Transseptal catheterization through the atrial septum has become a useful skill for electrophysiologists. The challenge for a successful transseptal puncture is positioning the Brockenbrough needle at the thinnest aspect of the atrial septum, the membranous fossa ovalis, guided by either intracardiac echocardiography (ICE) or fluoroscopy. This article describes the technical aspects of performing a transseptal puncture using ICE and fluoroscopic guidance.

Ultrasound-guided transseptal catheterization

The intent of ICE-guided transseptal catheterization is to image intracardiac anatomy and determine the exact position of the distal aspect of the transseptal dilator along the atrial septum, in particular, to assess for tenting of the fossa ovalis with the dilator tip. The following is the author’s preferred method.

The equipment used consisted of the following: 23-cm, 9Fr sheath for ICE catheter (model 406144, St. Jude Medical, Sylmar, CA); 62-cm, 8Fr transseptal sheath for left atrial cannulation (model 301-803M, Biosense-Webster, Diamond Bar, CA or model 406805, St. Jude Medical); 110-cm, 9Fr, 9-MHz intracardiac ultrasound transducer (model 9900, Boston-Scientific/EP Technologies, San Jose, CA); 71-cm Brockenbrough needle (model 407201, St. Jude Medical); and 190-cm, 0.014-inch guidewire (model 6724, Guidant Corp. St. Paul, MN).

Venous access is obtained via the femoral veins. To enhance image quality, all air must be eliminated from the distal tip of the 9Fr, 9-MHz ICE catheter by flushing vigorously with 5 to 10 mL of sterile water. The catheter then is connected to the ultrasound console and advanced until the tip of the rotary ICE catheter images the fossa ovalis.

Each sheath, dilator, and guidewire is flushed with heparinized saline. The transseptal sheath and dilator are advanced over a guidewire into the superior vena cava and often placed in the proximal portion of the left subclavian vein. The transseptal dilator is loaded with a Brockenbrough needle that is advanced to within 2 to 4 cm of the dilator tip. The Brockenbrough needle is prepackaged with an inner stylet left in place until the Brockenbrough needle is close to the tip of the transseptal dilator to protect it as it is advanced within the sheath (Figure 1A). The Brockenbrough needle and dilator are rotated toward the atrial septum (usually with the Brockenbrough needle arrow pointing at ~3 to 6 o’clock position relative to its shaft) and slowly withdrawn under fluoroscopic guidance (30° left anterior oblique [LAO]). At the same time, two characteristic lateral movements of the dilator tip are assessed: one as the tip passes under the aortic knob (Figure 1B) and a second “jump” as the tip passes under the muscular atrial septum onto the fossa ovalis (Figure 1C).

Before advancing the Brockenbrough needle, continuous ICE imaging directs adjustment of the transseptal dilator until ICE confirms the tip is in intimate contact with the middle of the fossa, confirms proper lateral movement of the dilator toward the fossa, and excludes inadvertent superior displacement toward the muscular septum and aortic valve. With further advancement of the dilator, ICE demonstrates tenting of the fossa (Figure 2A and B). If the distance from the tented fossa to the left atrial wall is small, minor adjustments in the dilator position can be made to maximize the space. The Brockenbrough needle is then advanced. With successful transseptal puncture, a palpable “pop” is heard, and sudden collapse of the tented fossa is observed. Advancement of the needle is then immediately stopped. Under fluoroscopic guidance, a 0.014-inch floppy guidewire is advanced through the Brockenbrough needle into a pulmonary vein (Figure 3A). This action confirms puncture of the atrial septum and access to the left atrium. If the guidewire cannot be advanced beyond the cardiac silhouette or if it seems to follow the path of the aorta, contrast should be injected to assess the position of the Brockenbrough needle before advancing the transseptal dilator. With no change in position of the Brockenbrough needle, the transseptal dilator and sheath are advanced over the guidewire into the left atrium (Figure 3B). At times, the dilator and sheath do not have sufficient stiffness to pass through the fossa. For this problem, the Brockenbrough needle can provide additional support by advancing it close to, but not beyond, the tip of the dilator.

Once the transseptal sheath is within the left atrium, the dilator, Brockenbrough needle, and guidewire are removed while suction is maintained through a syringe placed on the sheath sideport to minimize the risk of air embolism. Typically, a bolus and intermittent administration of heparin...
(100 IU/kg) is given to maintain an elevated activated clotting time (ACT >250–300 seconds).

Fluoroscopy-guided transseptal catheterization

With fluoroscopy-guided transseptal puncture, the goal is to use ancillary information to determine proper positioning of the transseptal dilator.4,5

Through femoral arterial access, a pigtail catheter is positioned just superior to the aortic valve. As described earlier, the transseptal sheath and dilator are advanced into the superior vena cava. With the Brockenbrough needle at the tip of the sheath, the sheath is torqued toward the atrial septum. Under fluoroscopic guidance (30° LAO), the sheath is pulled inferiorly to watch for the dilator to “jump” under the aortic knob and then a second “jump” under the muscular atrial septum onto the fossa ovalis. If in the proper position, the tip of the dilator should be inferior to the pigtail catheter and pointing laterally (LAO) and posteriorly (right anterior oblique [RAO]). Other electrode catheters positioned in the right atrial appendage, His-bundle region, and coronary sinus also can be used as anatomic landmarks to guide the transseptal sheath to the fossa ovalis.5 In the RAO projection, the tip of the Brockenbrough needle is halfway between the body of the right atrial appendage catheter and the electrodes recording the proximal His bundle. In the LAO projection, the tip of the needle is positioned to the left of the proximal His-bundle electrode recording site and below the right atrial appendage catheter. The catheter with the Brockenbrough needle should be parallel to the coronary sinus catheter in the LAO view. The aortic root is marked in the LAO view by the proximal His-bundle electrodes. Once in proper position, the Brockenbrough needle is advanced. If excessive force is applied without a palpable “pop” to the fossa, then the Brockenbrough needle likely was not in proper position. However, with the sensation of passing through the atrial septum, the operator needs to confirm that the Brockenbrough needle has passed into the left atrium rather than the ascending aorta or posterior into the pericardial space. A preferred method to confirm transseptal puncture is contrast injection to “stain” the septum. Other methods include measurement of intracardiac pressure and blood gas or use of a guidewire (as described earlier).

Complications

A major complication of transseptal catheterization is injury to cardiac and extracardiac structures. Because of its stiffness and large caliber, the transseptal dilator should never be advanced until the position of the Brockenbrough needle is confirmed with confidence. Advancing the dilator into an improper position can be fatal. For this reason, many operators (including the author) recommend, especially...
among patients with normal atrial size, use of ICE-guided transseptal puncture.

Another important procedural complication is embolism of either thrombus or air. To avoid air emboli, catheters must be advanced and withdrawn slowly so as not to “suck” air. Thromboembolic complications can be avoided by flushing all sheaths and guidewires with heparinized saline and maintaining the activated clotting time >300 seconds. In addition, a guidewire should not be left in the left atrium for more than approximately 1 minute, especially if no systemic heparin has been administered.

As a final suggestion, regardless of the technique, an inexperienced operator should observe and then be proctored by an experienced operator before attempting transseptal catheterization independently.

Figure 2  
A: As the transseptal (TS) dilator approaches the fossa ovalis (FO), the fossa becomes distorted. B: Proper alignment of the TS dilator is confirmed by tenting of the fossa. LA = left atrium; RA = right atrium.

Figure 3  
A: Guidewire in a pulmonary vein (PV). B: With the guidewire in the PV, the transseptal (TS) dilator and sheath are advanced into the left atrium with confidence. BB = Brockenbrough.

References