Bidirectional Intra-Atrial Conduction Block During Radiofrequency Ablation of an Epicardial Left Lateral Accessory Pathway

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ABSTRACT. Left lateral accessory pathways can be eliminated by endocardial radiofrequency ablation with very high success rates. During ablation near the lateral mitral annulus, intra-atrial conduction block across the mitral isthmus can occur, resulting in reversal in the sequence and timing of retrograde atrial activation during orthodromic atioventricular reciprocating tachycardia or rapid ventricular pacing. Furthermore, some of these pathways are located subepicardially and can be ablated from the coronary sinus. We report a case of transient bidirectional conduction block across the mitral isthmus during unsuccessful endocardial radiofrequency ablation of an epicardial left lateral accessory pathway. Ablating within the coronary sinus eliminated accessory pathway conduction.

KEYWORDS. left lateral accessory pathway, orthodromic atrioventricular reciprocating tachycardia, mitral isthmus.

Introduction

Success rates for accessory pathway (AP) radiofrequency (RF) ablation range between 87% and 99% for an atrial or ventricular endocardial approach.1 Subepicardial pathways account for approximately 8% of the failures encountered, especially along the mitral annulus. Although some epicardial left-sided APs are associated with coronary sinus (CS) diverticula, which contain myocardial fibers that connect both the ventricle and the CS myocardial coat, the majority (70%) of epicardial CS APs occur without a diverticulum or other venous anomaly and the ventricular end is located close to the middle cardiac vein or posterior cardiac vein.3 These pathways use the CS myocardial coat along or near the vein as the intermediary that connects the epicardial surface of the ventricle to the left atrium. Ablation of epicardial left-sided APs with RF energy and cryotherapy from inside the coronary sinus or great cardiac vein has been successfully and safely performed.4-6 A percu-
electrocardiogram revealed normal sinus rhythm with pre-excitation and delta wave morphology consistent with a left lateral AP. A transthoracic echocardiogram revealed a structurally normal heart. She underwent invasive electrophysiology study at another institution, during which the presence of a left lateral AP was confirmed. Attempts at endocardial RF ablation from a trans-septal approach were unsuccessful. She was treated with flecainide and metoprolol and referred to our institution for repeat electrophysiology study and catheter ablation.

Four catheters were advanced from the femoral veins to the His bundle and right ventricular apex (RVA) positions, the right atrium for intracardiac echocardiography (ICE), and along the lateral mitral annulus via a trans-septal puncture (4-mm ablation catheter). A decapolar catheter was inserted transvenously in the right internal jugular vein and positioned distally in the CS. Bipolar pacing from the RVA resulted in eccentric retrograde atrial activation, which was earliest in the distal CS. Orthodromic AV reciprocating tachycardia (ORT) at a cycle length (CL) of 404 ms utilizing the left lateral AP was reproducibly induced with programmed stimulation. Mapping with the ablation catheter during ORT revealed sites with earliest retrograde atrial activation along the lateral mitral annulus. Low atrial electrogram amplitudes were noted on the ablation catheter throughout this region and attributed to prior extensive ablation.

Ablation during ORT at a site just distal to the CS catheter (Figure 1a) resulted in transient intra-atrial conduction block, as demonstrated by delayed atrial activation on the ablation catheter without change in the eccentric retrograde atrial activation sequence in the CS (Figures 1b,c). This was consistent with complete conduction block just lateral to the AP insertion site, resulting in clockwise atrial activation around the mitral annulus and therefore delayed atrial activation recorded on the ablation catheter. The ablation catheter was then positioned at a site of early activation just proximal to the tip of the CS catheter (Figure 2a). RF ablation at this site during ORT resulted in transient intra-atrial conduction block with sudden delay and reversal of the atrial activation sequence along the CS (Figure 2b). This was consistent with complete conduction block just medial to the AP insertion site, resulting in counterclockwise atrial activation around the mitral annulus. Following extensive ablation in this region, the presence of the left lateral AP persisted and ORT remained readily inducible.

The decapolar CS catheter was removed and re-advanced into the distal CS through the right femoral vein. The ablation catheter was then withdrawn from the left atrium and advanced into the distal coronary sinus (Figure 3a). Mapping with the ablation catheter during rapid ventricular pacing revealed the site of earliest retrograde atrial activation to be just distal to the CS catheter (Figure 3b). A single RF lesion was delivered at this site, achieving a maximum power of 15 W. After 6 s of ablation, VA conduction was eliminated (Figure 3c).

Following ablation and a 30-min waiting period, pre-excitation was no longer evident and administration of adenosine resulted in AV block during isoproterenol infusion.
Discussion

Previous reports have demonstrated intra-atrial conduction block during RF ablation of left lateral APs. Reversal of the atrial activation sequence from eccentric to concentric during ablation in ORT could be misinterpreted as due to the presence of a second septal AP. However, this is unlikely, because the earliest left atrial activation site and timing were not changed by delivery of the RF lesion, indicating intact AP conduction. These

Figure 2: Transient intra-atrial conduction block medial to the accessory pathway (AP) insertion site. (a) Fluoroscopic left anterior oblique image showing the ablation catheter at a site of early retrograde atrial activation slightly medial to the distal coronary sinus (CS). (b) During orthodromic reciprocating tachycardia, intra-atrial conduction block medial to the AP insertion site during radiofrequency (RF) ablation is demonstrated by sudden delay and reversal of the atrial activation sequence in the coronary sinus (asterisk). Note that the tachycardia persists without change in the VA interval on the His bundle catheter.

Figure 3: Successful ablation of the epicardial left lateral accessory pathway in the distal coronary sinus (CS). (a) Fluoroscopic left anterior oblique image showing the site of successful ablation in the distal coronary sinus. Note that the diagnostic decapolar catheter has been re-advanced into the CS from the right femoral vein. (b) Intracardiac electrogram from the site of successful ablation during right ventricular pacing. (c) Loss of VA conduction 6 s after RF ablation.
findings are consistent with the presence of a left atrial isthmus bounded by the left inferior pulmonary vein and the inferolateral mitral annulus.

Double potentials may be recorded on the CS or ablation catheter during ORT, and are due to either mitral isthmus block or an AP connection to the left atrium via the CS musculature. An underlying anatomic substrate for the mitral isthmus has been proposed and consists of a discrete circumferential inferoposterior myocardial bundle that courses along the mitral annulus and extends across the entire thickness of the atrial wall in the posterior atrioventricular vestibule of the left atrium.

Although the data in this study are consistent with the presence of transient bi-directional intra-atrial conduction block during endocardial RF delivery (both lateral and medial to the AP atrial insertion site that fails to eliminate the AP), differential pacing along either side of the ablation lesion was not performed.

The AP was successfully ablated epicardially with a single RF lesion in the distal CS. This underscores the importance of understanding the implications of intra-atrial conduction block during RF ablation of left lateral APs and recognizing that these pathways may take a subepicardial course requiring ablation from the coronary sinus.

References