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Case Report

Overcoming Whale Tail Anatomy: Cardiac CT-Guided LAA Occlusion Using the Sandwich Deployment Technique

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Abstract

anticoagulation. However, anatomical variants such as the bilobar "whale-tail" morphology pose unique challenges for successful percutaneous exclusion. We present a case in which multimodality imaging, including transesophageal echocardiography (TEE), 3D reconstruction, and cardiac computed tomography angiography (CTA)—was critical for procedural planning and execution. A tailored "sandwich" deployment technique, previously described in chicken-wing morphologies, was adapted to achieve secure closure of the whale-tail LAA. To our knowledge, this represents the first reported case of this technique being employed for this specific configuration. This case illustrates the importance of individualized, image-guided strategies in managing anatomically complex LAA morphologies and expands the application of advanced closure techniques.

Kew Words: left atrial appendage; whale tail morphology; cardiac computed tomography; sandwich deploy technique

Introduction

An 83-year-old man was referred for non-pharmacologic stroke risk reduction in atrial fibrillation due to recurrent falls and head trauma, without intracranial bleeding. His CHA_2DS_2-VASc score was 5 and HAS-BLED score 4.

Transesophageal echocardiography (TEE) revealed a whale-tail morphology of the left atrial appendage (LAA) (Figures 1 and 2), with a shallow superoanterior lobe and an inferior lobe with a narrow neck. An inferoposterior transseptal puncture was attempted, but resulted in unstable device positioning with persistent patency of the superoanterior lobe. The procedure was aborted after failure to meet Amulet CLOSE criteria (Figure 3).

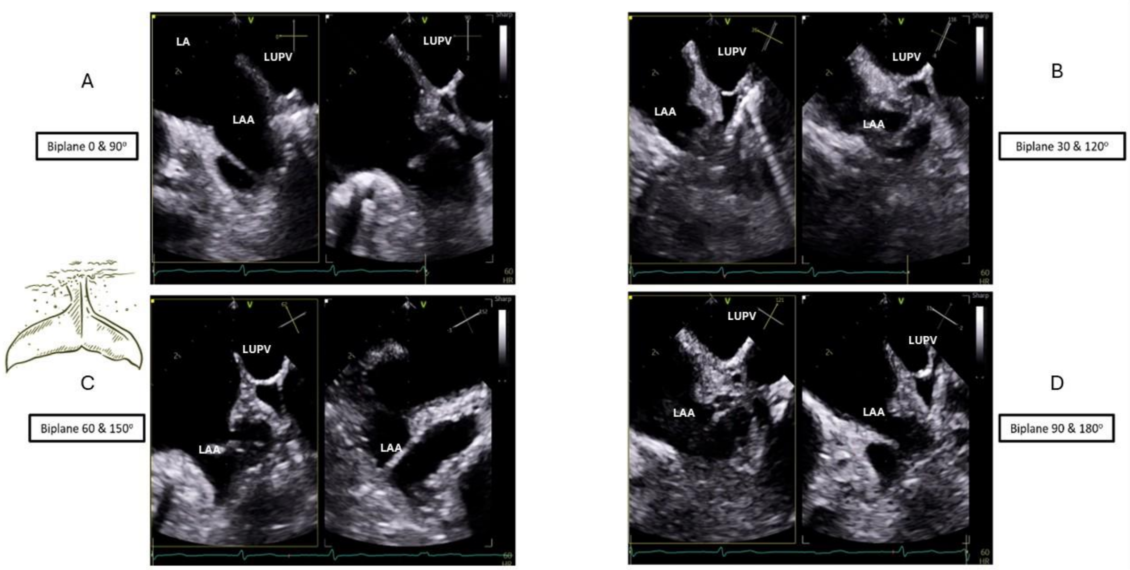

Figure 1: 2D Transesophageal multiplane images at different angles**. Figure 1C and 1D** demonstrating the whale-tail appendage morphology.

