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IMAGES IN INTERVENTION

Transcatheter Closure of a Sinus Venosus Atrial Septal Defect Via Transhepatic Access

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A 43-year-old functional female patient with end-stage renal disease, history of failed kidney transplant and arteriovenous fistulas, and factor V Leiden deficiency on chronic anticoagulation experienced recurrent ischemic strokes in multiple vascular territories. She is maintained on hemodialysis via a tunneled right subclavian venous catheter. Echocardiography revealed a large right-to-left shunt, which was further characterized as a sinus venosus atrial septal defect (SVASD), without concomitant anomalous pulmonary veins (**Figure 1**, Online Videos 1 and 2).

After a detailed multidisciplinary team discussion, percutaneous closure was recommended. Peripheral access was not possible because of the chronic occlusion of the inferior vena cava and the left and right innominate veins (**Figure 2**). We contemplated using the dialysis catheter access site for the procedure but were advised against it because it was the patient's last remaining dialysis access. Hence, percutaneous hepatic access was obtained under ultrasound guidance. A micropuncture needle was introduced to the right hepatic vein, and a 6-F catheter sheath was inserted. The sheath was then upsized to a 14-F catheter Cook sheath over a 0.035-inch Amplatz extra-stiff wire (Cook, Bloomington, Indiana). The pathway to the SVASD was intricate because the chronic calcified dialysis catheter was adjacent to the defect. An Agillis sheath (St. Jude Medical, Minneapolis, Minnesota) was used to navigate the complex route into the SVASD, which was accessed with a 6-F catheter multipurpose catheter and a Glide-wire (Terumo, Tokyo, Japan). A 25-mm Cardioform septal occluder (Gore, Newark, Delaware) was advanced to

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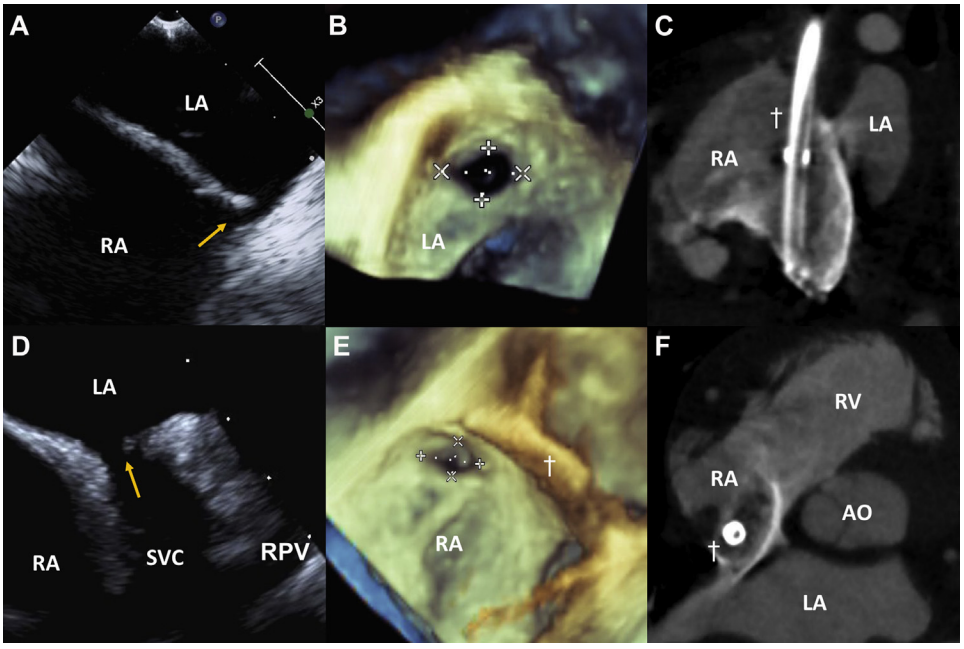
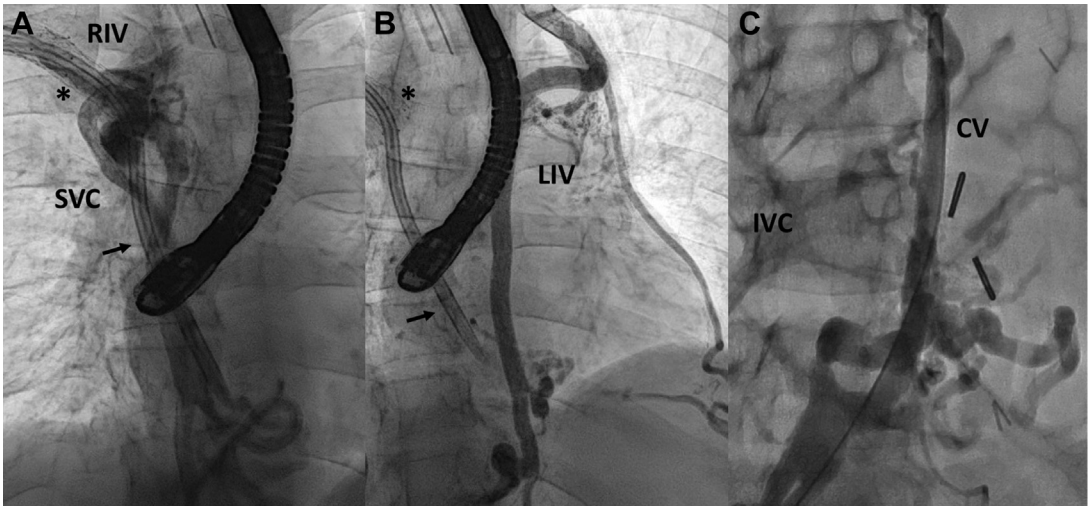
FIGURE 1 Multimodality Imaging of the Sinus Venoses Atrial Septal Defect



