A 52-year-old man presented with progressive dyspnea on exertion and hemoptysis following unsuccessful cardioversion and radiofrequency ablation for paroxysmal atrial fibrillation 5 months earlier. He underwent magnetic resonance angiography and CT angiography to assess pulmonary venous anatomy and to rule out pulmonary embolism. Imaging demonstrated an occluded left-lower pulmonary vein (Figure A).

The patient underwent angiography under general anesthesia with real-time 3D transosophageal echocardiography (TEE). Initially, angiographic guidance was used to locate the occluded pulmonary vein without success. However, with a combination of real-time 3D TEE rotation and 2D TEE Doppler views, the left-lower pulmonary vein, which was “flush occluded,” was located (Figure B), and a stiff 0.014-in guidewire was used to cross the total occlusion (Figure C and D).

The left-lower pulmonary vein was recanalized and serially dilated with 2.5-mm, 5-mm, and 8-mm balloons (Figure E), and a 7×17-mm Express LD stent was placed (Figure F). After stenting, the vessel was postdilated with a 9-mm balloon. Final imaging demonstrated that the stent was patent and well seated (Figure G). Real-time 3D TEE confirmed stent positioning with adequate overlap into the left atrium (Figure H).

The patient was discharged in stable condition on a regimen of aspirin, clopidogrel, and warfarin. At 4-month follow-up, he continued to report resolution of symptoms.

Pulmonary vein stenosis occurs in 1.3% of all atrial fibrillation ablations in modern series. Although there is a paucity of literature regarding this procedure, results suggest that pulmonary vein angioplasty and stenting can result in long-term patency rates of 80% if appropriately sized (≥10-mm) stents are used and properly placed.

During structural heart interventions, 2D TEE provides important information about structures, flow, and pressure gradients, but 3D TEE imaging allows for excellent spatial and temporal resolution, which provides improved dynamic morphological assessment as well as critical imaging of the spatial relationships among structures. Live 3D enface and rotational views provide more accurate guidance of wire manipulations in real time, with better imaging and more complete information about the relative positioning of intracardiac wires and devices than 2D TEE. Three-dimensional full-volume acquisitions allow for detailed interrogation of structures from a 360° perspective, which may lead to better technical outcomes with safer and shorter procedures and a diminished amount of radiation exposure. Although angiography is adequate to locate pulmonary vein stenoses after electrophysiology ablation, this technique may not identify occluded pulmonary veins easily. This report illustrates the use of real-time 3D TEE to help locate occluded pulmonary veins for percutaneous stenting and to assess wire position and adequate stent deployment. In this particular case, real-time 3D TEE proved essential in finding the origin of a pulmonary vein that was flush occluded and could not be seen on angiography or 2D TEE alone. Consideration should be given to this modality for use during structural heart interventions as a complement to real-time 2D TEE and fluoroscopic imaging.

Disclosures
None.

References

Key Words: Angiography ■ pulmonary veins ■ transosophageal echocardiography

Images and Case Reports in Interventional Cardiology

Use of Real-Time 3D Transosophageal Echocardiography in Percutaneous Intervention of a Flush-Occluded Pulmonary Vein

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Figure. A, An MRI image showing both arterial and venous phases of filling. A paucity of pulmonary vasculature is seen in the area normally supplied by the left-lower pulmonary vein (white arrow), suggesting occlusion. B, Real-time 3D TEE of the left pulmonary venous system (rotated image) revealing the origin of the occluded left-lower pulmonary vein (top orifice) in relation to the patent left-upper pulmonary vein (bottom orifice). C, Angiographic image revealing wire passage through an occluded left-lower pulmonary vein. D, Real-time 3D TEE assisting in wire passage through the occluded left-lower pulmonary vein orifice. E, Appearance of pulmonary vein after balloon dilation. F and G, The lesion is successfully dilated with a 5×40-mm Invatec Submarine Plus balloon and then successfully stented with an 8×20-mm Sterling stent, with resolution of flow. H, Real-time 3D TEE image of the stent well seated in the left-lower pulmonary vein.
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