Echocardiographic Imaging for Left Atrial Appendage Occlusion

Transesophageal Echocardiography and Intracardiac Echocardiographic Imaging

Dee Dee Wang, MD[a,*], Thomas J. Forbes, MD[b], James C. Lee, MD[a], Marvin H. Eng, MD[a]

KEYWORDS

• Transesophageal echocardiogram • TEE • Intracardiac echocardiographic imaging • ICE • LAA

KEY POINTS

- Left atrial appendage occlusion (LAAO) is a rapidly evolving technology.
- Multi-modality imaging and understanding of left atrial appendage anatomy are sure to advance.
- Two-dimensional and 3-dimensional transesophageal echocardiography with fluoroscopy are the mainstays for LAAO image-guided therapy.
- Key to successful LAAO is an understanding of the transseptal puncture, LAAO size selection for the device-specific landing zone, and post-deployment evaluation for leak and complications.
- With advancements in computed tomography, there may be a greater role for intracardiac echocardiographic imaging in specific types of LAAO anatomy and devices.

By imaging, the left atrial appendage (LAA) is the most-neglected and least understood anatomic structure of the heart. The LAA is chronically oversimplified as a blind-ending pouch projecting off of the left lateral wall of the left atrium.[1] Its importance was not appreciated until the LAA was deemed responsible for approximately 90% of cerebral thromboembolic events in the setting of nonvalvular atrial fibrillation.[1] Before the advent of percutaneous LAA occlusion therapies, traditional outpatient LAA imaging focused purely on the presence or absence of thrombus formation in the appendage before an electrophysiology ablation or cardioversion procedure for atrial fibrillation. However, recent advancements in endovascular LAA occlusion (LAAO) devices has necessitated a deeper understanding of the LAA anatomy.

LAAO interventions are not benign procedures.[2,3] In the PROTECT AF (Watchman Left Atrial Appendage System for Embolic Protection in Patients With Atrial Fibrillation) early clinical trial, new WATCHMAN (Boston Scientific, Natick, Massachusetts) implanters carried a 5% to 7% risk of LAA closure-related complications secondary to early operator learning curve associated with limited understanding of device deployment and sizing of the LAA.

[a] Center for Structural Heart Disease, Henry Ford Hospital, 2799 West Grand Boulevard, Clara Ford Pavilion 4th Floor, Detroit, MI 48202, USA; [b] Carmen and Ann Adams Department of Pediatrics, Children's Hospital of Michigan, Pediatric Cardiology, Wayne State University School of Medicine, 3901 Beaubien Street, Detroit, MI 48202, USA

* Corresponding author.

E-mail address: DWANG2@hfhs.org

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In the United States, WATCHMAN is currently the only commercially available endoluminal device available for LAAO. In US clinical trials, there is a second device under investigation, named the Amplatzer AMULET (Abbott Corp, Saint Paul, Minnesota). Both devices are commercially available in Europe. Competing markets and vastly different LAAO device shapes and anchoring mechanisms has led to increased understanding of the complexity and varied morphology of the LAA.[4] With more than one device size and shape option available, more emphasis is placed on periprocedural imaging evaluation of the LAA to optimize patient-specific device selection.

Present-day LAAO procedural evaluations have been done using transesophageal echocardiography (TEE) imaging. At this time, most implanters routinely use TEE imaging to assess LAA device size selection, residual shunting, and final device placement.[5] However, some operators have developed comfort in using intracardiac echocardiographic imaging (ICE) for LAAO. This article focuses on the application of key periprocedural imaging steps necessary for successful LAAO and techniques to use TEE and ICE for LAAO.

UNDERSTANDING LANDMARKS AND IMPACT TO LEFT ATRIAL APPENDAGE OCCLUSION

Imaging for LAA intervention requires knowledge of the chosen device, potential device-specific procedural complications, and patient-specific LAA anatomy.

The endocardial surface of the LAA has a complex trabeculated structure with a variable degree of pectinate muscles.[6] Crevices between pectinate muscles are potential areas for thrombus formation. Trabeculations within the LAA may limit the ability of devices to fully expand to their maximal width within the LAA landing zone.

The body of the LAA typically lies immediately anterior and inferior to the left upper pulmonary vein (LUPV) (Fig. 1). The separation between the LAA and the LUPV is commonly

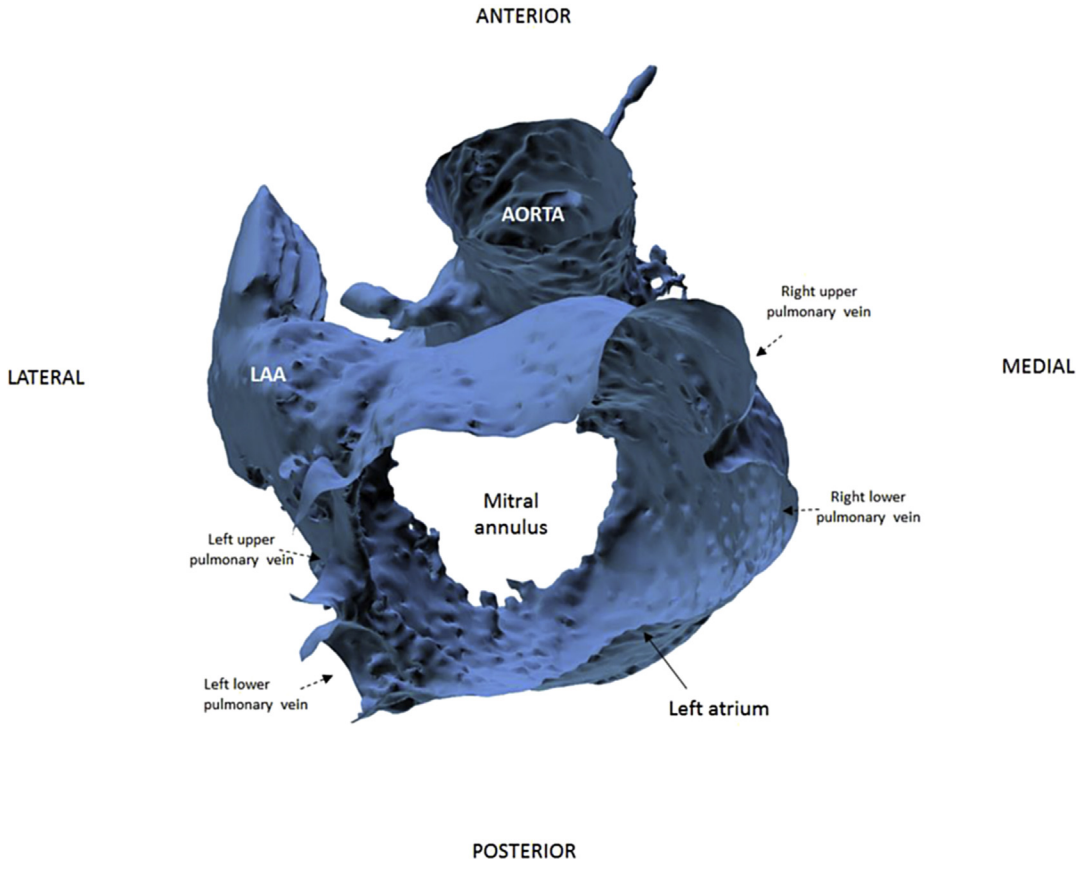

Fig. 1. Surgeon's view of the left atrium and LAA. An anatomy overview of the surrounding anatomic structures influencing the shape and landmarks for device implantation.