Timely Transesophageal Echocardiography After Left Atrial Appendage Occlusion May Avoid Delayed Detection of Device-Related Thrombus

Mohamed Abugrin, MD, Ankur Panchal, MD, Batoul Aboulqassim, MD, Muhammad Bilal, MD, and Jaswinder Virk, MD, *Cooperstown, New York*

INTRODUCTION

Atrial fibrillation (AF) poses a significant challenge in the management of thromboembolic risk, particularly in patients with contraindications to long-term anticoagulation. The left atrial appendage (LAA) is a source of intracardiac thrombus in >90% of patients who have stroke from AF.[1] The LAA occlusion (LAAO) procedure has emerged as a viable alternative for thromboembolic prevention in these individuals.[2,3] Although LAAO has demonstrated efficacy, complications such as device-related thrombus (DRT) have been reported, with an incidence of approximately 3.74%.[4] The mechanisms underlying DRT remain incompletely understood. In this case report, we present a patient with thromboembolic phenomena resulting from device-related thrombosis occurring 1 month after missing 45-day follow-up for transesophageal echocardiography (TEE).

CASE PRESENTATION

A 72-year-old patient with a medical history of hypertension, hyperlipidemia, diabetes, ischemic cardiomyopathy, reduced left ventricular function with an ejection fraction of 30% to 35%, stroke, and paroxysmal AF was on anticoagulation with a factor Xa inhibitor (apixaban). While on this medication, the patient developed a massive upper gastrointestinal bleed, though no definitive source was identified on imaging or by endoscopic evaluations. Furthermore, the patient developed a vision-threatening vitreous hemorrhage, attributed to proliferative diabetic retinopathy. Given the high thromboembolic risk (CHA_2DS_2-VASc score 7) and significant bleeding risk (HAS-BLED score 4), the patient was referred for LAAO.

TEE on the day of the procedure showed no intra-atrial or LAA thrombus, and a 20-mm LAAO device was placed. Device position was confirmed on TEE and fluoroscopy with an optimal compression factor (10%-13%), no peridevice leak, and no DRT (Figure 1, Videos 1 and 2). The patient was considered ineligible for warfarin and was discharged on aspirin and clopidogrel with 45-day follow-up for scheduled TEE.

The patient missed the scheduled TEE 45 days postprocedure and presented 1 month afterward with confusion and abdominal pain. On presentation, his blood pressure was 196/102 mm Hg, pulse rate 87 beats/min, temperature 36.4 °C, respiratory rate 16 breaths/min, and oxygen saturation 96% on room air. The cardiovascular examination revealed a normal rate, regular rhythm, no murmurs, and no jugular venous distension. Laboratory findings were remarkable for leukocytosis and lactic acidosis. Contrast-enhanced computed tomography (CT) of the abdomen revealed an embolus in the superior mesenteric artery (Figure 2), leading to an open laparotomy. The superior mesenteric artery was found to be soft and free of atherosclerotic disease but had an obstructing embolus, which was successfully retrieved, and heparin infusion was initiated.

After surgery, TEE was performed because of concern for a cardioembolic source. The TEE showed the LAAO device well seated without peridevice leak but with layered thrombus on the atrial surface consistent with DRT (Figure 3, Videos 3 and 4). The patient was transitioned from heparin to apixaban and tolerated anticoagulation, leading to discharge without apparent complications.

DISCUSSION

Managing AF in patients with high bleeding risk presents significant challenges. Traditional anticoagulation therapies, despite their efficacy in preventing thromboembolic events, often raise concerns about severe bleeding complications. The PROTECT AF (Watchman Left Atrial Appendage System for Embolic Protection in Patients With Atrial Fibrillation) and PREVAIL (Evaluation of the Watchman LAA Closure Device in Patients With Atrial Fibrillation Versus Long Term Warfarin Therapy) trials have been instrumental in establishing LAAO devices as a viable alternative in such cases, providing an effective solution to mitigate thromboembolic risk without the ongoing bleeding concerns associated with long-term anticoagulation.[2,3]

Both U.S. and European guidelines assign a class IIb recommendation for LAAO in patients with nonvalvular AF who have a high risk for stroke (CHA_2DS_2-VASc score ≥3) and elevated bleeding risks (HAS-BLED score ≥3) or contraindications to long-term oral anticoagulation.[5] The decision to transition to LAAO for this patient was influenced by the need for thromboembolic risk reduction, as indicated by a CHA_2DS_2-VASc score of 7, coupled with significant bleeding risk, as evidenced by a history of life-threatening gastrointestinal bleeding and vision-threatening vitreous hemorrhage (HAS-BLED score 4). The decision-making process was a collaborative

From the Department of Internal Medicine, Bassett Medical Center, Cooperstown, New York.

