

The Double-Orifice Left Atrial Appendage: Multimodality and Virtual Transillumination Imaging



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INTRODUCTION

The left atrial appendage (LAA) is a small pouch extending from the left atrium that is embryologically derived from the primitive atrium. It is the predominant source of thromboemboli in patients with atrial fibrillation (AF) and without rheumatic heart disease.^{1,2} We present a rarely reported case of an LAA with a double-orifice membrane as imaged using three-dimensional (3D) transesophageal echocardiography (TEE) and cardiac computed tomography (CCT).

CASE PRESENTATION

A 63-year-old man with a history of persistent AF and a rate-related cardiomyopathy was referred for radiofrequency ablation. The patient was treated with systemic anticoagulation therapy. He had no history of any surgical or invasive procedures. He presented for preprocedural TEE and CCT.

Two-dimensional TEE revealed a thin linear echodensity traversing the LAA ostium, and color Doppler demonstrated blood flow between the LAA and the left atrium (Figure 1, Video 1). Three-dimensional TEE with photorealistic transillumination with variable light source and transparency (TrueVue; Philips Healthcare) along with color Doppler revealed that the LAA had a “chicken wing” morphology, with a membrane at the ostium with two distinct orifices (Figure 2, Video 2).

There was no thrombus in the LAA or the left atrium. Preprocedural CCT with contrast was also performed and demonstrated the double-orifice LAA membrane (Figure 3), with orifice areas of 15.2 and 24.4 mm² using 3D volume rendering and multiplanar reconstruction imaging. The patient underwent successful radiofrequency ablation of AF and has been maintained on oral anticoagulation without embolic events.

DISCUSSION

Developmental abnormalities of the LAA are rare but have been reported, ranging from congenital absence of the LAA³ to LAA

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Keywords: Transesophageal echocardiogram, Cardiac computed tomography, Atrial fibrillation, Left atrial appendage, Adult congenital heart disease

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VIDEO HIGHLIGHTS

Video 1: Two-dimensional (2D) TEE and color Doppler. Two-dimensional TEE, midesophageal long-axis (90°) view with color flow Doppler, demonstrating the LAA membrane (*arrow*) with bidirectional flow between the left atrium (LA) and the LAA. *LV*, Left ventricle.

Video 2: Three-dimensional TEE, TrueVue display. Three-dimensional TEE, en face view of the double-orifice LAA (*arrow*). *AV*, Aortic valve; *MV*, mitral valve.

Video 3: Three-dimensional TEE with TrueVue transillumination. A series of 3D transesophageal echocardiographic images demonstrating the value of various techniques of LAA transillumination, including TrueVue, TrueVue Glass, increased transparency, light-source repositioning, plane cropping, and rotation, to enhance the visualization of the double-orifice LAA.

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

aneurysm.⁴ There have also been rare reports of LAA membranes involving the LAA orifice.⁴ Although there is no formal definition currently, these LAA membranes may be complete or partial and obstructive or nonobstructive. Recent reports demonstrate the clinical utility of transillumination in improving the visualization of anatomic details on echocardiography.^{5,6} Three-dimensional transillumination with variable light source and transparency enhances detection of edges on 3D TEE and allows blood pool imaging, which enables 3D anatomic views of the LAA (Video 3). We postulate that 3D TEE transillumination along with color Doppler may assist in the diagnosis and characterization of LAA membranes.

It has been suggested that the physiology of an LAA membrane is similar to a failed surgical ligation or a percutaneous LAA exclusion/occlusion device leak, possibly promoting stasis and clot formation,⁷ but the effects of orifice size or LAA emptying velocities are unknown. In our patient, there was no associated thrombus, and he was continued on long-term anticoagulation after ablation.

Last, it is also unknown whether there is an association between LAA membranes and AF or if these membranes are found incidentally when the LAA is evaluated in patients with AF because of a sampling bias. Given the rarity, the clinical significance is unknown, and the management is unclear. Further research is required to classify the various morphologies, follow longitudinal outcomes, and analyze tissue histopathology.

