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Advanced Mapping and Ablation: The Importance of the Coronary Sinus Catheter

Laurence M. Epstein, MD
Chief, Arrhythmia Service
Brigham and Women's Hospital, Boston, MA

Introduction

In recent years it has been recognized that rapidly firing ectopic foci, often arising from a muscular sleeve of atrial tissue extending into the pulmonary veins, can be responsible for triggering atrial fibrillation. Elimination or blocking conduction of these foci can prevent atrial fibrillation in selected patients. In this case study, a simplified approach to mapping and electrical isolation of the pulmonary veins is reviewed.

Case History

The patient is a 43-year-old man with a ten-year history of palpitations. The patient is very active, running at least 4 times per week. He describes initially feeling occasional skipped beats, which have increased over the years. Approximately 5 years prior, the patient presented with a sustained episode of rapid, irregular palpitations after jogging. He was found to be in atrial fibrillation with rapid ventricular response. The patient received IV diltiazem for rate control and spontaneously converted to sinus rhythm. The patient was discharged on atenolol and did well with continued occasional short bursts of AF. Two years ago, the frequency and duration of the episodes increased. The patient was begun on propafenone and a stress test was benign. Over the past year, despite increasing doses of propafenone, the patient has been increasingly disabled by episodes of atrial fibrillation and was referred for consideration of catheter ablation. Given that the patient's highly symptomatic atrial fibrillation that had failed an attempt of medical management, the patient was considered a candidate for catheter ablation. A limited approach was planned with isolation of the pulmonary veins and a left and right atrial flutter line.

Procedure

Prior to the procedure the patient underwent a cardiac MRI to define the left atrial and pulmonary venous anatomy (Figure 1). This demonstrated four distinct pulmonary veins.

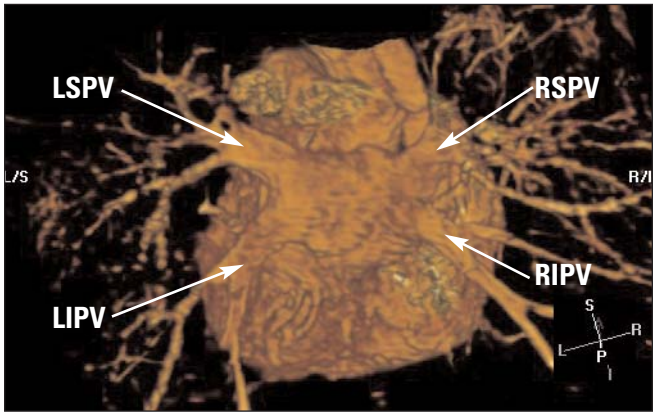

Figure 1

Three-dimensional MRI/MRA reconstruction of the left atrium viewed from a posterior-anterior projection. LIPV - Left Inferior Pulmonary Vein; LSPV - Left Superior Pulmonary Vein; RIPV - Right Inferior Pulmonary Vein; RSPV - Right Superior Pulmonary Vein.

After receiving informed written consent, the patient was taken to the electrophysiology laboratory of the Brigham and Women's Hospital. The procedure was performed under conscious sedation with versed and fentanyl. The "patches" of the Ensite NavX™ Mapping System *(St. Jude Medical, St. Paul, MN)* were placed. Two short 8F vascular sheaths were placed in the right femoral vein and one short 7F vascular sheath was placed in the left femoral vein.

Cannulation of the Coronary Sinus

Under biplane fluoroscopic guidance, a steerable decapolar electrode Polaris X™ Catheter *(Boston Scientific, San Jose, CA)* was employed to cannulate the coronary sinus via the left femoral vein. We routinely use the Polaris X Catheter for cannulating the coronary sinus from a femoral approach. The catheter combines excellent stiffness, superior torque response of the shaft, and flexibility of the distal tip. Therefore, the catheter tracks the IVC well for easy delivery to the right atrium. The steering mechanism allows for smooth, precise tip deflection with an easy-to-use feel. Cannulation of the coronary sinus is easily achieved by deflecting the tip of the catheter across the tricuspid valve in the RAO projection. While observing in the LAO projection, slightly withdrawing the catheter with clockwise rotation usually results in the tip of the Polaris X Catheter slipping easily into the ostium of the coronary sinus. By gently relaxing the curve the catheter can be advanced into the main body of the coronary sinus. One of the sheaths in the right femoral vein was replaced with a 120-degree, 8.5F Convoy™ Sheath *(Boston Scientific, San Jose, CA),* and an Ultra ICE™ Intracardiac Echo Catheter *(Boston Scientific, San Jose, CA)* was then positioned via that sheath to image the intra-atrial septum and guide the first transseptal puncture (Figure 2).

