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Utility of unipolar recordings for complex Wolff–Parkinson–White ablation

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ABSTRACT

Radiofrequency ablation has been shown to be a safe and effective treatment strategy for the management of symptomatic patients with Wolff–Parkinson–White syndrome. It is supported by a success rate of 95% and a recurrence rate of less than 5%. However, ablation of accessory pathways can be challenging at times. The causes for failure can be grouped into three categories – unusual location of the pathway, technical difficulties in delivering the ablation and localization error [1]. In this case report we are reporting a case of a young male who presented to us with symptomatic Wolff–Parkinson–White syndrome with two failed prior ablations at another institution. This case illustrates the importance of knowing accurate localization and course of the accessory pathway by utilizing the unipolar and bipolar electrograms simultaneously during radiofrequency ablation.

Case report

A 33-year-old male with a history of supraventricular tachycardia presented to us with frequent palpitations. He had two failed ablations at another institution. The tachycardia at that time was mapped to the right free wall. Despite giving multiple ablation pulses at the site of earliest retrograde atrial electrogram, the pathway could not be eliminated. Repeat ablation was considered as he remained symptomatic and did not wish to remain on Flecainide. Routine pre-procedure evaluation done in our institute ruled out structural heart disease. Surface electrocardiography showed sinus rhythm with a PR interval of 120 ms. An atrial ectopic beat resulted in manifest pre-excitation with QRS morphology suggestive of a right antero-lateral accessory pathway (Delta wave +ve in V1, II, III and aVF, small r in V1 and late QRS transition in chest lead). During the electrophysiology study, intracardiac electrograms showed a basal sinus cycle length of 1000 ms with an AH interval of 90 ms and HV interval of 30 ms. With incremental atrial pacing, maximum pre-excitation was noted at 400 ms (Fig. 1). There was no evidence of decremental pathway conduction, and the anterograde refractory period was 390 ms. Atriofascicular fiber-mediated tachycardia could be ruled by lack of decremental conduction property along with intact retrograde accessory pathway conduction. VA interval during the tachycardia and V pacing was approximately 140 ms over the pathway. A duodecapolar catheter was placed

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at the tricuspid annulus (TA) for better delineation of the accessory pathway. Mapping of the tricuspid annulus was done with a 3.5 mm irrigated thermacool catheter via SR2 sheath.

Ventricular pacing from the right ventricular (RV) apex showed earliest retrograde A at the TA 5 electrode (corresponding to the 8 o'clock position in the left anterior oblique view). In view of previous failed ablations, the possibility of an oblique course in the accessory pathway was considered. Differential pacing from the RV confirmed the oblique course of the pathway. During anterior paraseptal RV pacing, the local ventriculoatrial (VA) interval was long at the TA 5 electrode; during posterobasal RV pacing, the local VA interval was short at the TA 5 electrode. The difference between these two intervals (ΔVA) was >15 ms.

At the 8 o'clock tricuspid annular position, bipolar electrograms of the distal mapping catheter electrodes showed good VA fusion and earliest retrograde A. There was a small pathway potential noted at the onset of A wave (Fig. 2A), but the unipolar electrograms showed that the pathway potential corresponded to the second electrode (Fig. 2B). Since the earliest retrograde A site in patients with oblique pathway might not be the ideal site to target, annulus was mapped for a sharp and early pathway potential. After repositioning the catheter, local electrode showed VA signal with sharp and early accessory pathway potential (Fig. 3A). Unipolar electrogram confirmed that the sharp signal was from the distal electrode (Fig. 3B). Even though there was no local VA fusion, the pathway potential appeared to be early at that site. Radiofrequency ablation (power 50 W, temperature 50°) delivered at that site resulted in immediate interruption of pathway conduction with local VA separation. There was no recurrence of pathway conduction even after waiting 30 min.

Discussion

Catheter ablation of the accessory pathway (AP) is the treatment of choice for patients with symptomatic Wolff–Parkinson–White syndrome, with a success rate of about 95%. Despite the advances in electrophysiology, ablation of APs remains challenging [1].

