Double Trouble: A Bifid Left Atrial Appendage Requiring a Double Lobe-and-Disk Device Approach

Brian Hsia, MD, Daniel Bamira, MD, Lior Jankelson, MD, PhD, Anthony Aizer, MD, MS, Larry Chinitz, MD, and Muhamed Saric, MD, PhD, *New York, New York*

INTRODUCTION

Oral anticoagulants are preferred for patients with atrial fibrillation (AF) and elevated thromboembolic risk. The majority of cardioembolic events attributed to AF originate from the left atrial appendage (LAA) due to decreased contractility.[1] Thus, the most recent set of guidelines for nonvalvular AF state that patients who cannot tolerate anticoagulation due to a nonreversible cause are candidates for transcatheter LAA device closure.[2]

However, LAA anatomy is highly variable among patients. Multiple LAA morphologies—including chicken wing, wind sock, cauliflower, and cactus—have been identified in patients, as well as different numbers of LAA lobes.[1,3] These differences have procedural implications when pursuing LAA device closure. Multimodality imaging is required to optimize appropriate device selection and sizing. We present a case of a patient with a unique, bifid LAA, requiring 2 side-by-side lobe-and-disk devices for successful LAA closure.

CASE PRESENTATION

An 85-year-old patient presented to their outpatient cardiologist for recurrent falls. They had a history of paroxysmal nonvalvular AF, hypertension, stroke, severe aortic stenosis status post–transcatheter aortic valve implantation with a 29 mm self-expanding prosthesis, and complete heart block status post-dual-chamber permanent pacemaker.

They were receiving apixaban 2.5 mg twice daily for stroke prevention for the nonvalvular AF. Their CHA_2DSV_2ASc score was calculated to be 6, and HAS-BLED score was 3. Given their high calculated risk for both stroke and bleeding, as well as recurrent falls on anticoagulation, they were referred for placement of an LAA occlusion (LAAO) closure device. Their most recent preprocedure left atrial size was not dilated, with a left atrium volume index of 27 mL/m^2.

Preprocedural and intraprocedural transesophageal echocardiography (TEE) was performed with a three-dimensional (3D)-capable probe. Preprocedural cardiac computed tomography (CCT; Figure 1) and two-dimensional (2D) TEE (Videos 1-4, Figure 2) demonstrated an LAA with a prominent, centrally located pectinate muscle. Initially, LAA closure with a single 25 mm lobe-and-disk device proximal to the pectinate muscle was attempted but failed. Additional 3D TEE imaging demonstrated bifid LAA morphology with 2 lobes adjacent to each other (Figures 3 and 4). Despite multiple attempts, a single device was not well seated in the LAA with the disk

VIDEO HIGHLIGHTS

Video 1: Preprocedure 2D TEE, mid-esophageal zoomed image at 0°, demonstrates the LAA anatomy.

Video 2: Preprocedure 2D TEE, mid-esophageal zoomed image at 45°, demonstrates the LAA anatomy.

Video 3: Preprocedure 2D TEE, mid-esophageal zoomed image at 91°, demonstrates the LAA anatomy.

Video 4: Preprocedure 2D TEE, mid-esophageal zoomed image at 146°, demonstrates the complex LAA anatomy with a prominent pectinate muscle dividing the appendage into 2 similar sized lobes.

Video 5: Preprocedure 3D TEE, mid-esophageal volume-rendered reconstruction en face view of the LAA from the perspective of the left atrium, demonstrates bifid morphology with 2 separate orifices.

Video 6: Intraprocedure 2D TEE, mid-esophageal simultaneous orthogonal zoomed images (left, 0°; right, 90°), demonstrates the side-by-side deployment (within the *dashed yellow circle*) of two 16 mm lobe-and-disks still attached to their catheters.

Video 7: Intraprocedure 2D TEE, mid-esophageal zoomed image (0°), demonstrates that the lobe-and-disk, side-by-side devices pass the tension test and remain secure within their proper position.

Video 8: Postprocedure 2D TEE, mid-esophageal zoomed image (169°), demonstrates the fully deployed side-by-side devices with their attached positioning catheters removed.

Video 9: Postprocedure 3D TEE, mid-esophageal volume-rendered reconstruction en face view of the LAA from the perspective of the left atrium, demonstrates the fully deployed, properly positioned side-by-side devices.

Video 10: Postprocedure 2D TEE, mid-esophageal zoomed image (0°) with color-flow Doppler (reduced Nyquist limit, 38.5 cm/sec), demonstrates no peridevice leak at this immediate postprocedure time point.

View the video content online at www.cvcasejournal.com.

