Successful occlusion of left atrial appendage after failed surgical ligation utilizing 4-dimensional intracardiac echocardiography

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Introduction

Patients with surgical left atrial appendage (LAA) ligation that still have clinically significant LAA communication with the left atrium (LA) are at an increased risk of cardioembolic stroke. Anticoagulation is the mainstay treatment for these patients. However, those who have contraindications to anticoagulation have limited options. Few cases have reported successful LAA closure device implant via transesophageal echocardiography (TEE) guidance; however, for those with contraindications to TEE, no alternative options have been reported. Herein we report a case of a successful LAA occlusion achieved using a novel approach to help guide device deployment and cannulate the partially ligated LAA ostium using 4-dimensional (4D) intracardiac echocardiography (ICE) imaging.

KEY TEACHING POINTS

- There exist alternative options to oral anticoagulants for the prevention of cerebrovascular accident in atrial fibrillation patients who had unsuccessful surgical left atrial appendage (LAA) ligation.
- LAA occlusion using 4-dimensional intracardiac echocardiography is a feasible strategy following unsuccessful surgical LAA ligation.
- LAA occluder implant following failed surgical LAA ligation can be safely and successfully performed.

Case report

An 80-year-old female patient was referred to the electrophysiology department for evaluation of an elective LAA occlusion after an unsuccessful surgical LAA ligation for atrial fibrillation that was performed approximately 5 years prior at the time of coronary artery bypass graft (CABG) surgery. The patient had a past medical history significant for nonvalvular paroxysmal atrial fibrillation, cerebrovascular accident, congestive heart failure, CABG status post single-vessel saphenous vein graft in 2017, and mitral regurgitation status post replacement with a 29 mm mosaic bioprosthetic valve in 2017.

CHA_2DS_2-VASc score was 7 and an alternative to long-term oral anticoagulation was sought owing to the patient's history of recurrent gastrointestinal bleeding owing to arterial venous malformation. In 2018 she underwent concomitant LAA surgical ligation (via purse-string closure method) and was continued on anticoagulation for 6 months postoperatively with direct oral anticoagulation (DOAC). In 2019, coronary computed tomography angiography (CCTA) demonstrated residual communication between the LA and the LAA, for which DOAC therapy was reinitiated. In 2020, the patient developed melanotic stools and underwent colonoscopy and esophagogastroduodenoscopy, which revealed a polyp in the gastric fundus and arteriovenous malformation (AVM) in the duodenal bulb. In view of these findings, the patient was hesitant to resume anticoagulation for cardioembolic stroke. She was eventually restarted on anticoagulation with DOAC in 2021 but developed recurrent melanotic dark stools. She underwent repeat esophagogastroduodenoscopy and colonoscopy in 2022, with findings of pandiverticulosis, but no acute evidence of pathology was found to explain her acute bleeding. AVMs were suspected in the small intestine and anticoagulation was discontinued.

The patient underwent CCTA (Figure 1) LAA protocol to evaluate the LAA for occluder device options, as well as TEE

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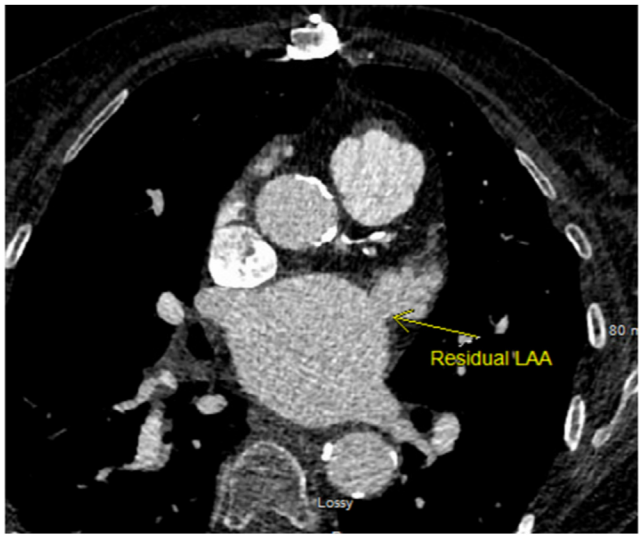

Figure 1 Coronary computed tomography angiography demonstrated residual communication between the left atrium and the left atrial appendage (LAA).

