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IMAGING VIGNETTE

# Percutaneous Closure of Atrial Septal Defect

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**ATRIAL SEPTAL DEFECT (ASD)** is a common congenital lesion in adults. Prolonged left-to-right shunting and excessive pulmonary blood flow may lead to pulmonary hypertension, Eisenmenger's syndrome, and right heart failure. A significant ASD should be closed irrespective of age.

Surgical closure of ASD had long been considered the definitive treatment (1,2), although percutaneous closure is now considered the treatment of choice. The main advantages of the percutaneous approach, besides the avoidance of surgery, include a high sealing rate (97% to 99%) of the defect, along with short times of procedure and hospital length of stay for the patient (3). The most frequently implanted devices consist of fabric mesh covering opposable double discs (Amplatzer, AGA Medical Corporation, Plymouth, Minnesota), a helix spiral occluder (Helex, W. L. Gore & Associates, Inc., Flagstaff, Arizona), or 2 square umbrella-like spring frames (STARFlex, Inc., NMT Medical, Boston, Massachusetts). Acute complications are rare but may include tears of the atrial septum from the sizing balloon, device embolization or entrapment, stroke, and cardiac tamponade.

The following images (fluoroscopy, 2-dimensional transesophageal echocardiogram and live 3-dimensional transesophageal echocardiogram) demonstrate a successful procedure (Fig. 1) with favorable anatomical criteria such as good septal margins and orientation of the septum and atria and an unsuccessful procedure (Fig. 2) due to a thin septum and very enlarged atria. The importance of imaging in guiding the procedure and determining the final outcome is highlighted.

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**Key Words:** atrial septal defect ■ occluder device ■ echocardiography ■ Doppler echocardiography.

**Figure 1. Successful Percutaneous ASD Closure**

A secundum atrial septal defect (ASD) with left-to-right shunt was confirmed by 2-dimensional transesophageal echocardiogram (TEE) **(A)**, 2-dimensional TEE color Doppler **(B)**, and live 3-dimensional TEE **(C)**. Live 3-dimensional TEE demonstrates **(D)** the deployment of the transseptal guide catheter for balloon sizing **(E)** (Online Videos 1, 2, and 3). Typically, ASD dimensions are assessed by a sizing balloon and/or 2-dimensional TEE imaging and closed with a slightly oversized (2- to 4-mm) closure device **(F)**. After deployment (opening) of the discs, before the device is released from the catheter, TEE or intracardiac echocardiography is used for the assessment of device location, the verification of no disruption of adjunct structures, and successful ASD closure **(G and H)** (Online Video 4). The next step is releasing the closure device from the guide catheter (Online Video 5). Echocardiography of the final result demonstrates: appropriate apposition of the device to adjacent structures **(I)** and no residual flow by color Doppler interrogation **(J)**. Live 3-dimensional TEE permits novel any-plane imaging during the procedure. In this case, the final device position is assessed from the perspective of the left atrium **(K)** or right atrium **(L)** (OnlineVideo 6).