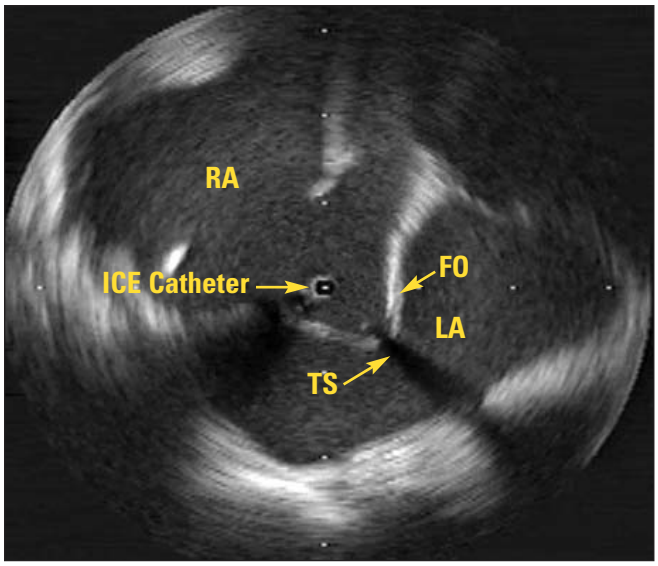

Figure 2

Intracardiac echocardiographic (ICE) image demonstrating ICE guidance of a transseptal puncture. Clear tenting of the fossa ovalis can been seen. RA - Right Atrium; LA - Left Atrium; TS - Transseptal apparatus; FO - fossa ovalis; ICE - Intracardiac echocardiography catheter.

The second 8F sheath in the right femoral vein was replaced with a standard transseptal sheath, which was positioned in the SVC. The transseptal puncture was performed with biplane fluoroscopic and intracardiac echo catheter guidance. The needle and dilator were removed after confirmation of positioning and the sheath was flushed. A 5mm tip bi-directional, steerable ablation catheter was then positioned in the left atrium. The intracardiac echo catheter was removed and a second transseptal puncture was performed with the 8.5F sheath. The intracardiac echo catheter was then positioned in the left atrium to help guide pulmonary vein mapping and isolation. Heparin was given to keep the ACT between 300 – 350 seconds.

CS catheter as reference

With the guidance of the intracardiac echo catheter to accurately identify the pulmonary venous ostia, a quick map of the left atrium and four pulmonary veins was performed. The mapping system allows for choice of reference for positioning. Patches placed on patient's thorax can be used; alternatively a catheter within the heart can be used. We choose to use the coronary sinus catheter for this purpose since cardiac motion is better accounted for as compared to the surface patches. With the stiffness of the shaft and flexibility of the distal component, the Polaris X Catheter remains in a stable position throughout the procedure. Once positioned, we rarely, if ever, need to reposition the Polaris X Catheter. Detailed mapping of the junction of the pulmonary veins and left atrium was then performed with intracardiac catheter guidance to accurately identify the true junction (see Figures 3 and 4 on next page).

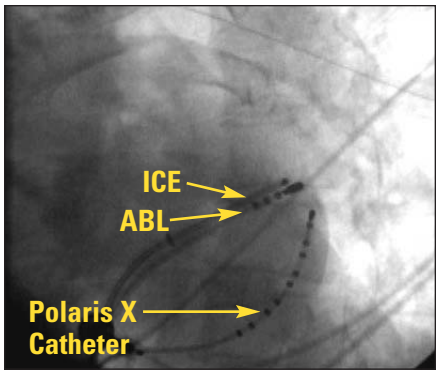

Figure 3

Left anterior oblique fluoroscopic image demonstrating the position of the Polaris X Catheter in the coronary sinus and ICE & ablation (ABL) catheters in the ostium of the left inferior pulmonary vein.

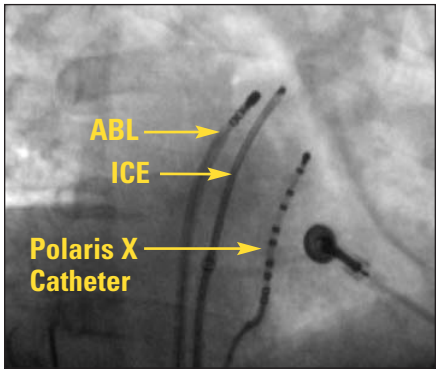

Figure 4

Right anterior oblique fluoroscopic image demonstrating the position of the Polaris X Catheter in the coronary sinus and ICE & ablation (ABL) catheters in the left atrial appendage.