Keywords: Atrial fibrillation, Device-related thrombosis, Dual antiplatelet therapy, Left atrial appendage occlusion, Transesophageal echocardiogram

Reprint requests: Mohamed Abugrin, MD, 10 Fernleigh Drive, Apt. C7, Cooperstown, NY 13326. (E-mail: *abugrinmohamed@gmail.com*).

2468-6441
https://doi.org/10.1016/j.case.2024.05.007

VIDEO HIGHLIGHTS

Video 1: Two-dimensional TEE performed immediately postprocedure, midesophageal (85°) view with color flow Doppler, demonstrates the LAAO device in the LAA with no peridevice leak and no DRT.

Video 2: Two-dimensional TEE performed immediately postprocedure, midesophageal orthogonal biplane (85° and 175°) views, demonstrates the LAAO device in the LAA with no DRT.

Video 3: Two-dimensional TEE performed after the embolic event, midesophageal (51°) view with color flow Doppler, demonstrates the LAAO device in the LAA with a layered thrombus on the atrial surface and no peridevice leak.

Video 4: Zoomed, two-dimensional TEE, midesophageal orthogonal biplane (90° and 180°) views, demonstrates the LAAO device in the LAA with a layered thrombus on the atrial surface.

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

effort involving the patient, their primary care provider, and the interventional team, emphasizing the importance of shared decision-making and tailoring treatment to the individual's characteristics.

Transitioning to LAAO presents its own set of challenges. Recognized complications include bleeding, pericardial effusion, device embolization, procedure-related stroke, and DRT.[5] The incidence of DRT in patients undergoing LAAO is approximately 4%,[4] representing a significant clinical concern. Pooled analyses from the PROTECT AF, PREVAIL, CAP (Continued Access to PROTECT AF), and CAP2 (Continued Access to PREVAIL) trials highlight this issue, showing that patients with DRT face a substantially increased risk for thromboembolic events. Risk factors for DRT after LAAO include a history of stroke or transient ischemic attack, older age, and nonparoxysmal AF, along with procedural and device-related factors such as LAA peak emptying velocity, larger occluder size, deeper device implantation, less coverage of the appendage ostium, peridevice leak, and the presence of spontaneous echocardiographic contrast.[6,7]

Periprocedural anticoagulation is often necessary and may further complicate the transition to LAAO. Manufacturers recommend a combination of a vitamin K antagonist and aspirin for the initial 45 days following the implantation of LAAO devices. Studies exploring alternatives such as non–vitamin K antagonist oral anticoagulants have shown promising results, demonstrating noninferiority

