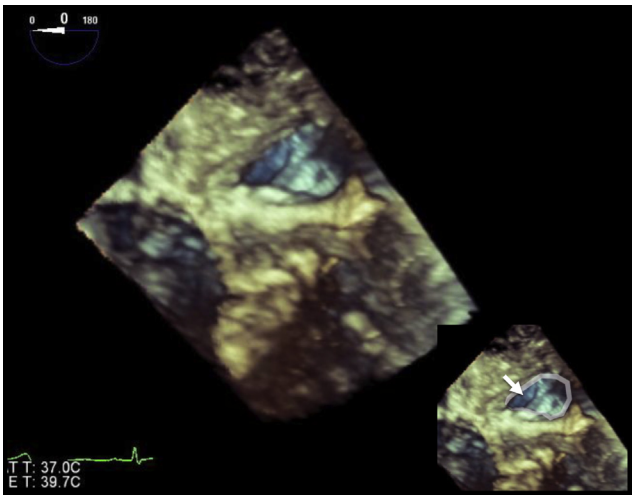

Figure 19 Unroofed coronary sinus on 3D TEE image as viewed from LA aspect. *Oval* indicates perimeter of unroofed portion of sinus in LA.

technical difficulty for a single operator. Table 2 provides a summary of the advantages and disadvantages of TTE, TEE, and ICE in percutaneous transcatheter guidance of PFO and ASD.

Transthoracic Echocardiography Imaging Protocol for Imaging the Interatrial Septum

The atrial septum can be evaluated fully using TTE. Ideally, multiple views should be used to evaluate the size, shape, and location of an atrial communication and the relationship of the defect to its surrounding structures (Figures 9 and 13–17 and 26–28). In particular, special attention must be paid to determine the relationship of the defect to the venae cavae, pulmonary veins, mitral and tricuspid valves, and coronary sinus. Assessment of the amount of the surrounding rims of tissue present is crucial. A deficiency of rim tissue between the defect and pulmonary veins, AV valve, or IVC will preclude transcatheter closure, and a deficiency of aortic rim can increase the risk of device erosion in certain circumstances.

Additional views of other structures such as the ventricles and great arteries are necessary to assess for secondary findings related to the hemodynamic consequences of an ASD such as RA, right ventricular (RV), and pulmonary artery (PA) dilation. In the pediatric population, the subxiphoid window typically allows the best visualization of the atrial septum and its related structures. In adolescence and adulthood, the subxiphoid window is often inadequate because of the distance from the probe to the atrial septum. Thus, other views such as the parasternal windows should be used to assess the atrial septum. In some cases, a full assessment of the atrial septum might not be possible with TTE. Thus, TEE could be required.

Subxiphoid Frontal (Four-Chamber) TTE View. The subxiphoid frontal (four-chamber) view allows imaging of the atrial septum along its anterior–posterior axis from the SVC to the AV valves. This is the preferred view for imaging the atrial septum, because the atrial septum runs near perpendicularly to the ultrasound beam, providing the highest axial resolution and permitting measurement of the defect diameter along its long axis. Because the septum is thin (especially in its midportion), placing the septum perpendicular to the ultrasound beam helps distinguish a true defect from dropout resulting from an artifact. Aneurysms of the atrial septum primum composed of tissue attached to the edges of the ASD are also well visualized from the subcostal frontal view. ASAs could be fenestrated (Figure 9) but also can be intact with no resultant atrial level shunt. Color Doppler interrogation and contrast studies should be used to detect shunting. The surrounding rim from the defect to the right pulmonary veins can be measured in this view. Sinus venosus defects will be difficult to visualize because the venae cavae are not viewed longitudinally in this view.

Subxiphoid Sagittal TTE View. The subxiphoid sagittal TTE view is acquired by turning the transducer 90° clockwise from the frontal view. This view is ideal for imaging the atrial septum along its superior–inferior axis in a plane orthogonal to the subxiphoid frontal four-chamber view. Sweeping the transducer from right to left in this axis allows determination of the orthogonal dimension of the ASD (Figures 15 and 17). This dimension can be compared with the dimension measured in the subxiphoid frontal view to help determine the shape (circular or oval) of the defect. This view can be used to measure the rim from the defect to the SVC and IVC and is an excellent window to image a sinus venosus type defect (Figures 14B and 15).

Left Anterior Oblique TTE View. The left anterior oblique TTE view is acquired by turning the transducer approximately 45° counterclockwise from the frontal (four-chamber) view. This view allows imaging of the length of the atrial septum and is therefore ideal to identify ostium primum ASDs and for assessment of coronary sinus dilation (Figures 13B and 17B). In addition, it allows evaluation of the relation of the SVC to the defect. Furthermore, this view can be used to evaluate the entrance of the right-sided pulmonary veins into the heart.

Apical Four-Chamber TTE View. In the apical four-chamber TTE view, the diagnosis and measurement of ASDs should be avoided because the atrial septum is aligned parallel to the ultrasound beam. Thus, artifactual dropout is frequently seen in this view, which could result in overestimation of the defect size. This view is used to assess the hemodynamic consequences of ASDs, such as RA and RV dilation, and to estimate RV pressure using the tricuspid valve regurgitant jet velocity. This view is also used to evaluate for right-to-left shunting with agitated saline (Figure 29).

Modified Apical Four-Chamber TTE View (Half Way in Between Apical Four-Chamber and Parasternal Short-Axis View). The modified apical four-chamber TTE view is obtained by sliding the transducer medially from the apical four-chamber view to the sternal border. This view highlights the atrial septum at an improved incidence angle to the sound bean (30°–45°). In the patients in whom the subcostal views are difficult to obtain, the modified apical four-chamber view is an alternative method for imaging the atrial septum in the direction of the axial resolution of the equipment.

Parasternal Short-Axis TTE View. In the parasternal short-axis TTE view at the base of the heart, the atrial septum is visualized posterior to the aortic root running in an anterior–posterior orientation. This view is ideal to identify the aortic rim of the defect (Figures 26 and 27). It also highlights the posterior rim (or lack thereof) in sinus venosus and posteroinferior secundum defects. The size of the defect itself should not be measured in this view, because the beam orientation is parallel to the septum, and drop out resulting from artifact can occur.

High Right Parasternal View. The high right parasternal view is a parasagittal view performed with the patient in the right lateral decubitus position with the probe in the superior–inferior orientation. In