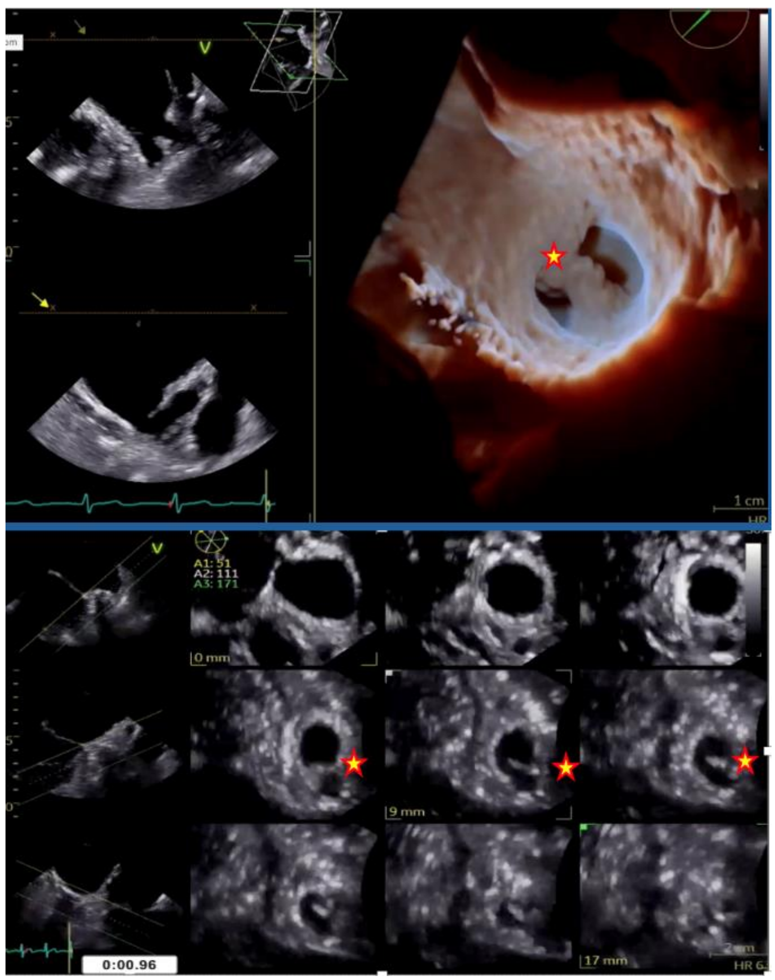

Figure 2: Multimodality transesophageal echocardiographic assessment of the mitral valve.

Top panel: Real-time 3D TEE en face view of the left atrial perspective demonstrating the whale tail morphology (★). Bottom panel: Multislice reconstruction of 3D TEE dataset shows detailed short-axis views at the level of the LAA ostium to the tip.

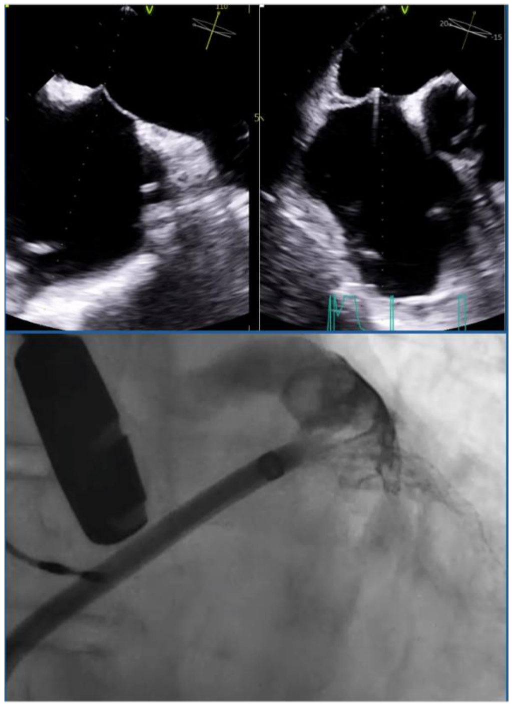

Figure 3: Multimodality imaging of a whale-tail left atrial appendage (LAA). Top Row: TEE images at the time of the orginal transseptal puncture - inferior and posterior.Bottom row: fluoroscopic frame showing contrast injection into a bilobar whale-tail LAA via a delivery sheath with significant opacification of one of the lobes. Note the bilobar structure and narrow neck of the inferior lobe, targeted for lobe anchoring in the sandwich technique.