From the Leon H. Charney Division of Cardiology, NYU Langone Health, New York, New York.

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Correspondence: Brian Hsia, MD, Leon H. Charney Division of Cardiology, NYU Langone Health, 530 1st Ave, HCC 7th Floor, New York, NY 10016 (E-mail: *Brian.Hsia@nyulangone.org*).

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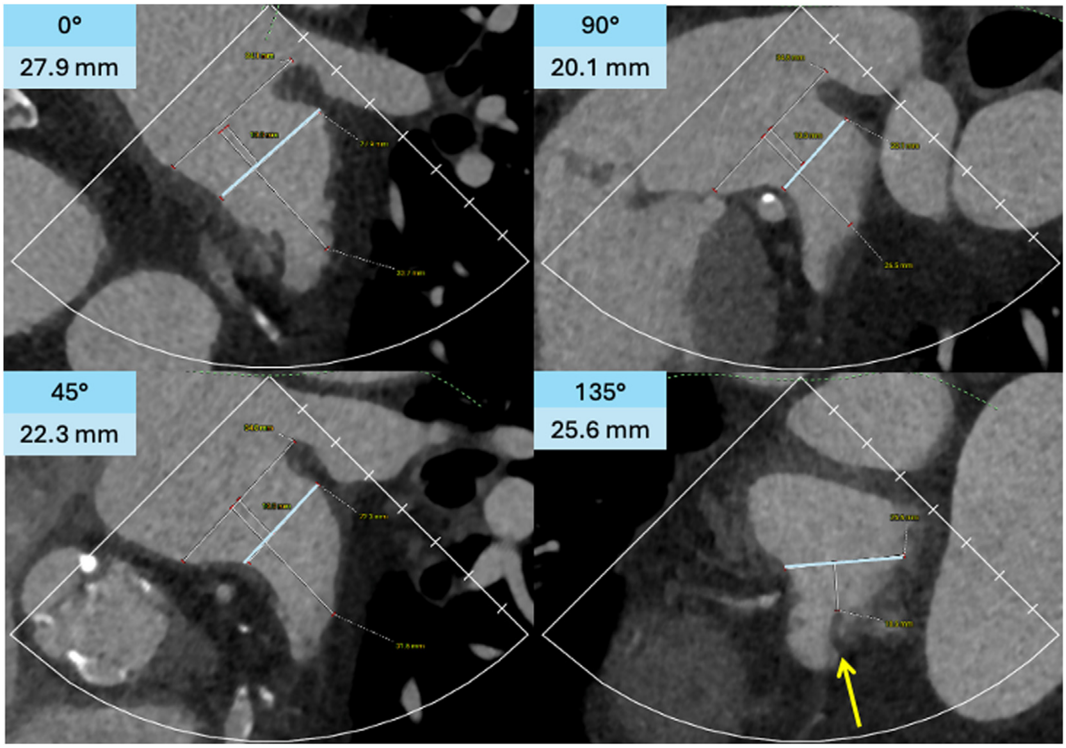

Figure 1 Preprocedure CCT, multiplanar reconstruction axial displays of the LAA to assist with sizing for placement of a transcatheter LAAO device, demonstrates the LAA anatomy as seen in 4 conventional TEE views (0°, 45°, 90°, 135°) and landing zone diameters (*blue lines*); the complex bifid LAA anatomy with the large central pectinate muscle is best seen at 135° (*arrow*).