Although the site with the shortest local VA interval during orthodromic AV reentrant tachycardia or ventricular pacing is often considered the optimal target for pathway ablation, this has been debated [2]. This is particularly true in patients with oblique pathways. Most APs described had their atrial and ventricular insertions in separate histological sections consistent with an oblique course [3].

Otomo et al. [4] studied 114 patients with single accessory pathways. The direction of atrial and ventricular wavefronts along the tricuspid annulus was reversed by differential atrial and ventricular pacing from the opposite sides of the APs. Reversing the ventricular wavefront increased the local VA interval by >15 ms in 91 of 106 patients (88%). Mapping during longer VA intervals identified accessory pathway potential in 102 of 114 patients (89%). Ablation at the accessory pathway recording site eliminated AP conduction with a median of one radiofrequency ablation. The same principle was applied in our patient. By reversing the wavefront of activation, we could demonstrate the oblique course of the pathway. The ablation was targeted at the site of early and sharp accessory pathway potential and not at the site of earliest retrograde atrial electrogram. A single ablation pulse eliminated the pathway conduction immediately, again confirming the oblique course of the pathway.

The utility of unfiltered unipolar electrograms for successful ablation of the accessory pathway has been

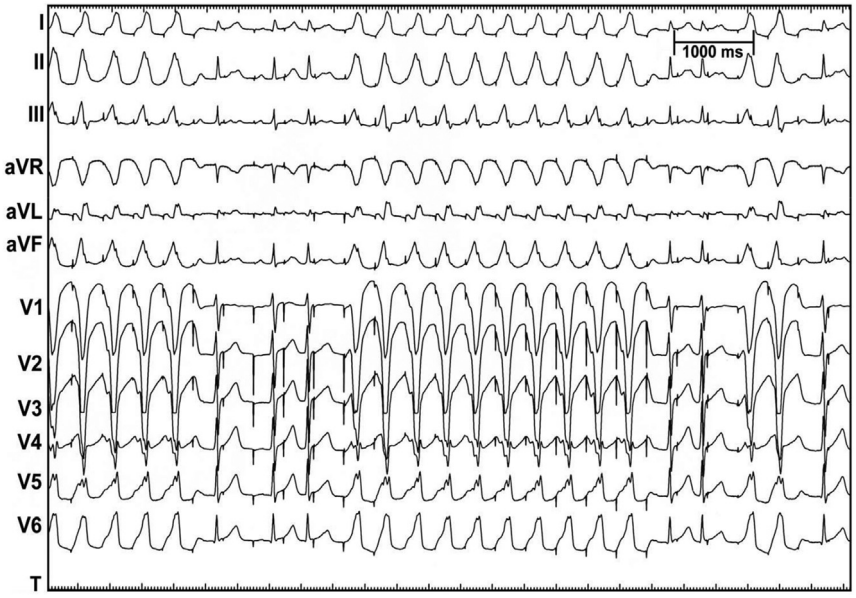

Fig. 1 – Incremental atrial pacing showing maximum pre-excitation at 400 ms pacing cycle length.

