Using a multielectrode catheter to facilitate mapping and ablation of idiopathic fascicular ventricular tachycardia

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Introduction

Idiopathic fascicular ventricular tachycardia (IFVT), also called verapamil-sensitive ventricular tachycardia (VT) and Belhassen's VT, accounts for 10%–15% of idiopathic VT, and is an uncommon cause for tachyarrhythmia in children.[1] The most common form is hypothesized to involve an anterograde verapamil-sensitive slow conduction zone of Purkinje fibers in the ventricular septum and a retrograde fast conduction zone of the left posterior fascicle, with ventricular activation occurring at the distal turnaround site.[2–5] It is classically characterized by right bundle branch block, left or superior axis deviation, induction with atrial pacing and atrial extrastimuli, and the absence of structural heart disease.[3] Catheter ablation has a high success rate.[6,7]

Mapping of the tachycardia circuit during IFVT involves delineating 2 distinct potentials: Purkinje potentials (P2, high-frequency signals representing activation of the left posterior fascicle) and pre-Purkinje potentials (P1, lower-frequency signals representing activation of the verapamil-sensitive slow conduction zone in the septum).[3,7] During sinus rhythm, P1 potentials might not be recordable, since the activation might occur during the ventricular electrogram. Ablation usually targets the distal P1, earliest P2, or junction of P1 and P2, although other methods have been described as well.[2,3] Although multielectrode catheters have been used to aid in the mapping of the tachycardia circuit, this is not routinely performed. The DECANAV® catheter (Biosense Webster, Irvine, CA) is a multielectrode catheter that is commonly used for mapping of cardiac chambers in various arrhythmias.[8] It has not, to our knowledge, been described for mapping of the left ventricle in IFVT. Herein, we present the case of an adolescent with IFVT who underwent successful ablation facilitated by mapping using a DECANAV catheter in the left ventricle.

KEY TEACHING POINTS

- Multielectrode catheters may allow for quicker mapping of the anatomic left ventricle than standard bipolar catheters.
- During ablation of idiopathic fascicular ventricular tachycardia (IFVT) the distal most pre-Purkinje potentials, earliest Purkinje potentials, or the junction of these 2 potentials can be targeted.
- Placement of a DECANAV multielectrode catheter (Biosense Webster) along the left ventricular septum facilitates precise identification of the ablation targets in IFVT.

Case report

A previously healthy 16-year-old male patient (59 kg, 176 cm) presented to his pediatrician's office with palpitations. An electrocardiogram revealed a wide complex tachycardia with right bundle branch block and left axis deviation (Figure 1A). There was spontaneous and abrupt termination of the tachycardia en route to the hospital with emergency medical services. Further history revealed that he had been experiencing multiple episodes of palpitations monthly over the last 2–3 years that were typically triggered by coughing. An echocardiogram revealed normal cardiac anatomy and function with mild mitral and tricuspid valve regurgitation. Based on the electrocardiogram and symptoms, he was suspected to have IFVT. He therefore underwent elective electrophysiology study (EPS) and ablation, after discussing various management options.

During the EPS, standard catheters were placed in the coronary sinus, right ventricle, and His bundle region using the CARTO® 3 (Biosense Webster) electroanatomical mapping system. Baseline rhythm was noted to be sinus rhythm with

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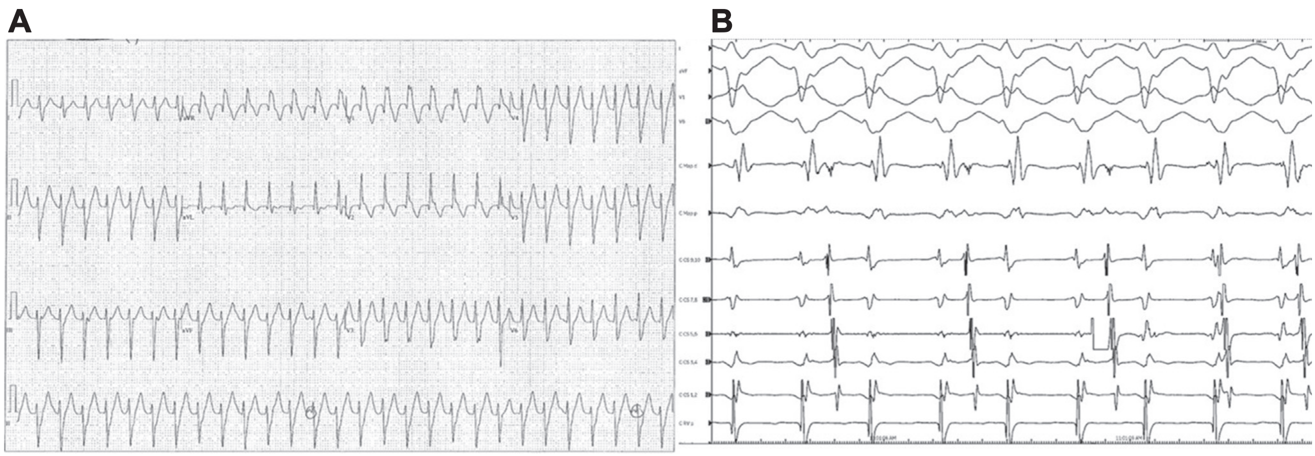