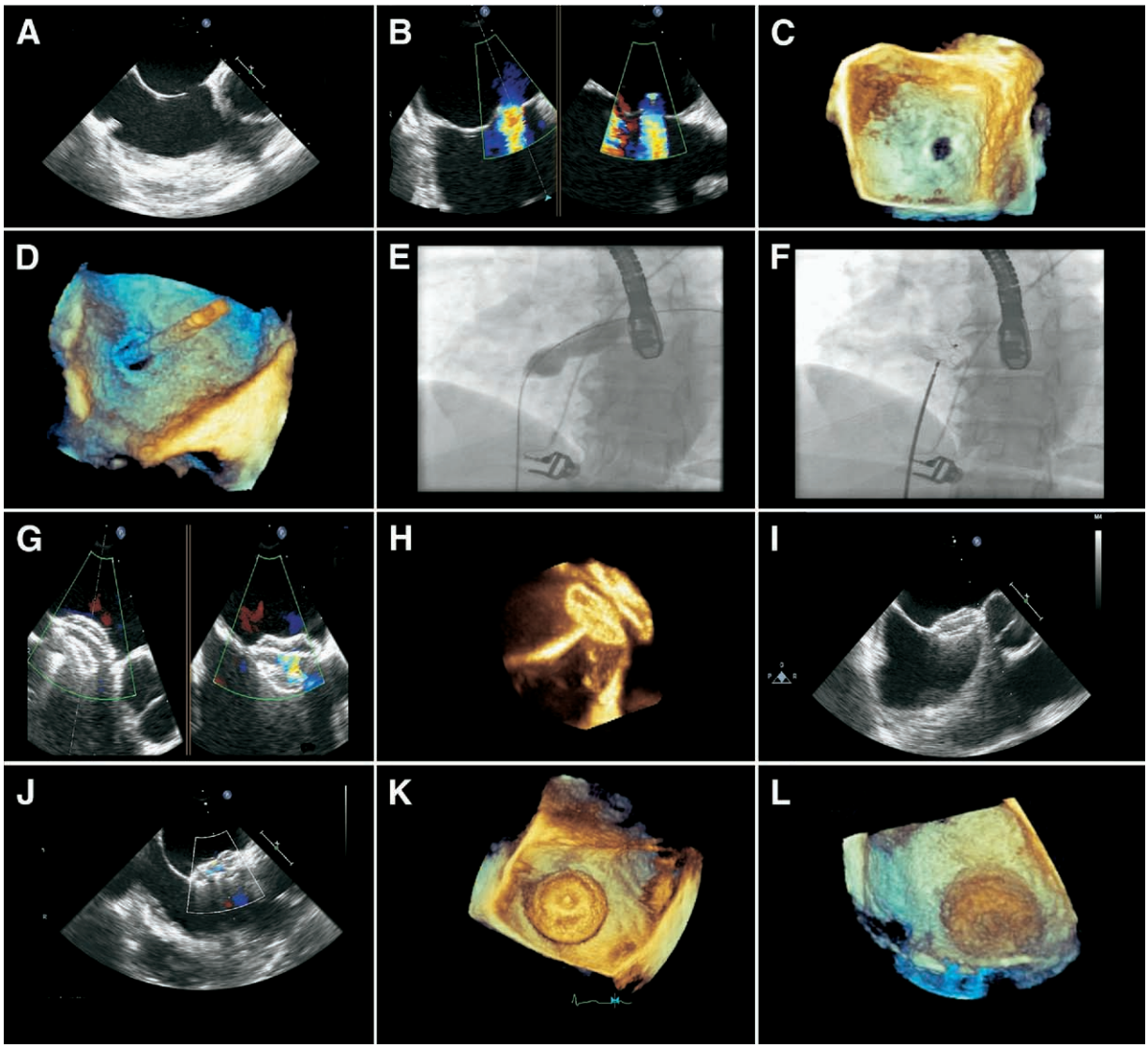

**Figure 2. Unsuccessful Percutaneous ASD Closure**

A patient with Lutembacher's syndrome (mild mitral stenosis and secundum ASD, Qp/Qs = 2:1) and severe pulmonary hypertension was referred for percutaneous ASD closure. Imaging with 2-dimensional TEE **(A)** (OnlineVideo 7) and 2-dimensional TEE color Doppler **(B)** (OnlineVideo 8) showed a thin floppy septum and very large atria. Live 3-dimensional TEE with the guide catheter across the ASD confirmed the thin septum **(C)**. An ASD diameter of 1.6 cm was measured with balloon sizing **(D)** (OnlineVideo 9) and 2-dimensional TEE. Successful positioning of the ASD closure device could not be achieved because of the orientation of the thin septum and the large atria **(E)**. Recurrent attempts to deploy the ASD closure device failed, with a possible tear of the thin septum in the process. The largest Amplatzer Septal Occluder device could no longer cover the entire septal defect **(E, F, and G)** (Online Video 10). The procedure was aborted. The use of 2- and 3-dimensional TEE demonstrated a large ASD with floppy irregular borders **(H and I)** (OnlineVideo 11). The patient underwent a surgical closure of the ASD without any complications. Abbreviations as in Figure 1.