A Practical Guide to the Use of Echocardiography in Assisting Structural Heart Disease Interventions

Ming-Sum Lee, MD, PhD[a],
Tasneem Z. Naqvi, MD, FRCP, MMM[b,*]

KEYWORDS

• Echocardiography • Percutaneous intervention • Structural heart disease • TAVR • ASD

KEY POINTS

- Traditional imaging using fluoroscopy alone does not provide the necessary resolution to delineate intracardiac structures.
- Echocardiography allows detailed assessment of intracardiac pathology, aids in determining the suitability of that pathology for percutaneous intervention, guides the actual procedure through real-time imaging, and enables serial follow-up.
- Echocardiography has emerged as a fundamental imaging modality and is likely to remains in the forefront during percutaneous treatment of structural heart disease.

INTRODUCTION

Percutaneous intervention has emerged as an effective and less-invasive treatment option for patients with valvular heart disease who are poor surgical candidates. Echocardiography plays an integral role through all stages in the evaluation and treatment of patients undergoing percutaneous interventions.[1] Before the procedure, accurate assessment of cardiac anatomy using echocardiography is crucial in determining patient eligibility for the procedure. During catheterization, echocardiography is used in conjunction with fluoroscopy for procedural guidance. Unlike intracardiac catheters that are readily visualized with fluoroscopy, intracardiac structures require an imaging modality such as echocardiography for clear delineation. As an additional imaging modality beyond fluoroscopy, echocardiography helps improve the safety of the procedure. Because echocardiography uses ultrasound instead of radiation, the radiation exposure to the patient and operator is reduced, which is particularly important in patients who are young, who are pregnant, and in whom the use of radiographic contrast must be minimized. After the procedure, echocardiography is the most commonly used tool for patient follow-up, evaluating the percutaneously placed device or valve, and determining the effect of percutaneous intervention on cardiac remodeling over time.

This article focuses on the role of echocardiography in guiding the most commonly performed interventional procedures for structural heart disease, including percutaneous atrial septal defect (ASD) closure, transcatheter aortic valve replacement (TAVR), percutaneous repair of paravalvular leaks, percutaneous mitral valve edge-to-edge repair, and percutaneous placement of appendage occlusion devices.

[a] Division of Cardiology, Keck School of Medicine, University of Southern California, 1510 San Pablo Street, Los Angeles, CA 90033, USA; [b] Mayo Clinic, 13400 E. Shea Blvd, Scottsdale, AZ 85259, USA
* Corresponding author.
E-mail address: naqvi.tasneem@mayo.edu

Cardiol Clin 31 (2013) 441–454
http://dx.doi.org/10.1016/j.ccl.2013.04.004
0733-8651/13/$ – see front matter

cardiology.theclinics.com

PERCUTANEOUS ASD CLOSURE

Closure of an ASD is recommended in all patients with evidence of right atrial and right ventricular enlargement, regardless of symptoms.[2] In patients with secundum ASD, percutaneous closure is currently the preferred treatment. Clinical trials comparing percutaneous versus surgical closure of ASD showed lower complication rates and shorter hospital stay with percutaneous closure, while achieving similar efficacy rates as surgical repair.[3,4] However, not all patients have the appropriate anatomy for percutaneous closure. Superior and inferior sinus venosus defects and septum primum defects are currently not amenable to percutaneous closure because of inadequate/deficient rims and the risk of encroachment by the device on adjacent cardiac structures. Transthoracic echocardiogram (TTE) provides evidence of shunting across the interatrial septum and is often able to diagnose a secundum ASD. Transesophageal echocardiogram (TEE) helps confirm ASD presence and location and defines patient eligibility through providing an accurate assessment of the size of ASD, identifying the margins of the ASD, and determining the relationship of the ASD with the adjacent cardiac structures.[5]

It is important to image the ASD and its rims in multiple different planes. The rims of the secundum ASD are named based on the adjacent structures: aortic, mitral, superior venacaval, inferior venacaval, and posterior. Having an adequate tissue rim of greater than 5 mm around the defect is ideal for percutaneous closure.[6] Having adequate inferior caval and superior caval rims is particularly important for successful closure, whereas deficiency of the aortic rim is well tolerated and usually does not preclude a percutaneous option. Complete assessment of all the rims is performed using different omniplane angles on TEE. The posterior and the mitral rims can be assessed with the TEE probe at 0° at the midesophageal level (**Fig. 1**A). The probe should be moved in and out to assess the rims at different levels. At 45° to 65°, the posterior and the aortic rims can be assessed (see **Fig. 1**B). This view also usually shows the maximum size of the defect. The TEE probe at an angle of 90° to 110° is usually best for imaging the superior venacaval and inferior venacaval rims (see **Fig. 1**C). Three-dimensional echocardiography should be used when available, because it enables imaging of the interatrial septum en face and provides a comprehensive view of the ASD in one image.

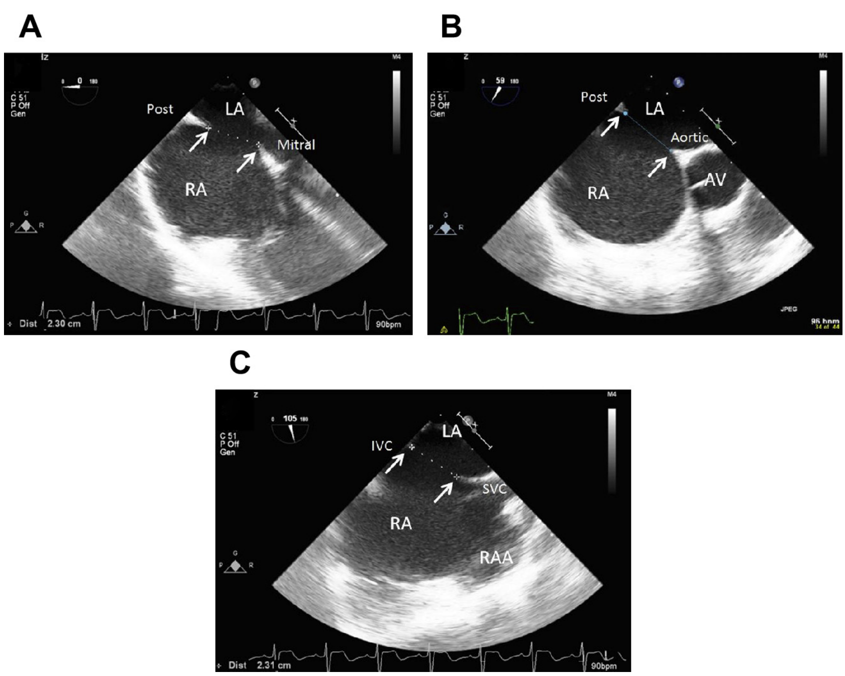

Fig. 1. Assessment of the different rims of a secundum ASD using TEE. (*A*) TEE at midesophageal level at 0° showing the margins of the ASD (*arrows*). The mitral rim (mitral) and the posterior rim (post) are clearly demonstrated. (*B*) At 50°, the aortic rim (aortic) and the posterior rim (post) are visualized (*arrows*). (*C*) TEE at 105° showing the typical bicaval view with the superior vena cava and inferior vena cava. The superior venacaval rim (SVC) and the inferior venacaval rim (IVC) can be assessed from this view (*arrows*). AV, aortic valve; IVC, inferior vena cava; RA, right atrium; RAA, right atrial appendage; RV, right ventricle; SVC, superior vena cava.