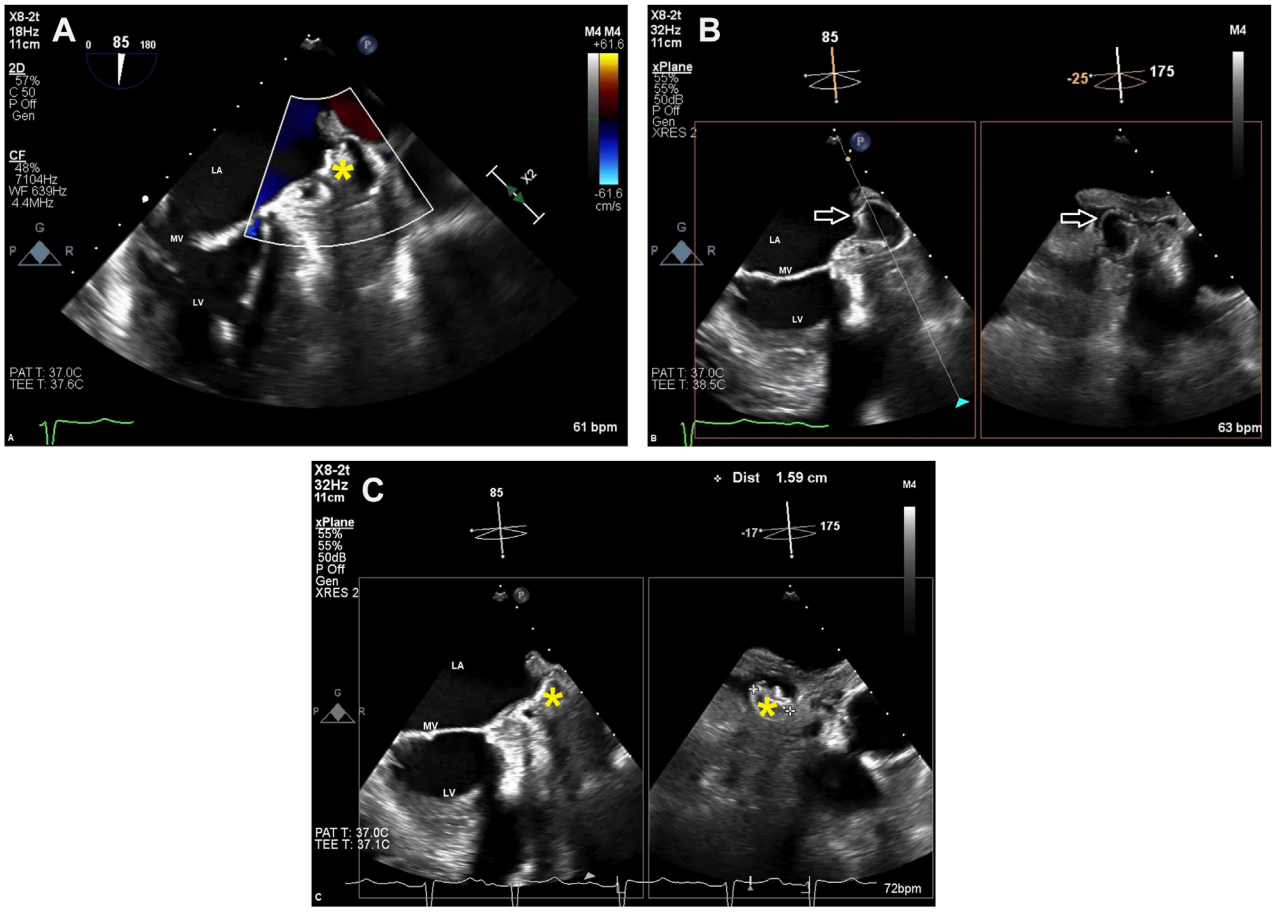

Figure 1 **(A)** Two-dimensional TEE performed immediately postprocedure, midesophageal (85°) view with color flow Doppler during diastole, demonstrates LAAO device in the LAA (*asterisk*) with no peridevice leak and no DRT. Two-dimensional TEE, midesophageal orthogonal biplane (85° and 175°) views during late diastole **(B)** and systole **(C)**, demonstrates the LAAO device in the LAA (*asterisk*) with no DRT (*arrows*).