While the sandwich technique has been reported in patients with chicken wing LAA morphology (Sogabe et al., 2021), whale-tail anatomy remains a procedural challenge. Prior cases have required separate devices for each lobe, increasing the risk of embolization and complexity (Hecht, 2021).

Cardiac CT angiography (CTA) confirmed the bilobar morphology and revealed that the inferior lobe had a chicken wing configuration with a narrow neck, suitable for Amulet lobe deployment. CTA also facilitated planning of a more anterior-superior transseptal puncture (Figures 4 and 5) and informed the use of the sandwich technique—deploying the lobe into the inferior lobe and positioning the disc over the superoanterior lobe.

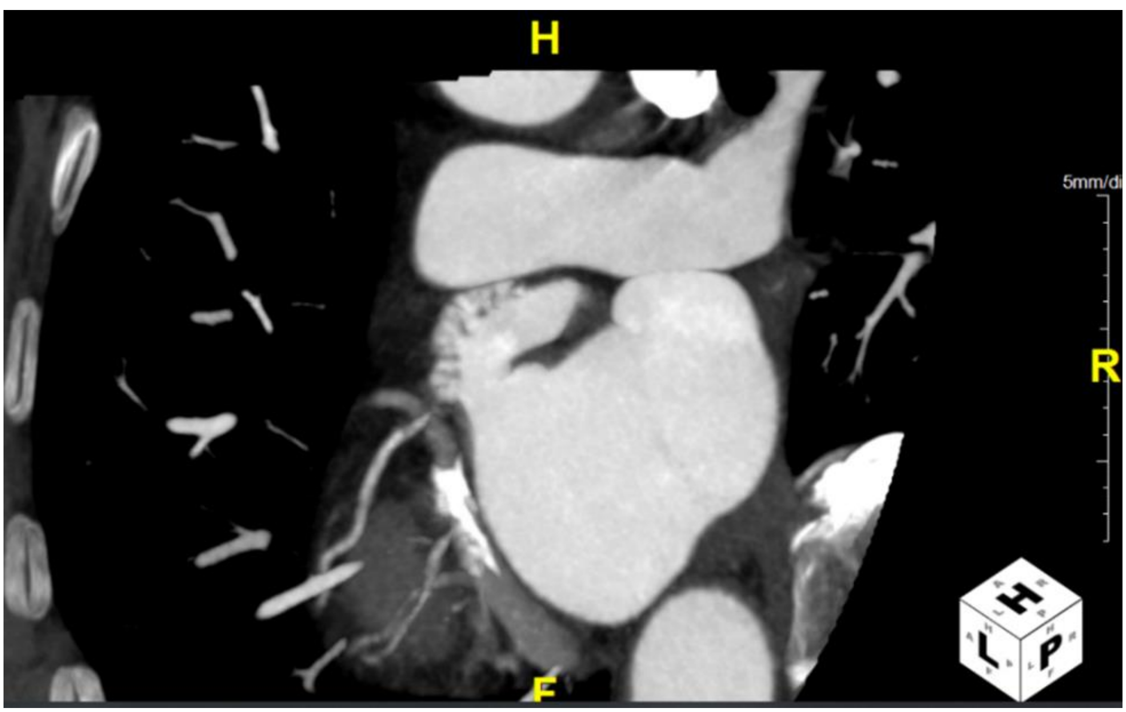

Figure 4: Cardiac CTA revealing the main lobe and anteromedial lobe.

