

# Imaging to Guide ASD and PFO Closure: Intracardiac Echocardiography

Mustafa H. Abdullah Al-Qbandi, Qi-Ling Cao, and Ziyad M. Hijazi

## Introduction

Intracardiac echocardiography (ICE) is increasingly being used to guide percutaneous interventional procedures, principally the closure of interatrial septal defects.<sup>1-3</sup> Since its introduction to guide device closure of atrial septal defect (ASD) and patent foramen ovale (PFO) in the early 2000s,<sup>4</sup> its use in congenital heart disease has become well established. The main advantages of ICE over transesophageal echocardiography (TEE) during closure of ASD and PFO include no need for general anesthesia, better views of the left atrium, better views of the posteroinferior part of the septum, shorter procedure times, and the ability of the interventional cardiologist to perform the interventional procedure as well as the imaging part of the procedure without needing an expert echocardiographer for transesophageal echocardiography.

The principal disadvantage is the additional cost of the imaging catheter, although this can be offset by improved turnaround times in a busy catheterization laboratory and reduced personnel costs (anesthesia and echocardiography).<sup>5-7</sup> Table 8.1 lists the important advantages/disadvantages of each imaging modality.

ICE systems currently commercially available include the AcuNav catheter manufactured by Siemens Medical Systems and distributed by Biosense Webster, California; the ViewFlex catheter (St. Jude Medical, Minnesota) and the Ultra ICE catheter (Boston Scientific, Boston, Massachusetts). Most operators currently use the AcuNav ICE catheter. It is available as an 8 or 10F catheter, multifrequency (5–10 MHz), 64-elements, linear phased array, ultrasound catheter that can perform pulsed and color Doppler imaging. The control handle has three knobs: a posterior/anterior knob, a right/left

TEE (Transesophageal echocardiography)	ICE (Intracardiac echocardiography)
Requires general anesthesia	Sedation only
Fluoroscopic time may be prolonged	Fluoroscopic time may be shortened
Not patient friendly! More stress to patient	Less stress to patient
Requires a separate operator	One operator can do both intervention and imaging
Difficulty in visualization of posteroinferior rim	Excellent for visualization of the posteroinferior rim
Only one femoral venous access	Need a second femoral venous puncture
Less cost	Higher cost?
Multiple use of the probe	Limited use of catheter
Temperature sensing	No temperature sensing. Cooling effect of blood on the catheter
TEE probe sometimes interferes with balloon sizing during fluoroscopy	Probe is in right atrium and is small with no interference during fluoroscopy
Esophageal injury	Vascular injury

**Table 8.1**—Advantages/Disadvantages of TEE and ICE

knob, and a locking knob (Fig 8.1 demonstrates the AcuNav catheter with its control handle and the tip). It is capable of tissue penetration of up to 14 cm, thereby allowing imaging of the left atrial structures from a position in the right atrium.



**Fig 8.1**—The AcuNav Intracardiac Echocardiographic (ICE) Catheter. Note, the control handle with the three knobs.

## Imaging Protocol for ASD/PFO Device Closure

We reported the protocol of image guidance during ASD/PFO closure (4) and it is summarized here.

Under local anesthesia, venous access is usually obtained via the same femoral vein (if the patient's weight is > 35 kg) and from the contralateral vein (if the weight is < 35 kg) and, while under continuous fluoroscopic guidance, the catheter is gently advanced to the mid-right atrium.

Most patients undergoing device closure of their defect (ASD/PFO) have already undergone complete transthoracic echocardiographic and/or TEE evaluation of their defect and associated structures. Nonetheless, we believe that ICE also can be used to fully evaluate the defect