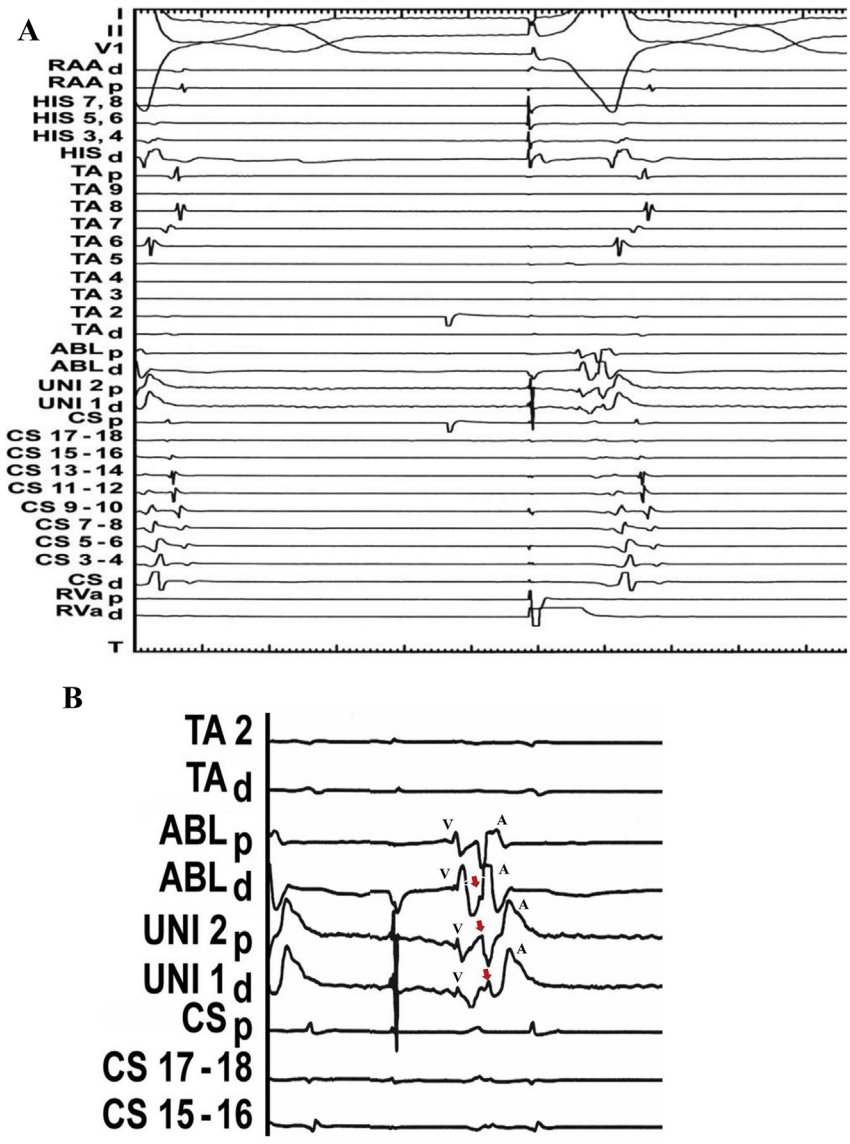

Fig. 2 – A: Mapping of the tricuspid annulus, showing earliest retrograde A in the distal mapping electrode. B: Enlarged view of Fig. 2A, showing fused VA signals but the pathway potential (marked by red arrow) was not earliest at the distal electrode.

extensively studied. Barlow et al. [5] studied the characteristics of the unipolar electrogram that are useful in predicting successful ablation of accessory pathways. A QS pattern was seen at 90% of permanently successful sites as compared to 55% of the unsuccessful sites. Activation times were significantly shorter at permanently successful sites than at unsuccessful sites (P value < 0.0001). Furthermore rapid down stroke of QS is important as well. These features were equally applicable for both atrial and ventricular potential mapping.

Nevertheless, filtered bipolar electrogram is the preferred mapping tool because of its concentration on local activation. The unipolar electrogram provides information about the onset of distant activation, precise timing of the local activation and the quality of tissue contact by the catheter. The bipolar electrogram reflects the equal influence of two electrodes separated by the interelectrode distance, whereas the unipolar electrogram reflects the activity under one particular electrode. Consequently, the unipolar recording from the distal tip of an ablation catheter provides more accurate and relevant information than a bipolar recording from the distal pair of electrodes. Even in our patient, the initial catheter position (position A) showed good VA fusion with accessory pathway potential in the bipolar electrogram; the unipolar electrograms localized the potential to the second electrode. After repositioning, the sharp pathway potential was recorded at both distal unipolar and bipolar electrograms. Ablation at that site resulted in abolition of the accessory pathway.