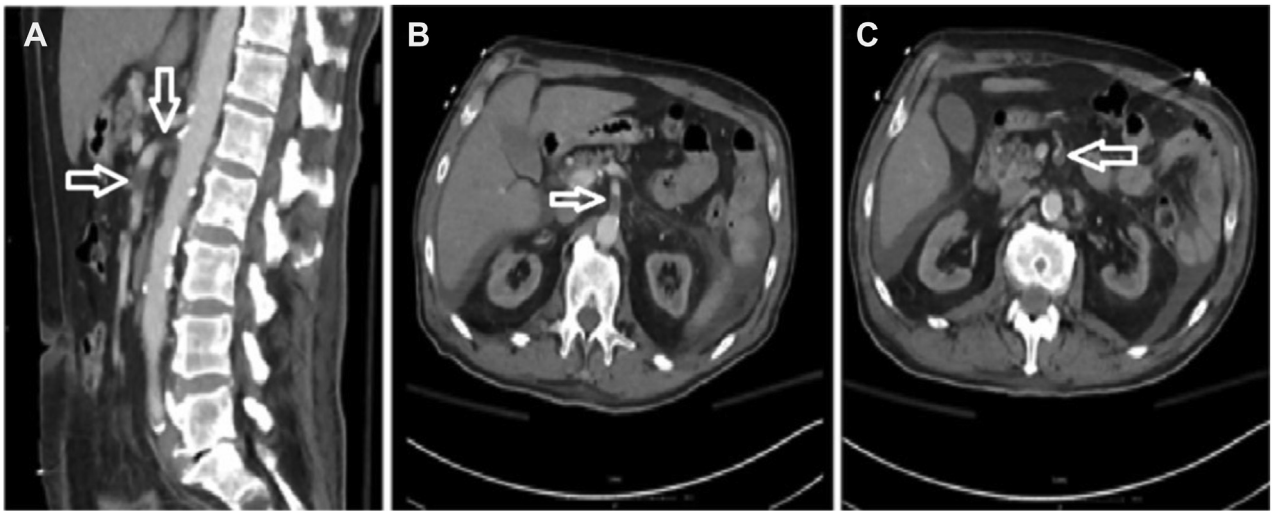

Figure 2 Contrast-enhanced CT of the abdomen and pelvis, sagittal **(A)** and axial **(B, C)** views, demonstrates a filling defect (*arrows*) from an embolus in the superior mesenteric artery.

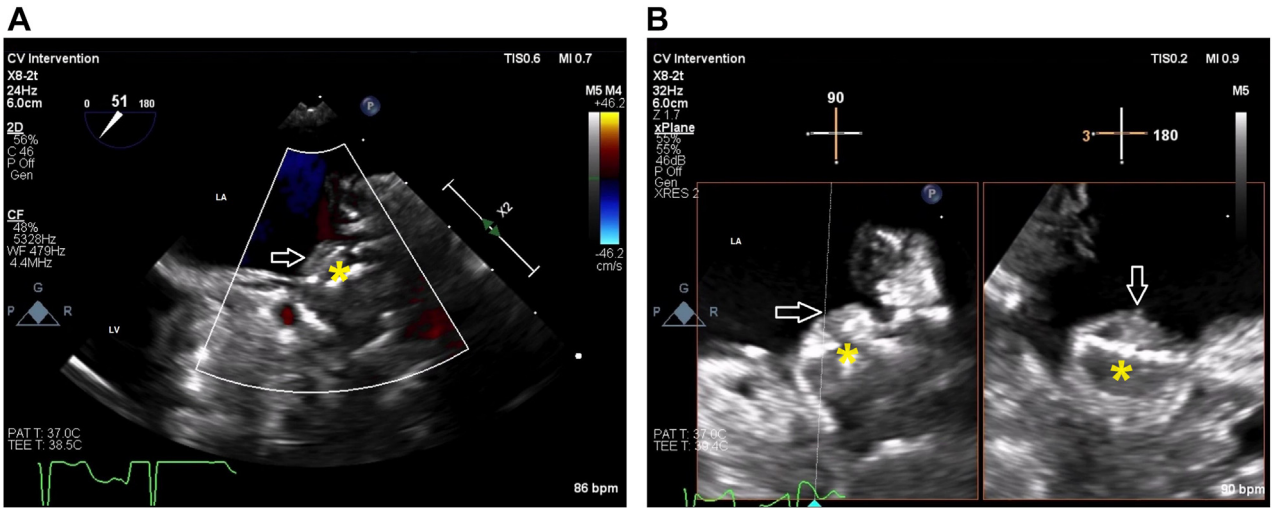

Figure 3 **(A)** Two-dimensional TEE performed after the embolic event, midesophageal (51°) view with color flow Doppler during diastole, demonstrates the LAAO device in LAA (*asterisk*) with a layered thrombus on the atrial surface (*arrow*) and no peridevice leak. **(B)** Zoomed, two-dimensional TEE, midesophageal orthogonal biplane (90° and 180°) views during systole, demonstrates the LAAO device in the LAA (*asterisk*) with a layered thrombus on the atrial surface (*arrows*).

and offering a viable, potentially safer anticoagulation option for patients who may not tolerate traditional methods.[8]

In cases in which anticoagulation is contraindicated, studies have demonstrated the noninferiority of dual-antiplatelet therapy (DAPT).[9,10] This approach offers an alternative strategy for preventing DRT in specific high-risk groups. The guidelines do not provide specific directives on when to choose DAPT over oral anticoagulation. Instead, they recommend tailoring this decision to the individual patient's characteristics. In this case, the decision to opt for DAPT was driven by the patient's recent severe bleed, compounded by concerns over the chance of recurrent vision-threatening vitreous hemorrhage. This choice was further supported by the fewer device-related risk factors for DRT with adequate size and position of the LAAO device.