(Supplemental Figure 1), which noted residual LAA. CCTA demonstrated the LAA was partially ligated surgically with residual communications between the left atrium and LAA, with residual ostium with a maximal diameter of 11 mm and minimum diameter of 9 mm. The LAA minimal depth was 19 mm, and no LAA thrombus was noted. The decision was made to attempt occlusion using a Watchman FLX (Boston Scientific, Marlborough, MA) device with the guidance of 4D ICE. Femoral venous cannulation was performed in the usual manner. Initially, the 4D ICE catheter was advanced into the right ventricle and LAA thrombus was excluded. Transseptal puncture was then performed under 4D ICE guidance. A pigtail wire was positioned in the LA via the transseptal sheath. The sheath was withdrawn to the right atrium and the 4D ICE catheter was pushed across the puncture site into the LA using both echocardiographic and fluoroscopic imaging. A fixed double-curve delivery sheath was prepped and advanced over the pigtail wire and positioned in the LA. The 4D ICE catheter was positional along the mitral valve annulus for optimal imaging. Multiplanar and 3-dimensional imaging was obtained. Orthogonal views were obtained to help guide cannulation of the partially ligated LAA ostium. The partially ligated ostium was visualized (Figure 2) and measured to be 6 mm by the 4D ICE catheter. A pigtail catheter was advanced and a stiff wire was used to partially straighten the tip of the catheter. Under ICE guidance, the catheter cannulated the partially ligated LAA (Supplemental Video 1). Once inside the LAA, the wire was removed, and the pigtail catheter was used as a rail to deliver the sheath through the ostial narrowing. The pigtail was then removed, and the 20 mm Watchman FLX (Boston Scientific, Marlborough, MA) device was prepped and advanced under fluoroscopic guidance. The device was unsheathed (Supplemental Video 2) and released after confirming proper position, anchor, size, and seal criteria (Figure 3).

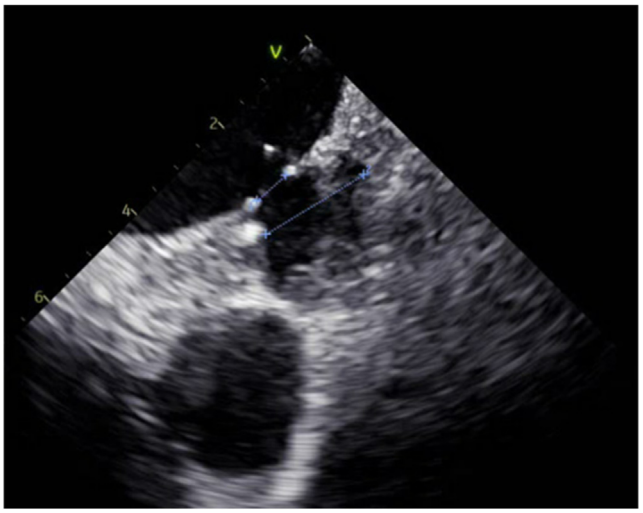

Figure 2 Four-dimensional intracardiac echocardiography catheter in left atrium used for final measurements of left atrial appendage occluder device.

Approximately 10% compression was observed, and postdeployment angiography did not demonstrate any evidence of peri-device leak (Supplemental Videos 3 and 4). Postimplant 45-day TEE (Supplemental Video 5) demonstrated a well-seated device with complete LAA closure and no evidence of device-related thrombus or peri-device leak. The patient was successfully able to discontinue their DOAC in view of these findings.

Discussion

Atrial fibrillation is a supraventricular arrhythmia characterized by an irregularly irregular rhythm that is prevalent in up to 33.5 million individuals globally. The chaotic electrical signals in atrial fibrillation result in a heterogenic conduction pathway that causes ineffective atrial contraction.[1] The LAA is the vestigial remnant of the primordial LA and is thought to function as a static decompression chamber during ventricular systole. Variations in forward flow, relative stagnation

Figure 3 Left atrial appendage Watchman (Boston Scientific, Marlborough, MA) post deployment.

owing to the location, and extensive atrial trabeculations result in a high risk for thrombogenesis.[2,3] Compared to the general population, patients with atrial fibrillation are at an increased risk of stroke.[4] Atrial fibrillation accounts for 15% of strokes in all age groups and 30% in those over the age of 80.[2]

Patients with atrial fibrillation undergoing cardiothoracic surgery (eg, CABG or valve repair) will usually have their LAA surgically excised.[5] Retrospective analysis has shown that surgical ligation success depends on the technique used by the surgeon, with the highest LAA closure success at 87% in patients who had LAA excision.[6] Patients with surgical LAA ligation who still have clinically significant LAA communication with the LA are at an increased risk of cardioembolic stroke, and anticoagulation is the mainstay treatment for these patients. However, our patient was at an increased risk of gastrointestinal bleeding owing to AVMs. In this case, successful LAA occlusion was achieved using a novel approach to help guide device deployment and cannulate the partially ligated LAA ostium using 4D ICE imaging. The 4D ICE catheter obtains 2-dimensional and 3-dimensional volumetric images and cine-videos in real time.[7] Four-dimensional ICE can be used to exclude LAA thrombus and guide device deployment, including intracardiac positioning, sizing, anchoring, and sealing. It can also be used to detect peri-device leaks and assess for intraprocedural complications such as pericardial effusions. Successful LAA occluder implant can be achieved in complicated cases such as failed surgical ligation with the use of 4D ICE imaging.

Conclusion

LAA occlusion using 4D ICE guidance is a novel and feasible strategy that should be considered to achieve long-term stroke prevention in patients with atrial fibrillation. LAA occluder implantation in complicated cases, such as after failed surgical ligation therapy, can be safely and successfully performed in patients under the guidance of a 4D ICE catheter.

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Appendix

Supplementary Data

Supplementary data associated with this article can be found in the online version at https://doi.org/10.1016/j.hrcr.2023.09.019.

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