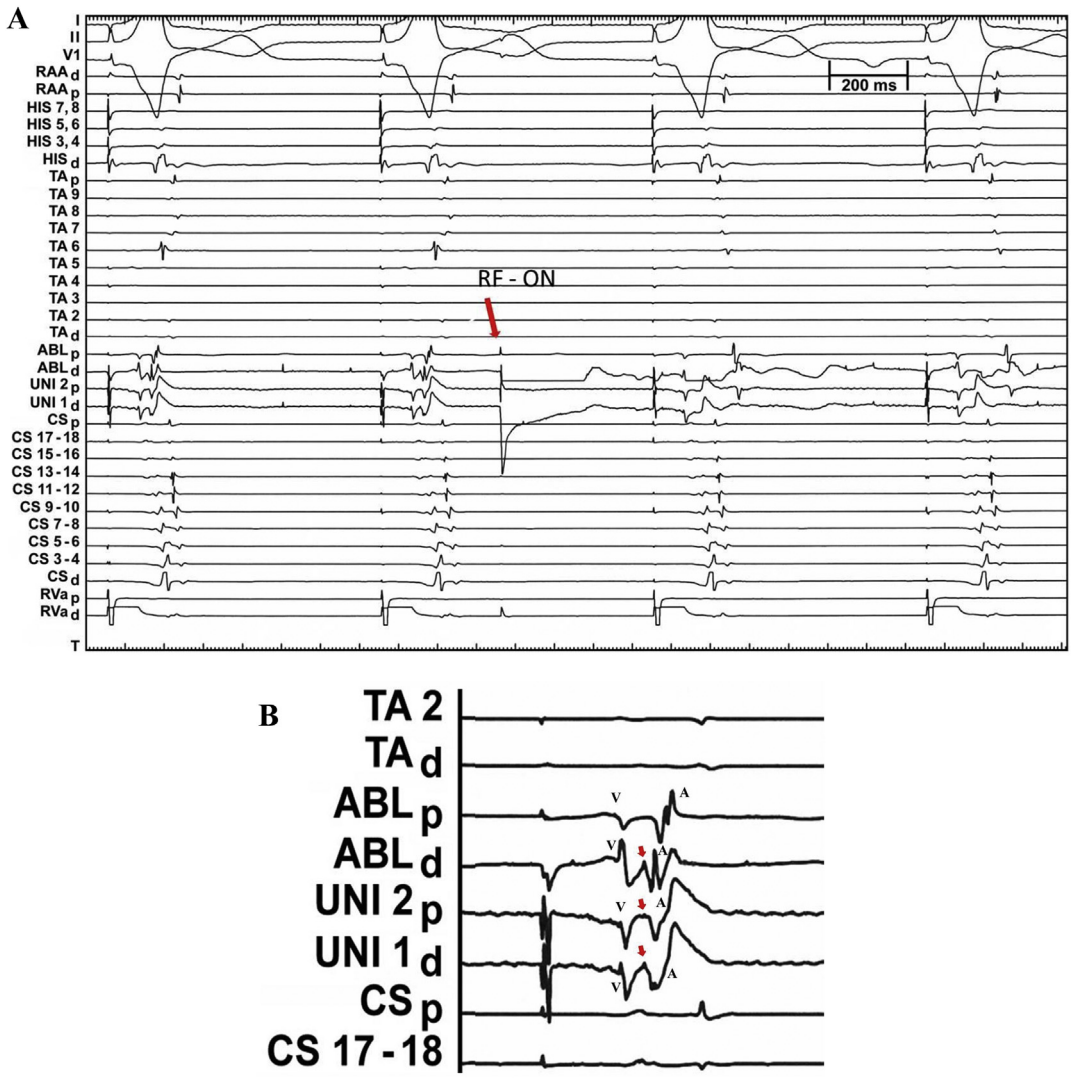

Fig. 3 – A: Ablation catheter at the right lateral aspect of the tricuspid annulus. The distal electrode is recording a sharp and early pathway potential. Immediate interruption of pathway conduction was noted with the onset of radiofrequency application. B: Enlarged view of Fig. 3A, showing the accessory pathway potential (marked as red arrows) in the ablation electrode. Note that local VA was not fused but there was a sharp pathway potential noted at the distal unipolar and bipolar electrode.

Conclusion

Oblique course of the accessory pathway is a common phenomenon. This has to be considered especially in patients with a history of previous failed ablation. Differential atrial and ventricular pacing protocols should be utilized to demonstrate the course and to identify the site of successful ablation. The site showing early and sharp accessory pathway potential in both the bipolar and unipolar distal electrode should be targeted.

Conflict of interest

None to report.

Funding

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