However, it is important to note that the average CHA_2DS_2-VASc score in the trials examining the efficacy of DAPT was about 4.4. In contrast, the patient in this case presented a considerably higher thromboembolic risk, with a CHA_2DS_2-VASc score of 7. Only 8.7% of patients in ASAP (ASA Plavix Feasibility Study With Watchman Left Atrial Appendage Closure Technology) shared similar elevated risks,[9] which could raise potential concerns about the efficacy of DAPT in individuals with increased thromboembolic risks. The ongoing ASAP-TOO (Assessment of the Watchman Device in Patients Unsuitable for Oral Anticoagulation) trial may provide further insights into the efficacy of DAPT in such high-risk patient groups.

TEE is considered the standard imaging modality for evaluating the left atrium, LAA, and LAAO device. TEE is instrumental in assessing several key factors: the risk for thrombus formation, indicated by flow velocity at the LAA ostium and spontaneous echocardiographic contrast; peridevice leak; device position; and DRT.[11,12] The addition of contrast agents during TEE can significantly enhance the visualization of thrombi, spontaneous echocardiographic contrast, and LAA

flow pattern that might predispose to DRT, further increasing the sensitivity and specificity of this test.[11,12]

Cardiac CT also demonstrates diagnostic accuracy comparable with TEE for thrombus detection and may be considered an alternative in specific clinical scenarios in which TEE is contraindicated or limited. The choice between TEE and cardiac CT should be based on patient-specific factors, emphasizing the importance of shared decision-making in selecting the most appropriate imaging technique.[13]

The highest risk for DRT is in the first 45 to 90 days, and routine follow-up imaging with TEE or cardiac CT is recommended at 45 days and 1 year after implantation to assess device placement and detect any early signs of device-related complications. When DRT is identified, aggressive treatment with anticoagulation is warranted.[14] However, the type of anticoagulant, specific dosages, and duration of antithrombotic therapy following DRT detection are not standardized and should be individualized on the basis of patient characteristics and clinical judgment.[14] It is also recommended that device imaging surveillance be routinely performed to monitor for resolution.

The significance of these guideline recommendations is highlighted by findings from the ASAP trial, in which five of six cases of DRT were identified during 45-day follow-up TEE and were effectively managed without complications.[9] In this case, the missed TEE may have played a critical role, potentially delaying the identification of DRT that led to the development of thromboembolic events. Had this TEE been performed as scheduled and detected DRT, immediate therapeutic intervention with anticoagulation would have been warranted, which may have prevented the thromboembolic event. Alternatively, if the TEE had identified risk factors for DRT but no actual thrombus, it might have influenced the decision to transition to anticoagulation alongside intensified monitoring. If no DRT had been detected, management would likely have continued with DAPT.

It is possible that DRT could have developed between the time of the scheduled TEE and the date of presentation with the thromboembolic event. This scenario is less likely, as there is an immediate increase in hemostatic activation postprocedure, with a subsequent decline toward baseline levels about 1 month postprocedure.[14] Furthermore, animal studies suggest that device endothelialization occurs by 45 days unless there is an overlying thrombus, which may delay endothelialization up to 90 days.[15] Accordingly, follow-up TEE might have detected DRT, changed management, and potentially prevented the thromboembolic event. This highlights the importance of adhering to recommended follow-up schedules to ensure timely detection and management of potential complications.

CONCLUSION

This case highlights AF management complexities through LAAO. Despite its promise, careful consideration of postprocedural anticoagulation and follow-up is crucial. The missed 45-day follow-up TEE may have resulted in delayed detection of DRT, highlighting the necessity of timely postprocedural monitoring to detect and manage complications such as device-related thrombosis.

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.

