Computed Tomography for Left Atrial Appendage Occlusion Case Planning

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KEYWORDS

• Atrial fibrillation • Left atrial appendage • Thromboprophylaxis • Computed tomography

KEY POINTS

- Because of its variable structure and anatomic location, accurate analysis of the left atrial appendage (LAA) relies on multiple imaging planes; therefore a complete characterization of the LAA by TEE imaging can be challenging and highly operator dependent.
- Computed tomography (CT) is sensitive for LAA thrombus, with high negative predictive value; however, given its relatively low specificity, TEE is required for confirmation.
- Compared with CT, TEE systematically underestimates LAA ostial dimension and LAA depth; CT also identifies patients in whom Watchman LAA closure is feasible but are excluded by TEE, most commonly because of LAA depth that is sufficient but undetected by echocardiography.
- Preprocedural CT evaluation appears to improve procedural efficiency (ie, sheath selection and device size) compared with TEE guidance alone; this could improve procedural complication rates.
- Other potential benefits of preprocedural CT imaging of the LAA include identifying the coplanar viewing angle on left atrial angiography and 3-dimensional printing for *ex-vivo* device implant simulation.

INTRODUCTION

The left atrial appendage (LAA) has been under intense scrutiny since being identified as a source for systemic thromboembolism, most notably stroke. Approximately 795,000 patients in the United States experience a new or recurrent stroke and 87% of strokes are ischemic.[1] Atrial arrhythmias, especially atrial fibrillation remain a major contributor of ischemic stroke, as 23.5% of ischemic strokes in patients from the ages of 80 to 89 years are attributed to atrial fibrillation.[2,3] Review of several echocardiographic and surgical observations have confirmed that approximately 91% of thrombi in cases of nonvalvular atrial fibrillation originates from the atrial appendage; therefore, efforts have been directed toward obliterating this space in hopes of mitigating strokes.[4] Although anticoagulation can prevent stroke, for various reasons many patients are not treated, and several investigative trials have focused on mechanically obliterating the LAA.[5–7] Percutaneous occlusion of the atrial appendage has been a focus of research recently and with the maturation of endovascular devices, detailed anatomic analysis of the left atrial appendage has come to the forefront of cardiology in the interest of optimizing the safety and efficacy of appendage interventions. Both 3-dimensional

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echocardiography and contrast computed tomography (CT) are the primary modalities considered. This article focuses on the use and impact of the latter.

The LAA is a complex, multiform structure with great variability across individuals. LAA may have single, double or several small lobes, and LAA size does not correlate to body habitus or gender. Most appendages (54%) have 2 lobes; approximately 25 percent have 3 lobes, and 20% have 1 lobe.[8] Above 20 years of age, body size, age and gender do not correlate to atrial appendage size; however, there is a weak relationship with height.[8] One can broadly categorize the various morphologic shapes into windsock, chicken-wing, cactus, and cauliflower based on CT characterization; however, the authors find this categorization an oversimplification of the morphologic variability found in appendage anatomy (Fig. 1).[9] Retrospective review of a large cohort of patients with left atrial CT scans revealed that morphology may play a role in thromboembolic risk. Chicken-wing appendages were found to have the lowest incidence of thromboemboli, while the rate of stroke in cauliflower appendages were increased by eight-fold.[10] Morphologic variability extends to appendage ostia, as some are oval-shaped, while others are triangular, teardrop, foot-like, and round-shaped.[8,9] Given the thin-walled, compliant nature of this anatomic structure, a detailed understanding of relevant dimensions is necessary for safe implantation of devices.

Initial interventional treatment was fraught with complications. The WATCHMAN (Boston Scientific, Natick, Massachusetts), was the first device in the United States to undergo prospective clinical investigations and has the most complete dataset

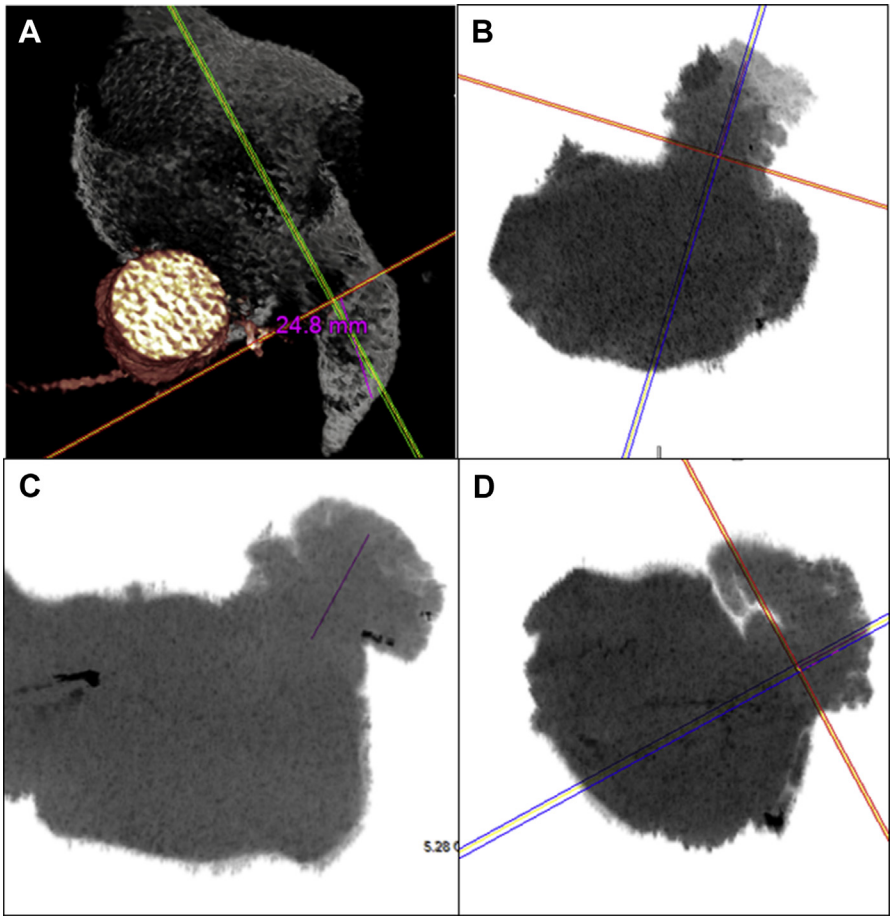

Fig. 1. Morphologic types of atrial appendages as previously categorized by Wang and colleagues. (*A*) Windsock shaped appendage. (*B*) Cactus shaped appendage. (*C*) Cauliflower shaped appendage. (*D*) Chicken-wing shaped appendage.