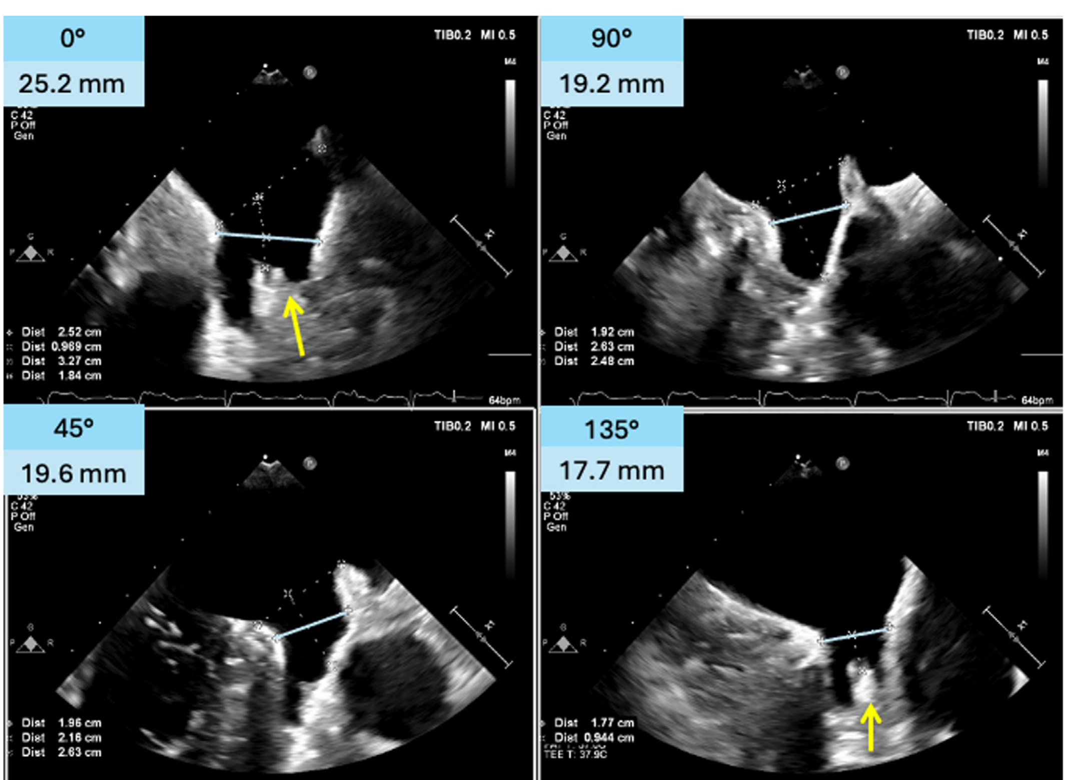

Figure 2 Preprocedure 2D TEE, mid-esophageal zoomed images displayed in 4 conventional TEE views (0°, 45°, 90°, and 135°) to assist with sizing for placement of a transcatheter LAAO device, demonstrates the LAA anatomy and landing zone diameters (*blue lines*); the complex bifid LAA anatomy with the large central pectinate muscle is best seen at 0° and 135° (*arrows*).

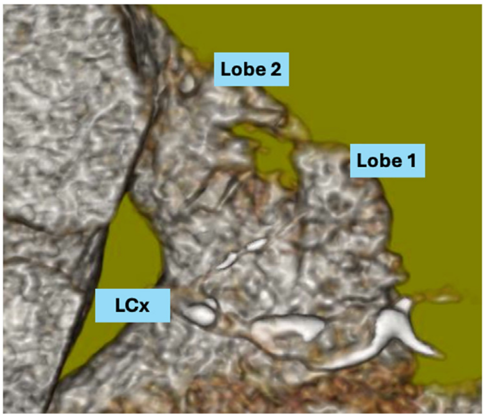

Figure 3 Preprocedure CCT, volume-rendered reconstruction of the LAA in the right anterior oblique (RAO) caudal projection, demonstrates the complex bifid LAA morphology. *LCx*, Left circumflex coronary artery.

