ATRIAL FIBRILLATION

COMPLEX CASE STUDY

Dissociated Pulmonary Vein Tachycardia during Atrial Fibrillation

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ABSTRACT. In this report, we discuss an unusual case of a dissociated pulmonary vein tachycardia during ablation of atrial fibrillation.

KEYWORDS. atrial fibrillation, pulmonary vein tachycardia.

Case report

A 68-year-old man with a history of symptomatic paroxysmal atrial fibrillation (AF) for 1 year presented for catheter ablation. His echocardiogram demonstrated normal left ventricular function with a left atrial diameter of 4.0 cm. Cardiac magnetic resonance imaging revealed an ejection fraction of 69%.

The patient arrived in sinus rhythm, but AF was induced during irrigated radiofrequency ablation along the superior aspect of the left superior pulmonary vein (LSPV) (Figure 1). Following circumferential ablation around the antrum of the left inferior pulmonary vein (LIPV), PV activity became organized. Close inspection of the electrograms of the circular mapping catheter (CMC) within the LIPV show that the entire cycle length of the PV tachycardia, suggesting a re-entrant mechanism (Figure 2a). A single ablation lesion along the inferior aspect of the LIPV ostium, just distal to our circumferential lesion set, led to termination of the PV tachycardia with continued entrance block (Figure 2b,c). Ablation was performed around the remaining right-sided PVs, and, following electrical cardioversion, persistence of bidirectional block (PV entrance and exit block) was confirmed (Figure 3).

Commentary

The key element for successful of ablation of paroxysmal AF is the establishment of pulmonary vein isolation. During ablation around the pulmonary vein, electrical isolation becomes apparent with the abolition of PV potentials and can be confirmed with coronary sinus (CS) and left atrial appendage pacing if necessary (entrance block). Exit block is confirmed by the absence of left atrial capture during pacing from a CMC positioned within the PV. The presence of PV activity, whether isolated PV ectopic beats or PV rhythm, that is dissociated from the atrium establishes both entrance and exit block.

Furthermore, when two tachycardias are present, one in the left atrium (LA) and another within the PV, it is difficult to determine if the LA is driving the PV, the PV is driving the LA, or the two tachycardias are independent of each other. For example, exit block cannot be established because the presence of AF precludes evaluation of LA activation during PV pacing. Furthermore, a regular PV rhythm observed within the PV during left atrial AF may be due to limited entrance conduction into the PV or the presence of an independent PV rhythm due to reentry or a focal source.1,2

In our case above, the activation sequence of the entire PV tachycardia cycle length (150 ms) was observed circumferentially along all sequential poles of CMC, suggesting a re-entrant mechanism. A single ablation lesion along the inferior aspect of the LIPV led to termination of the PV tachycardia. This unmasked the continued presence of AF in the left atrium with persistent entrance block to the PV. This finding suggests that the two tachycardias were indeed independent of each other. An alternative approach to terminating the PV tachycardia with ablation would have been to convert both rhythms to

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**Figure 1:** Initiation of atrial fibrillation during ablation along roof of left atrium. Surface electrocardiograms (I, aVF, and V1) followed by intracardiac electrograms from the right atrium (RA), coronary sinus (CS), circular mapping catheters (CMCs). p: proximal; d: distal.

**Figure 2:** (a) Organized tachycardia within the left inferior pulmonary vein (LIPV) during atrial fibrillation. Note the chaotic activity within the right atrium and coronary sinus from atrial fibrillation and the simultaneous organized circumferential activation within the LIPV from pulmonary vein tachycardia. Arrows show that the entire cycle length (150 ms) of the tachycardia is encompassed along the circular mapping catheters. Surface and intracardiac electrograms as described previously. (b) Termination of the PV tachycardia during ablation along the inferior aspect of the LIPV. Surface and intracardiac electrograms as described previously. (c) Fluoroscopic view in the left anterior oblique projection of the circular mapping catheter within the LIPV and the ablation catheter at the site of termination.
sinus with a direct current shock and subsequently establish the presence of entrance and exit block.\(^3\)

This case illustrates the ability to have two dissociated left atrial rhythms in the presence of PV isolation: AF in the left atrium and a localized re-entrant tachycardia within the PV. Takashashi, et al.\(^2\) were able to induce sustained PV tachycardia with burst pacing in 2.6% of veins following PV isolation, most of which demonstrated properties consistent with re-entry. Although less likely, it is possible the PV tachycardia in our case was a focal tachycardia with centrifugal, unidirectional activation along the pulmonary vein. It is important to recognize that when two different tachycardias are observed in the left atrium and the PV, additional ablation around the PV may not be necessary because the vein may already be isolated. However, termination of one or both rhythms (with ablation or DC cardioversion, respectively) is necessary to test for entrance and exit block in order to establish PV isolation.

References


Figure 3: (a) Following cardioversion to sinus rhythm, bidirectional block is observed within the left inferior pulmonary vein (LIPV) with the presence of dissociated pulmonary vein potentials. Surface and intracardiac electrograms as described previously. (b) Exit pacing within the LIPV demonstrates local PV capture and exit block, confirming exit block. Surface and intracardiac electrograms as described previously.