphology as sinus QRS with HV of 0 ms; hence a diagnosis of infra-Hisian AP, likely an FVP, was confirmed (Supplemental Figure 2).

This case also highlights that FVP can have shorter local HV than surface HV. In fact because of this characteristic, a few studies have measured 'H-to-delta interval' instead of the conventional HV interval while analyzing FVP cases.[4] We also speculate that FVP may not show any evident pre-excitation on surface ECG when ipsilateral bundle branch block is present. This is more relevant in the presence of underlying RBBB, as FVP is nearly always right-sided.

Although FVP does not participate in any tachycardia, its recognition is of paramount importance to avoid inadvertent mapping and ablation near conduction system/His. As described by Saito and colleagues,[1] 31% of cases of FVP can have associated atrioventricular AP and the FVP can confound the result after successful ablation. Our case presented the same dilemma of an additional septal AP forming the retrograde limb of reentrant tachycardia. The above-mentioned features and a para-Hisian pacing maneuver excluded any additional atrioventricular AP. In essence, we present a case of incidental FVP noted after elimination of a manifest RPL pathway. As expected, no tachycardia was inducible afterwards. She is asymptomatic at 9-month follow-up.

To conclude, our case illustrates that the PR interval can be completely normal in FVP, although more often it is slightly short.[5,6] Generally, FVPs have Q in V_1 and ECG features of anteroseptal or midseptal AP, unlike our case.[7] To the best of our knowledge, this is the first report of FVP without any subtle pre-excitation on surface ECG.

Acknowledgments

Consent has been taken from the patient.

Data availability statement: All raw data are available for review.

Appendix

Supplementary data

Supplementary data associated with this article can be found in the online version at https://doi.org/10.1016/j.hrcr.2022.01.018.

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