FUNDING STATEMENT

The authors declare that this report did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

DISCLOSURE STATEMENT

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

SUPPLEMENTARY DATA

Supplementary data related to this article can be found at https://doi.org/10.1016/j.case.2024.05.007.

REFERENCES

1. Blackshear JL, Odell JA. Appendage obliteration to reduce stroke in cardiac surgical patients with atrial fibrillation. Ann Thorac Surg 1996;61:755-9.
2. Belgaid DR, Khan Z, Zaidi M, et al. Prospective randomized evaluation of the watchman left atrial appendage closure device in patients with atrial fibrillation versus long-term warfarin therapy: the PREVAIL trial. Int J Cardiol 2016;219:177-9.
3. Holmes DR, Reddy VY, Turi ZG, et al. Percutaneous closure of the left atrial appendage versus warfarin therapy for prevention of stroke in patients with atrial fibrillation: a randomised non-inferiority trial. Lancet 2009;374:534-42.
4. Dukkipati SR, Kar S, Holmes DR, et al. Device-related thrombus after left atrial appendage closure: incidence, predictors, and outcomes. Circulation 2018;138:874-85.
5. Saw J, Holmes DR, Cavalcante JL, et al. SCAI/HRS expert consensus statement on transcatheter left atrial appendage closure. Heart Rhythm 2023;20:e1-16.
6. Simard T, Jung RG, Lehenbauer K, et al. Predictors of device-related thrombus following percutaneous left atrial appendage occlusion. J Am Coll Cardiol 2021;78:297-313.
7. Vij V, Piayda K, Nelles D, et al. Clinical and echocardiographic risk factors for device-related thrombus after left atrial appendage closure: an analysis from the multicenter EUROC-DRT registry. Clin Res Cardiol 2022;111:1276-85.
8. Enomoto Y, Gadiyaram VK, Gianni C, et al. Use of non-warfarin oral anticoagulants instead of warfarin during left atrial appendage closure with the Watchman device. Heart Rhythm 2017;14:19-24.
9. Reddy VY, Möbius-Winkler S, Miller MA, et al. Left atrial appendage closure with the watchman device in patients with a contraindication for oral anticoagulation: the ASAP study (ASA Plavix feasibility study with watchman left atrial appendage closure technology). J Am Coll Cardiol 2013;61:2551-6.
10. Bergmann MW, Ince H, Kische S, et al. Real-world safety and efficacy of WATCHMAN LAA closure at one year in patients on dual antiplatelet therapy: results of the DAPT subgroup from the EWOLUTION all-comers study. EuroIntervention 2018;13:2003-11.
11. Hahn RT, Abraham T, Adams MS, et al. Guidelines for performing a comprehensive transesophageal echocardiographic examination:

recommendations from the American Society of Echocardiography and the Society of Cardiovascular Anesthesiologists. J Am Soc Echocardiogr 2013;26:921-64.
12. Doherty JU, Kort S, Mehran R, et al. ACC/AATS/AHA/ASE/ASNC/HRS/SCAI/SCCT/SCMR/STS 2019 Appropriate Use Criteria for Multimodality Imaging in the Assessment of Cardiac Structure and Function in Nonvalvular Heart Disease: A Report of the American College of Cardiology Appropriate Use Criteria Task Force, American Association for Thoracic Surgery, American Heart Association, American Society of Echocardiography, American Society of Nuclear Cardiology, Heart Rhythm Society, Society for Cardiovascular Angiography and Interventions, Society of Cardiovascular Computed Tomography, Society for Cardiovascular Magnetic Resonance, and the Society of Thoracic Surgeons. J Am Coll Cardiol 2019;73:488-516.
13. Korsholm K, Jensen JM, Nørgaard BL, et al. Detection of device-related thrombosis following left atrial appendage occlusion: a comparison between cardiac computed tomography and transesophageal echocardiography. Circ Cardiovasc Interv 2019;12:e008112.
14. Kramer A, Patti G, Nielsen-Kudsk JE, et al. Left atrial appendage occlusion and post-procedural antithrombotic management. J Clin Med 2024;13.
15. Schwartz RS, Holmes DR, Van Tassel RA, et al. Left atrial appendage obliteration: mechanisms of healing and intracardiac integration. JACC Cardiovasc Interv 2010;3:870-7.