Figure 1 **A:** The initial tracing from emergency medical services of a 16-year-old patient demonstrating a wide complex tachycardia with a right bundle branch block and superior axis deviation and ventriculoatrial dissociation (circles indicate P waves). **B:** Intracardiac tracings showing ventriculoatrial dissociation during ventricular tachycardia. (Map catheter in the right ventricle, atrial electrograms with far-field ventricular signals noted in the coronary sinus catheter.)

normal baseline intervals. Atrial and ventricular pacing revealed no abnormalities. Following isoproterenol infusion, incremental atrial pacing initiated a wide complex tachycardia with cycle length of 277 ms, right bundle branch block, and a superior axis. There was ventriculoatrial dissociation, further supporting our suspicion for verapamil-sensitive ventricular tachycardia (Figure 1B).

The left ventricular (LV) septum was initially mapped retrograde after obtaining arterial access using the ablation/mapping catheter (NAVISTAR® catheter; Biosense Webster). However there was difficulty defining the tachycardia circuit with this approach and a multielectrode catheter was felt necessary. Therefore, the multielectrode DECANAV catheter was used via a retrograde approach prolapsed through the aorta. The catheter aligned well with the LV septum with minor manipulation and clearly noted linear high-frequency posterior fascicular potentials (P2) during sinus rhythm (Figure 2). During VT, the catheter identified the fascicular potentials (P2) and noted P1 intermittently (Figure 3). After marking of the site of dual potentials (P1 and P2) with electroanatomic notations, the multielectrode catheter was exchanged for the ablation catheter. Placement of a radiofrequency lesion at this site resulted in a brief acceleration of the tachycardia prior to termination. Tachycardia was unable to be induced following this lesion. Additional consolidation lesions were placed. A slight rightward axis shift without QRS prolongation was also noted following these lesions, which has been reported to be an optimal endpoint of IFVT ablation.[9] At follow-up 1 month after his ablation, he was asymptomatic without recurrence of tachycardia.

Discussion

We presented the case of an adolescent with IFVT who underwent mapping of the reentrant circuit using the DECANAV catheter.

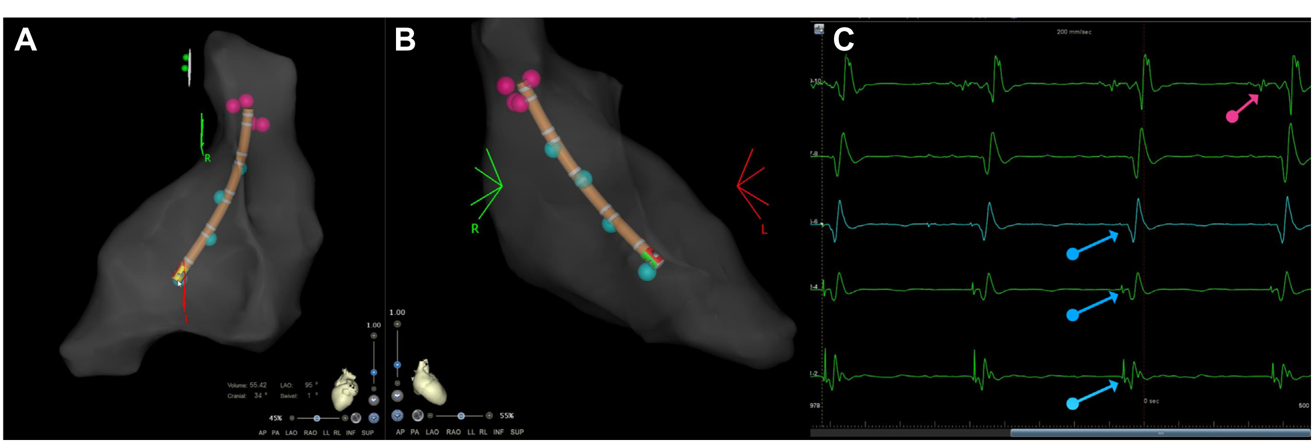

Figure 2 **A, B:** Right anterior oblique (**A**) and laterolateral (**B**) projection of the electroanatomic map during sinus rhythm with the DECANAV catheter (Biosense Webster) placed on the left ventricular septum via retrograde approach. Blue dots indicate Purkinje potentials (P2). Pink dots indicate His bundle electrograms. **C:** P2 potentials (*blue arrows*) are clearly visualized along with the proximal His bundle electrograms (*pink arrow*).