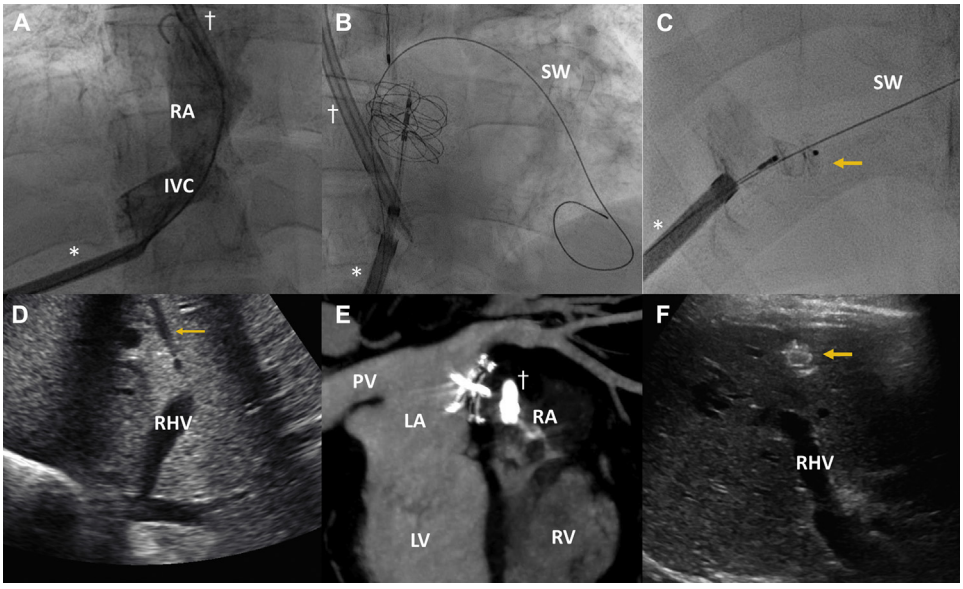
(A, D) Two-dimensional transesophageal echocardiography short and long axis views of the defect. **(B, E)** Three-dimensional transesophageal echocardiography left and right atrial views of the defect. **(C, F)** Multiplanar reconstructed computed tomography image of the defect. **Arrow** = atrial septal defect. **Dagger** = tunneled dialysis catheter. AO = ascending aorta; LA = left atrium; RA = right atrium; RPV = right pulmonary vein; RV = right ventricle; SVC = superior vena cava. See Online Videos 1 and 2.

FIGURE 2 Angiographic Illustration of the Chronic Total Occlusion of the Major Central Veins



(A) Angiography of the SVC via a 4F catheter advanced peripherally into the SVC stent (next to the dialysis catheter). **(B)** Angiography of the LIV via the left internal jugular vein. **(C)** Angiography of occluded IVC via the right femoral vein. *Superior vena cava stent. CV = collateral vein; IVC = interior vena cava; LIV = left innominate vein; RIV = right innominate vein; other abbreviations as in Figure 1. **Arrow** refers to the tunneled dialysis catheter.

FIGURE 3 **Illustration of the Closure Procedure Via a Percutaneous Hepatic Access**



(A) Angiography via a 14F catheter sheath in the right hepatic vein. **(B)** Deployment of the 25-mm Cardioform device, maintaining a 0.018-inch safety wire access because of the intricate route to the defect. **(C)** Percutaneous closure of the hepatic access site with an 8-mm AVP-II device **(arrow)**. **(D)** Ultrasound guidance for percutaneous hepatic access. **Arrow** depicts the eventual access spot. **(E)** Multiplanar reconstructed computed tomography image of the defect after device closure. **(F)** Liver ultrasound post-device closure illustrating the AVP-II closure device. **Dagger** = tunneled dialysis catheter. **Asterisk** = 14-F catheter Cook sheath. LV = left ventricle; PV = pulmonary vein; RHV = right hepatic vein; SW = safety wire; other abbreviations as in **Figure 1**. See Online Video 3.

the left atrium over an Amplatz extra-stiff wire and deployed across the SVASD (**Figure 3**, Online Video 3). The 14F catheter sheath was removed and the access site was closed with an 8-mm Amplatzer-Vascular-Plug-II (St. Jude Medical). The patient remained free of further events at 3-month follow-up.

Percutaneous hepatic access provides a viable route for adult patients with structural heart diseases and no other access. Although surgery remains the first-line treatment for SVASD, transcatheter closure is a feasible alternative in high-risk surgical candidates.

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APPENDIX For supplemental videos, please see the online version of this paper.