Percutaneous Transjugular Device Closure of Postoperative Residual Atrial Septal Defect

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ABSTRACT: Percutaneous closure of postoperative mal aligned residual atrial septal defect was successfully performed from the transjugular approach under transesophageal echocardiography guidance in a 38-year-old symptomatic woman with patent femoral venous access using the usual hardware. This demonstrates the feasibility of transjugular approach as an alternative to femoral or transhepatic approaches in patients with difficult atrial septal anatomy who are usually referred for surgery.

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Key words: postoperative residual ASD, trans jugular approach, TEE

Though percutaneous closure is the established treatment for ostium secundum atrial septal defect (ASD), malaligned unusually located defects with adequate rims pose a challenge to the interventionist. Such defects occasionally are not amenable to closure from the femoral venous route and are referred for surgical closure. Transhepatic and transjugular approaches have been described to be useful in patients in whom femoral venous approach is not feasible. We describe the transjugular closure of a mal aligned postsurgical (supracardiac total anomalous pulmonary venous connection [TAPVC] surgical correction) residual ASD in a lady with patent femoral venous access. To our knowledge, this is the first case report of usage of this approach for a mal aligned postoperative ASD in the literature.

Case Description
A 38-year-old woman presented with history of dyspnea on exertion and regular palpitations of 6-month duration for evaluation. She had had surgery for supracardiac TAPVC 22 years prior (at 16 years of age), the records of which were not available with her. Evaluation revealed the presence of sinus rhythm, right bundle branch block, moderate pulmonary arterial hypertension (PAH), and flow across the interatrial septum, which was not well profiled from transthoracic windows, with no evidence of obstruction to the pulmonary veins. Transesophageal echocardiography (TEE) revealed the presence of a 14 x 16 mm high posterosuperior mal aligned ostium secundum residual ASD with just adequate rims for percutaneous closure (Figure 1 and Video 1). Saline contrast injection in upper limb vein confirmed drainage of superior vena cava to right atrium with mild override across the interatrial septum (Video 2). Cardiac catheterization was performed and revealed moderate PAH (PA pressures of 52/26 m34), left-to-right shunt of 1.8:1, and pulmonary vascular resistance (PVR) of 2.58 woods units. Right and left pulmonary artery injections showed laminar flow from the pulmonary veins into the common chamber and left atrium with no anomalous drainage (Videos 3 and 4). In view of the unfavorable location of the ASD for percutaneous closure, it was not done in the same sitting. The options of percutaneous closure of the defect versus surgical closure of the defect were discussed with the patient, who was keen for percutaneous closure in view of the risks of redo surgery.

One month later, the patient underwent percutaneous closure of the defect. Under general anesthesia, after loading doses of aspirin and clopidogrel, femoral venous access was obtained
and heparin (100 U/kg) was administered. Repeated attempts to cross the defect from the inferior vena cava were unsuccessful in view of the posterosuperior location of the defect. Hence, it was decided to proceed with closure from internal jugular venous (IJV) access in the same sitting. A 7 Fr introducer sheath (Medtronic Inc) was placed in the right IJV. Under TEE guidance, a 0.035" 150 cm Radifocus guidewire M (Terumo Corporation) was advanced into the left atrium (LA) from the IJV, over which a 6 Fr right coronary artery (RCA) catheter (Medtronic Inc) could be tracked into the LA. Since a 0.035" teflon wire was not supporting sheath passage into the LA, a 0.035" 260 cm Amplatz extra-stiff guidewire (Cook Corporation) was introduced via the RCA catheter. The wire was not maintaining a stable position in any of the pulmonary veins. Hence, with the wire pointing toward the LA roof, a 10 Fr Mullins sheath (Cook Corporation) with dilator was advanced into the LA. The dilator was removed with the checkflow of the sheath under water to prevent air embolism. Based on TEE assessment, a 24 mm HEART R ASD device (Lifetech Scientific) (double-disc self-centering occluder comprised of nitinol mesh with polyester fabric inside) was selected as per operator preference. The LA disc deployed pointing toward the LV inflow and withdrawn toward the septum (Figure 2) was well aligned with the defect as seen by TEE. On first deployment, the device caught all the rims with no residual flow (Figure 3). The stability of the device was confirmed by wiggling the device under fluoroscopy (Video 5) and TEE, after which it was released. Post procedure, the patient had no electrical or hemodynamic disturbances and the device remained stable at 1- and 3-month follow-up exams. The patient is on dual-antiplatelet therapy for 6 months.