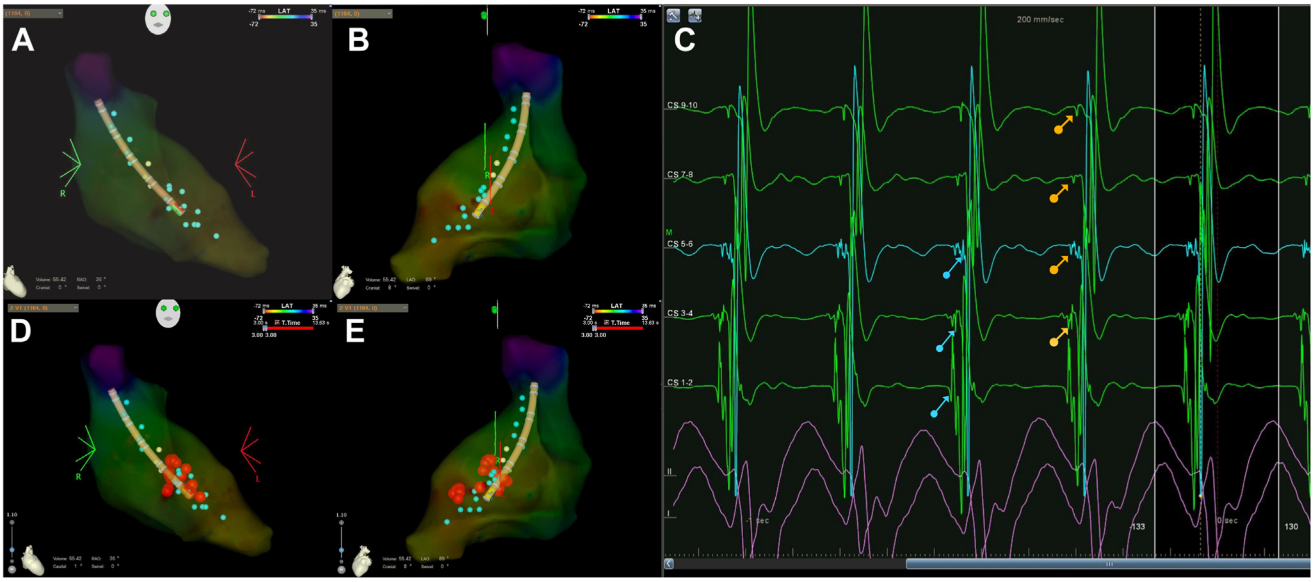

Figure 3 **A, B:** Right anterior oblique (RAO) (**A**) and laterolateral (LL) (**B**) projection of the electroanatomic map during fascicular ventricular tachycardia with the DECANAV catheter (Biosense Webster) placed on the left ventricular septum via retrograde approach through the aorta. Blue dots indicate Purkinje potentials (P2), yellow dots indicate pre-Purkinje potentials (P1). **C:** On the DECANAV catheter, P2 potentials are clearly visualized (*blue arrows*) and P1 potentials (*yellow arrows*) are seen as part of double potentials at CS 3–4 and CS 5–6, suggesting the point of turnaround of circuit. **D, E:** RAO (**D**) and LL (**E**) projection of the same map with the radiofrequency ablation lesions as red dots.

Typical mapping of this arrhythmia for ablation involves use of a quadripolar electrode mapping catheter.[2,9–13] However, this can be challenging to define the entire circuit, and use of multielectrode catheter has been recommended.[5] Multielectrode high-density mapping catheters such as INTELLAMAP ORION™ and PENTARAY® have been described in adult patients for identification of P1 and P2.[14,15] However, these might require significant manipulation to align with the septum and even require trans-septal access. We believe that the DECANAV catheter is more specifically suited for this arrhythmia, owing to the catheter's curvature, which allows it to lie along the mid portion of the LV septum when introduced retrograde with slight curvature. Once positioned appropriately, the catheter allows immediate visualization of the activation of the LV septum from the base to the more distal part of the LV without need for further manipulation of the catheter. The catheter's ability to acquire electroanatomic localization through all electrodes further improves the ease of annotating the tachycardia circuit. Finally, this is a catheter that is not uncommonly used in pediatric EPS and has good user familiarity, which allows for more comfortable manipulation of the device.

Conclusion

The DECANAV catheter might be specifically suitable for mapping the LV septum retrograde during ablation of IFVT.

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