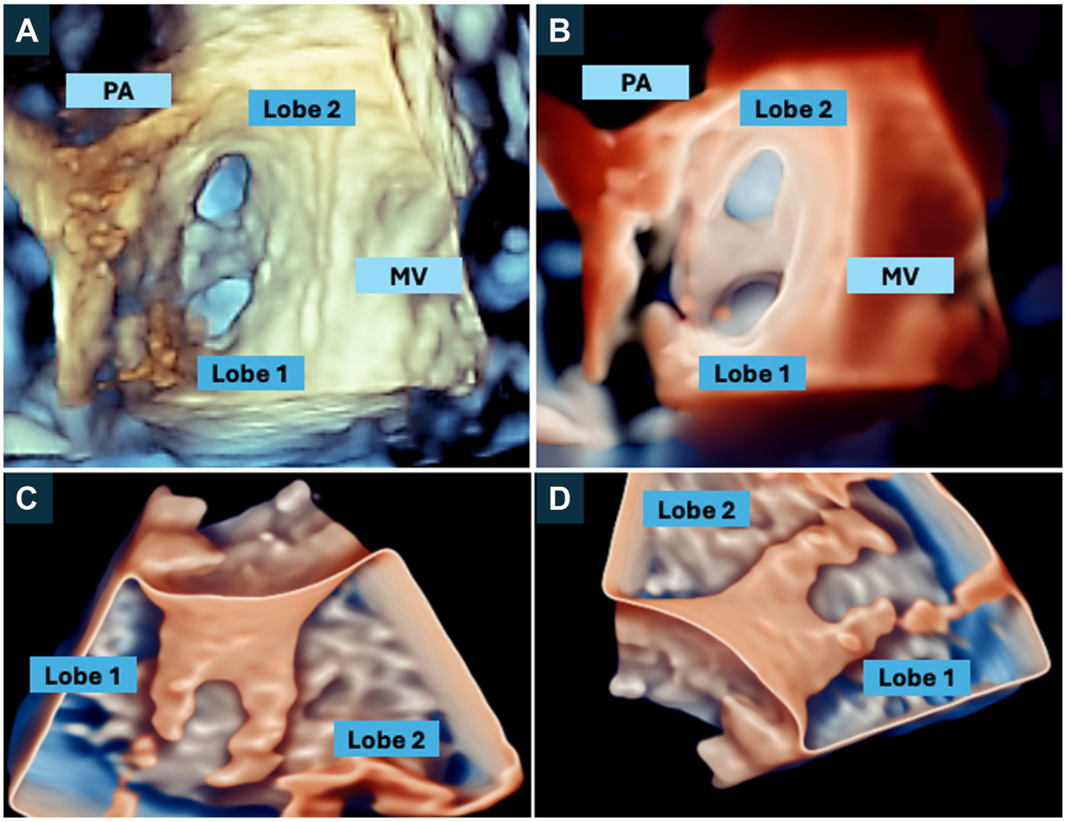

Figure 4 Preprocedure 3D TEE, mid-esophageal conventional **(A)** and light-source manipulation **(B)** volume-rendered reconstruction of the LAA from the perspective of the left atrium, demonstrates complex bifid morphology of the LAA with 2 separate, equal-sized orifices, leading to a change in procedural planning from deploying 1 large lobe-and-disk device to deploying 2 smaller lobe-and-disk devices; additional 3D transillumination technology volume-rendered reconstruction was performed to demonstrate the bifid morphology of the LAA in the 135° 2D TEE view **(C)** and the representative fluoroscopic RAO caudal view **(D)**. *MV*, Mitral valve; *PA*, pulmonary artery.

protruding into the left atrial cavity, likely due to the central prominence dividing the 2 lobes of the LAA.

Given the atypical anatomy and failed prior attempt to place a single large 25 mm lobe-and-disk device, the procedural strategy was altered. We deployed 2 side-by-side 16 mm lobe-and-disk devices for successful closure. We initially identified the 2 lobes of the LAA under fluoroscopy with radio-opaque contrast (Figure 5A). We subsequently deployed the 2 lobes of the 16 mm devices sequentially into 2 separate landing zones of the bifid LAA lobes (Figure 5B). Finally, the 2 disks of the devices were deployed sequentially with their final orientation interlocked over each other (Figure 5C).

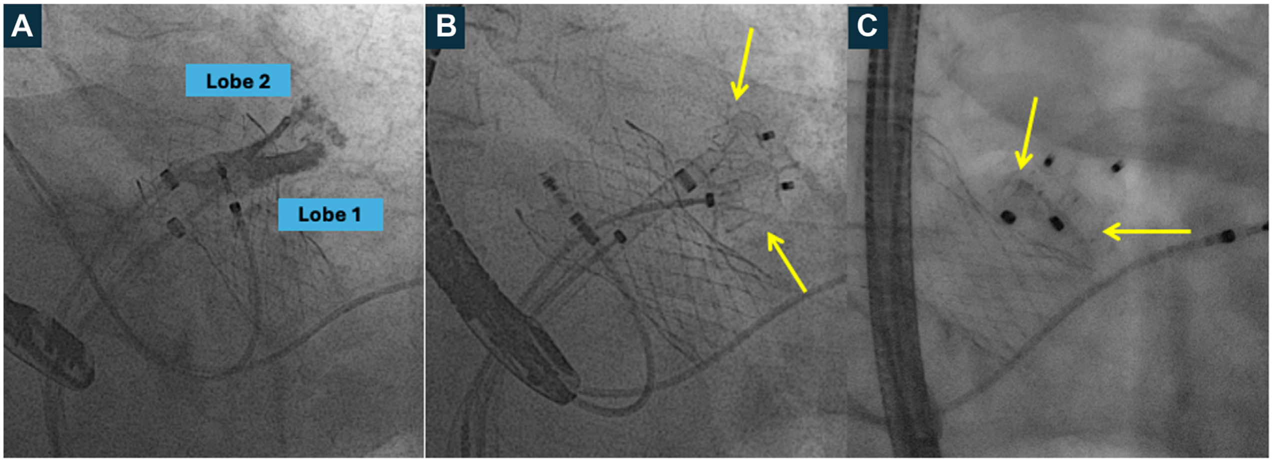

Figure 5 X-ray fluoroscopic RAO, caudal views obtained pre- **(A)**, intra- **(B)**, and postprocedure **(C)**, demonstrates the complex bifid LAA morphology, with the two 16 mm lobe-and-disk devices positioned side-by-side (*arrows*) and after being fully deployed with the disks overlaying each other; the dual-chamber pacemaker leads and transcatheter aortic valve implantation are also seen.