Discussion
Since its introduction in 1974, percutaneous closure of ASDs has evolved to become the preferred modality of treatment of ASD. Although the devices and delivery systems are designed to be used from the femoral venous side, situations exist where femoral venous deployment is not feasible, as in inferior vena cava (IVC) interruption and thrombosis. Transhepatic deployment of the ASD device has been used in such situations with a higher incidence of complications. The transjugular approach is a potentially safer alternative, as has been shown in a few case reports in the past. However, use of this approach in patients with malaligned ASDs with a patent femoral venous access has not been described. Device closure of postoperative ASDs has also been established as a reliable alternative to redo surgery, although there are only a few published case reports. Postoperative ASDs are often malaligned and situated at unusual locations, leading to difficulty in percutaneous closure with the usual hardware from femoral venous access. Chessa et al reported successful transcatheter closure in 4 out of 5 cases with postoperative residual ASDs from femoral access. Regarding the technique of ASD closure from jugular approach, crossing the ASD and retaining a stable wire position in the LA for sheath delivery appear to be the most crucial steps for successful closure. Previous case reports of closure from this route also mention the difficulty in maintaining a pulmonary venous wire position and the feasibility of deploying the device from a sheath pointed toward the LV inflow or LA appendage. TEE plays a crucial role in not only assessing the defect but also in tracking the wire and sheath into the LA. We do not perform routine balloon sizing of the ASDs. Heat preshaped catheters and sheaths and guidewires with steerable tip may be useful in successful device deployment from this access, although it was not required in our patient. The risk of air embolism was negated by the underwater technique of removal of dilator from the sheath.

Pulmonary arterial hypertension and arrhythmias are common problems in adult postoperative residual ASD patients and influence management options. Our patient had moderate pulmonary hypertension with an acceptable PVR and was in sinus rhythm, making percutaneous closure the appropriate option.

In conclusion, the ease of performing ASD closure via jugular approach in adults with the usual hardware should make this an alternative in patients with failed femoral venous approach in unusually located malaligned ASDs with adequate rims before deciding in favor of surgical
closure. Availability of devices that require smaller sheaths for delivery may facilitate this approach in children with such ASDs as well.

References

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Supplementary materials, available at www.invasivecardiology.com

Video 1. Transesophageal echocardiogram image at mid-esophageal level bicaval view showing the relationship of the defect to superior vena cava, right atrium, and left atrium.

Video 2. Transesophageal echocardiogram image at mid-esophageal level bicaval view with saline contrast injection in upper-limb vein showing the flow from superior vena cava to right atrium with mild straddling of superior vena cava across the atrial septum.

Video 3. Left pulmonary artery injection showing the left-sided pulmonary venous return to common chamber and left atrium.

Video 4. Right pulmonary artery injection showing the right-sided pulmonary veins draining to common chamber and left atrium.

Video 5. Minnesota wiggle of the device under transesophageal echocardiogram confirming the stable device position.
Figure 1. Transesophageal echocardiogram at mid-esophageal level bicaval view showing the malaligned atrial septal defect.
**Figure 2.** Left atrial disc of the device deployed pointing toward the left ventricular inflow and withdrawn toward the septum.
**Figure 3.** The device positioned with both superior and inferior rims well caught as seen by transesophageal echocardiogram at mid-esophageal level bicaval view.