Pacing with the Polaris X Catheter

To better identify pulmonary vein potentials for the left sided veins, pacing from the coronary sinus can be performed to dissociate pulmonary vein potentials from the far field left atrium and left atrial appendage. Ablation was then performed segmentally at the junction of the pulmonary veins and left atrium, specifically at sites of pulmonary vein potentials. Radiofrequency energy was delivered in the temperature control mode with settings of 50W and 50°C for 90 seconds. On average only 5-6 RF deliveries are required to isolate each vein. Electrical isolation, with exit block, is demonstrated by pacing at various sites around the circumference within each vein and by looking for activation of the left atrium in the coronary sinus catheter (Figures 5 and 6).

Recording with the Polaris X Catheter

The Polaris X Catheter provides accurate, sharp electrograms from the left atrium when positioned in the coronary sinus. This is crucial for identifying left atrial and coronary sinus activation patterns that can often be encountered in these cases. If conduction still exists, the ablation catheter is withdrawn from the site of capture within the pulmonary vein to just outside the os, while pacing. Ablation is then performed at that site. After complete electrical isolation of all four pulmonary veins was achieved, an ablation line was created from the left inferior pulmonary vein to the mitral annulus (50W, 60°C). Both sheaths in the left atrium were then withdrawn to the right atrium. While pacing from the coronary sinus with the Polaris X Catheter, ablation was performed from the tricuspid annulus to the IVC in order to create bi-directional conduction block (50W, 60°C). Pacing the coronary sinus helps dissociate the electrograms in the typical flutter isthmus and allows for mapping of split potentials to identify sites of breakthrough. Ablation was then performed around the mouth of the coronary sinus. The catheters and sheaths were removed and hemostasis was achieved with pressure when the ACT reached 190 seconds.

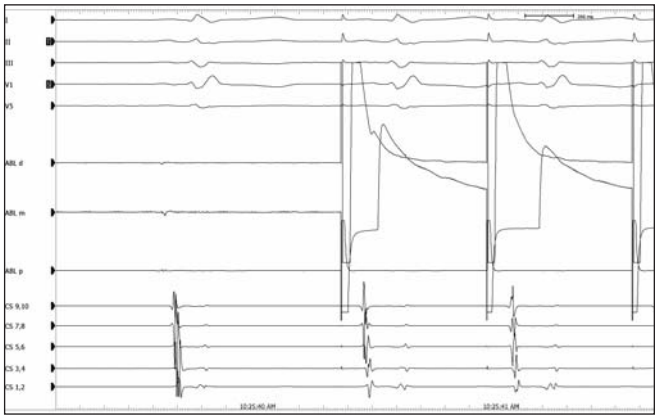

Figure 5

Surface and intracardiac recordings during pacing from within the pulmonary vein. Activation of the left atrium can clearly be seen in the coronary sinus catheter, therefore demonstrating conduction between the pulmonary vein and left atrium.

Figure 6

Surface and intracardiac recordings during pacing from within the pulmonary vein. Electrical isolation of the pulmonary vein is confirmed by the recording in the coronary sinus catheter demonstrating clear electrical dissociation.

The patient was monitored overnight and discharged the following day on warfarin, enoxaparin, atenolol, and propafenone. The patient is now 5 months post ablation, off all medications and back to an active life without atrial fibrillation.

Conclusion

This case demonstrates the utility of the Polaris X™ Catheter to facilitate mapping and ablation. The ease of positioning, stability and excellent recording and pacing performance make this an ideal catheter for these procedures. The ease of cannulating the CS with the Polaris X Catheter and it's stability in the CS allow the operator to focus on mapping and ablation.

Polaris X Catheter
Uni-directional Decapolar

Address for Correspondence
Laurence M. Epstein, MD
Cardiovascular Medicine
Brigham and Women's Hospital
75 Francis Street
Boston, MA 02115
FAX: (617) 7277-4981
Phone: (617) 732-6393
E-mail: lmepstein@partners.org

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Boston Scientific Corporation
2710 Orchard Parkway
San Jose, CA 95134
www.bostonscientific.com/electrophysiology

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Article excerpt reprinted with permission from EP Lab Digest April 2007, Vol 7, No 4.
Printed in the U.S. EPT-10637_01/2007