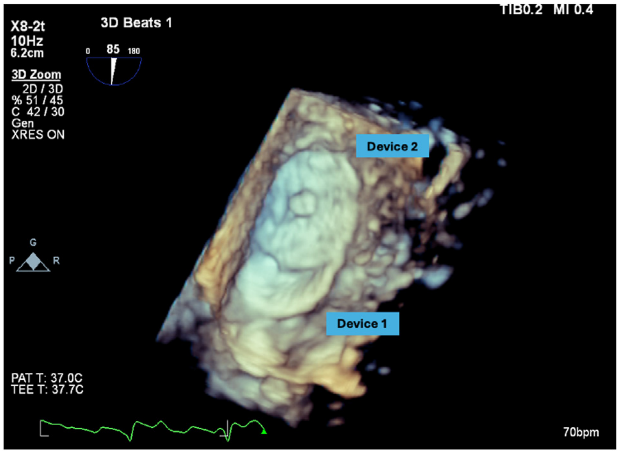

Figure 6 Postprocedure 3D TEE, mid-esophageal volume-rendered reconstruction en face diastolic view of the LAA from the perspective of the left atrium demonstrates the fully deployed devices in a side-by-side position.

The placement of the adjacent lobe-and-disk devices was confirmed with 2D TEE simultaneous biplane (Video 6). Both devices were placed under tension without displacement from the LAA, passing the tension test (Video 7). Catheters were subsequently removed, and the final position at the end of the case was confirmed by both 2D and 3D TEE imaging (Videos 8-9, Figure 6). With the application of color-flow Doppler, we demonstrated the absence of peridevice leak (Video 10).

DISCUSSION

Understanding the role of multimodality imaging is crucial as the volume of LAAO device procedures increases. Imaging aids in procedural success, while also potentially mitigating both early and late postprocedural complications.[3,4] Preprocedural CCT and 2D and 3D TEE imaging allows for proper device selection best suited for an individual patient's LAA anatomy. A more common example includes those with a "chicken wing" morphology, which poses difficulties due to its short neck, often requiring a specialized technique for closure.[3-5] Additionally, precise measurements of orifice and landing zone diameters and depth on preprocedural imaging allow for device oversizing, which has been associated with fewer composite peridevice leaks and device migration and embolization.[6]

Intraprocedural imaging with 2D TEE, 3D TEE, and fluoroscopy provides live, real-time feedback both for safe catheter manipulation to avoid damaging anatomic structures and for optimal device placement. Confirming device placement intraprocedurally is critical in preventing device-related thrombus as recent studies demonstrate that a deep or off-axis position may predispose toward clot formation.[7-9]

This case emphasizes these critical benefits associated with multimodality imaging in LAAO device placement. This specific bifid LAA morphology is an uncommon variant but has been previously described in a prior case series and occasionally encountered in clinical practice.[10] In this specific case, a single lobe-and-disk device was unstably seated due to the central prominence dividing the 2 lobes of the LAA. While this was somewhat appreciated on the preprocedural CCT, the full implications of this morphology were better comprehended on 3D TEE. Thus, troubleshooting the unsuccessful initial approach with a single device required integration of the patient's preprocedural CCT and intraprocedural TEE imaging.

One other case series has described a similar technique to close bifid LAA using dual LAAO devices but of a lobe-only design.[11] The authors demonstrated stable device position in the majority of patients at 2 years. However, few others have demonstrated this technique with lobe-and-disk designs. Our case shows that this technique is applicable across a broader range of devices and not unique to a single device.

This case demonstrates that multimodality imaging is useful to provide comprehensive understanding of the complex LAA anatomy, offers real-time feedback to the proceduralist deploying the device, and allows innovative procedural modification for challenging morphologies.

CONCLUSION

This case demonstrates the importance of preprocedural and intraprocedural multimodality imaging for characterizing precise LAA morphology and highlighting potential barriers for LAAO device deployment.

ETHICS STATEMENT

The authors declare that the work described has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for experiments involving humans.

CONSENT STATEMENT

Complete written informed consent was obtained from the patient (or appropriate parent, guardian, or power of attorney) for the publication of this study and accompanying images.

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DISCLOSURE STATEMENT

The authors reported no actual or potential conflicts of interest relative to this document.

SUPPLEMENTARY DATA

Supplementary data related to this article can be found at https://doi.org/10.1016/j.case.2025.05.002.

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