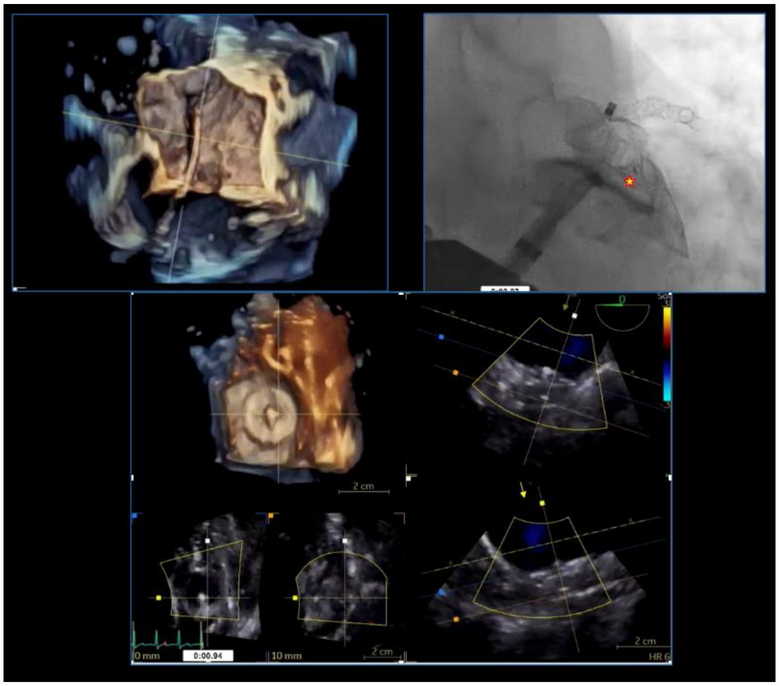

Figure 5: CTA facilitating planning of a "mid-mid" transseptal puncture, rather than inferoposterior as previously described, and the successful deployment and LAA exclusion.

During the procedure, the lobe was deployed distal to the left circumflex artery with appropriate compression. The disc and lobe were adequately separated, with the disc assuming an elliptical (concave) configuration. Mild coaxial deviation between the disc and lobe was expected. Color Doppler showed no peri-device or intra-device flow, confirming successful LAA exclusion (Figure 6). Follow-up CTA demonstrated stable device position without thrombus, hypoattenuated leaflet thickening (HALT), or leaks on early and delayed imaging. The LAA remained completely excluded (Figure 7).

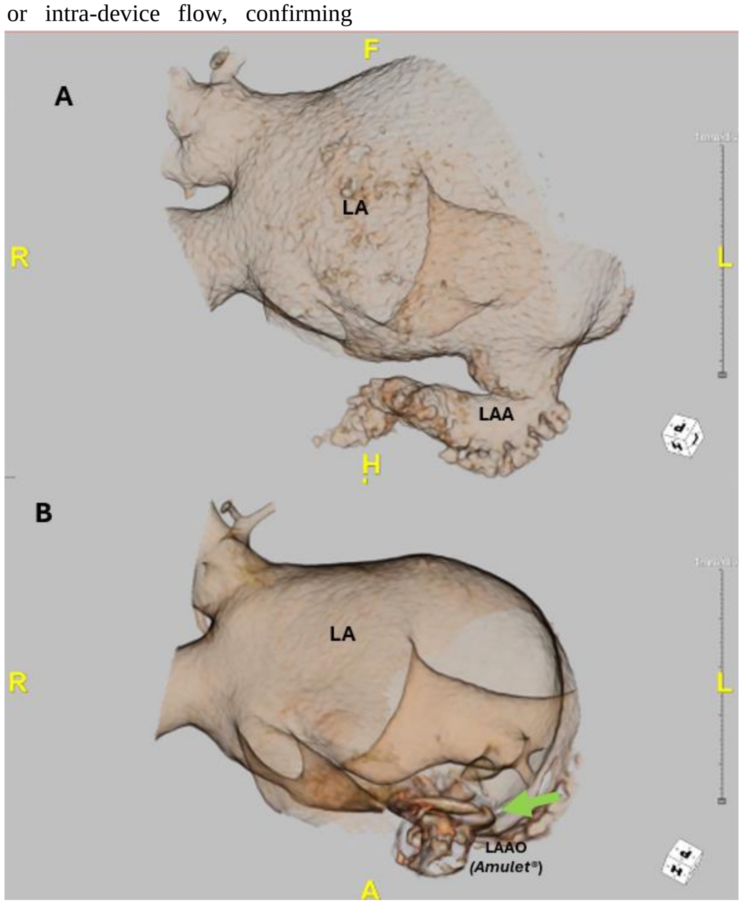

Figure 6: 3D Volume rendered images of the initial LAA (6A) and the excluded appendage with an Amulet device in position.