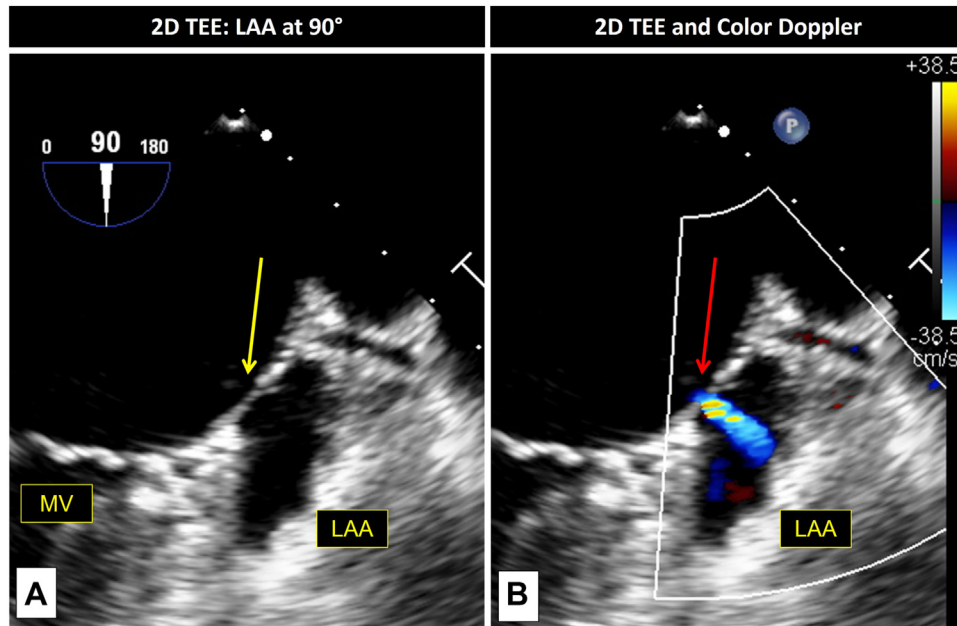


Figure 1 Double-orifice LAA on two-dimensional (2D) TEE. Two-dimensional, zoomed TEE, midesophageal long-axis view of the LAA (90°) without **(A)** and with **(B)** color flow Doppler, demonstrating a thin membrane (yellow arrow) across the orifice with flow between the left atrium and the LAA (red arrow). *MV*, Mitral valve.

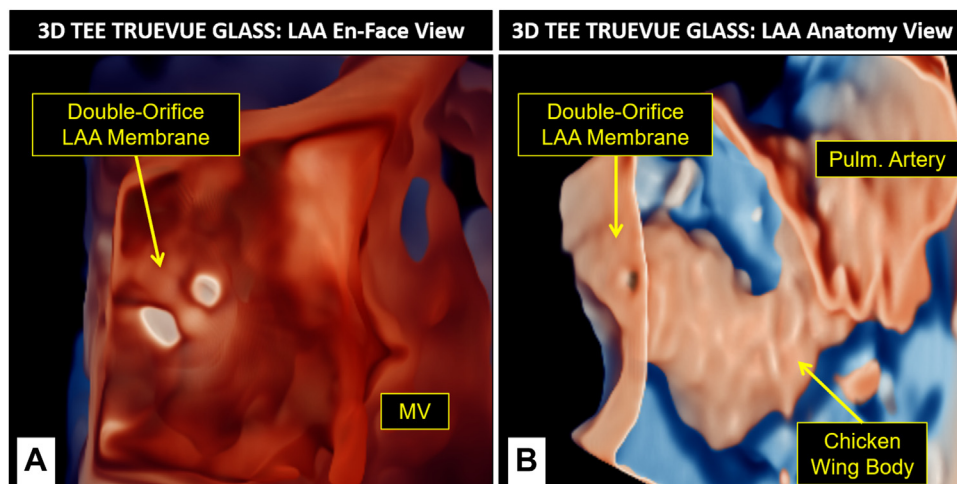


Figure 2 Double-orifice LAA on 3D TEE. **(A)** Three-dimensional TEE, en face display of the LAA membrane with TrueVue and light source positioned inside the LAA body, transilluminating the double-orifice LAA. **(B)** Three-dimensional TEE with TrueVue anatomy display of the LAA, demonstrating a chicken-wing morphology. *MV*, Mitral valve; *Pulm.*, pulmonary.

CONCLUSION

We present multimodality imaging of a double-orifice LAA due to a LAA orifice membrane using two-dimensional and 3D TEE transillumination and CCT. This is a rarely reported case of multimodality imaging of such anatomy and could contribute to our future understanding of this rare entity.

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

The authors declare that since this was a non-interventional, retrospective, observational study utilizing de-identified data, informed consent was not required from the patient under an IRB exemption status.

FUNDING STATEMENT

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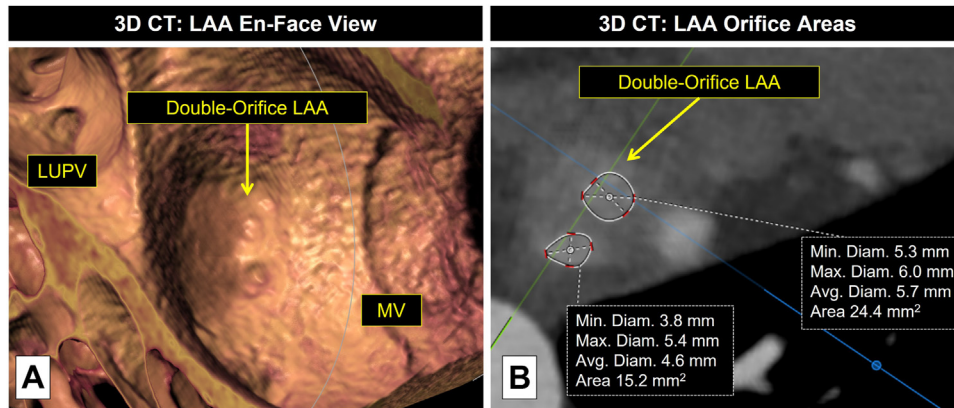


Figure 3 Double-orifice LAA on CCT. **(A)** CCT, 3D volume-rendered display of the left atrium and LAA, en face view, demonstrating the double-orifice LAA (arrow). **(B)** CCT, multiplanar reconstruction display, demonstrating detailed measurements of the two orifices of the LAA (arrow; 15.2 and 24.4 mm²). Avg., Average; CT, computed tomography; Diam., diameter; LUPV, left upper pulmonary vein; Max., maximum; Min., minimum; MV, mitral valve.

DISCLOSURE STATEMENT

The authors report no conflict of interest.

SUPPLEMENTARY DATA

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.case.2023.04.009>.

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