Discussion:

Our case underscores the role, and often critical importance, of pre-procedural planning in left atrial appendage occlusion procedures. Such procedure entails the thorough understanding of all the nuances in every step, extending from femoral access, followed by trans-septal puncture, left atrial and left atrial appendage anatomy, exclusion of an intracardiac thrombus, as well as the involved catheters, their lengths, and angulations. Therefore, systematic preprocedural planning not only helps optimize intraprocedural timing, but also in ensuring successful closure while mitigating potential complication risks.

Multiple publications have previously discussed these issues. Prior reviews have extensively discussed the utility of pre-procedural cardiac CTA as part of the patient candidacy evaluation process for both Watchman (Hecht, 2021) and Amulet (Buysschaert & Viaene, 2021) devices. Current CTAs provide excellent temporal and spatial resolution which allows close evaluation of the LAA throughout the cardiac cycle, preferentially in 10% R-R increments. The LAA ostium, landing zone, and depth can, therefore, be accurately measured aiming to minimize procedural under-sizing, which which may lead to peri-device leaks or embolization.

With the advent of artificial intelligence, such tools have been tested to determine whether there is additional value in artificial intelligence-enabled, CT-based computational model. The PREDICT-LAA was a prospective, multicenter, randomized trial evaluating anatomical analysis. The patients randomized to the computer AI simulated group experienced higher rates of optimal appendage exclusion without leaks, less device-related thrombus, lower intraprocedural radiation doses, and improved procedural efficiency with fewer Amulet devices, and fewer repositioning attempts (Buysschaert & Viaene, 2021).

Similarly, a retrospective study evaluated the accuracy of cardiac CTA evaluation compared to intraprocedural 3D-TEE imaging of the left atrial appendage at the time of device implantation (Ranard et al., 2022). This study evaluated whether CTA based AI simulations could accurately predict the appropriate device size, location, and compression. In three quarter of the reviewed patients, 3D TEE measurements were not significantly different to those from CT, and no patient having a significant peridevice leak. Yet, the study acknowledges that further studies are required to evaluate whether computation modeling can improve confidence in sizing, positioning, and compression without compromising technical success.

In our case, due to logistics, the patient was unable to obtain a cardiac CTA prior to the LAAO procedure. The intraprocedural TEE revealed the patient’s particular anatomy and despite attempts to reposition the device, it remained suboptimal for implantation either unstable or with a large leak involving one of the lobes. The cardiac CTA allowed accurate measurement of both atria, evaluation of the interatrial septum's relationship to the LAA, and precise assessment of LAA morphology and dimensions. Accounting for all these, it was determined that an Amulet device in a “sandwich technique” could potentially exclude both lobes. The dual occlusive mechanism of the Amulet occluder could further facilitate successful closure, even in this challenging anatomic scenario.

The sandwich technique has been previously described mostly for chicken wing left atrial appendage anatomy (Freixa et al., 2021). Unlike the conventional Amplatzer Amulet implantation, this technique involves the positioning of the device lobe along the length of the LAA “wing” creating a sandwich between the lobe and the appendage wall. In large patient series, this has been found to be a feasible and safe (Freixa et al., 2021). To the best of our knowledge, this is the first documented case of successful closure of a whale-tail appendage morphology.

Conclusion:

This case underscores the pivotal role of advanced multimodality imaging in characterizing complex left atrial appendage (LAA) morphologies, such as the whale-tail configuration, which can present unique challenges for percutaneous closure. Real-time 3D transesophageal echocardiography and cardiac CTA provided complementary anatomical detail, enabling precise transseptal puncture planning and individualized device deployment. Notably, the sandwich deployment technique—previously described in the setting of chicken-wing morphology—was successfully adapted in this case for exclusion of a bilobar whale-tail LAA. To the best of our knowledge, this represents a novel application of the technique for this specific anatomy. As structural interventions continue to evolve, integrating high-resolution imaging with procedural innovation will be critical to optimizing outcomes in anatomically complex LAA cases. Further studies are warranted to explore the reproducibility and long-term performance of such strategies in diverse morphologies.

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