



Transient Left Atrial Appendage Inversion During Transcatheter Closure Device Placement

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Abstract

A 72-year-old female patient underwent left atrial appendage closure. During recapture of the occlusion device, transient inversion of the appendageal wall occurred. We describe the mechanism with real-time imaging and share our experience of handling this situation. To the best of our knowledge, this is the first case report of this unique recapture complication.

Introduction

Left atrial appendage (LAA) closure is a feasible alternative to patients with non-valvular atrial fibrillation at increased risk of ischemic stroke. Although the procedure is generally considered safe, complications still can occur. We report the first case of transient LAA inversion during transcatheter LAA closure device placement.

Case Presentation

A 72-year-old female with past medical history including persistent atrial fibrillation and essential hypertension was referred for LAA closure. She never underwent any cardiac surgery. She had been on anticoagulation with warfarin for increased risk of cerebrovascular accidents (CHA₂DS₂-VASc score of 3); However, she had previous massive gastrointestinal bleeding from underlying ulcerative colitis and esophagoduodenoscopy revealed a non-bleeding gastric ulcer. Ultimately, she was deemed a candidate for LAA closure. A standard procedure protocol was followed. Transesophageal echocardiogram (TEE) was used throughout the procedure. Multiplane images and measurements of the LAA were obtained [Figure 1A]. There was no evidence of thrombi or spontaneous echo contrast (“smoke”) inside the LAA. Following the preliminary images, right femoral venous access was obtained and transseptal puncture was performed. A 14-F delivery sheath (Watchman Double Curve) was then advanced into the left atrium. Through the double curve sheath, a pigtail catheter was then used to engage the LAA and allow for safe advancement of the sheath. After the Watchman closure device was deployed, positioning and compression were verified using TEE and fluoroscopy ([Figure 1B]; Videos 1-3, available online). The position

of the device was deemed too proximal to the intended landing zone and compression of the device was less than 10%.

During an attempt at full recapture of the device through the sheath, inversion of the LAA was noticed on TEE and the device failed to retreat into the sheath [Figure 2A]. The distal aspect of the inverted LAA attached to the anchors of the device and appeared as a finger-like heteroechoic projection pointing towards the endovascular space of the left atrium ([Figure 2B]; Video 4, available online). There was no significant change in the patient’s hemodynamic status or evidence of pericardial effusion on TEE.

Entrapment of the device and inversion of the appendage resolved after a few series of partial deployment and recapture along with minimal gentle clockwise and counterclockwise rotation ([Figure 3A], Video 5, available online). The retrieved device showed no apparent signs of damage or malfunction. A new Watchman device of the same size was then deployed and released after proper position, anchor, compression and seal were confirmed ([Figure 3B-3E]; Videos 6-8, available online). Postoperatively, anticoagulation with warfarin was resumed. A repeat TEE 6 weeks later showed the Watchman device in place with adequate seal and no peridevice leak. Warfarin was then stopped and aspirin 81 mg daily was started. After 1 year follow up, the patient was doing well and had no symptoms of cerebrovascular accident (CVA).

Discussion

LAA closure has been shown as an effective alternative to anticoagulation to help reduce stroke risk in patients with atrial fibrillation.^[1, 2] The procedure is generally considered safe and carries low rates of complications including pericardial effusion, air embolism, thrombus formation during device implantation, and device embolization.^[3] Left atrial appendage inversion during this procedure has never been reported. Partial or full recapture might be needed to attain appropriate positioning of the device. It is done by advancing the sheath over the deployed device with constant traction.

Key Words

Left atrial appendage inversion, Transcatheter closure, Atrial fibrillation

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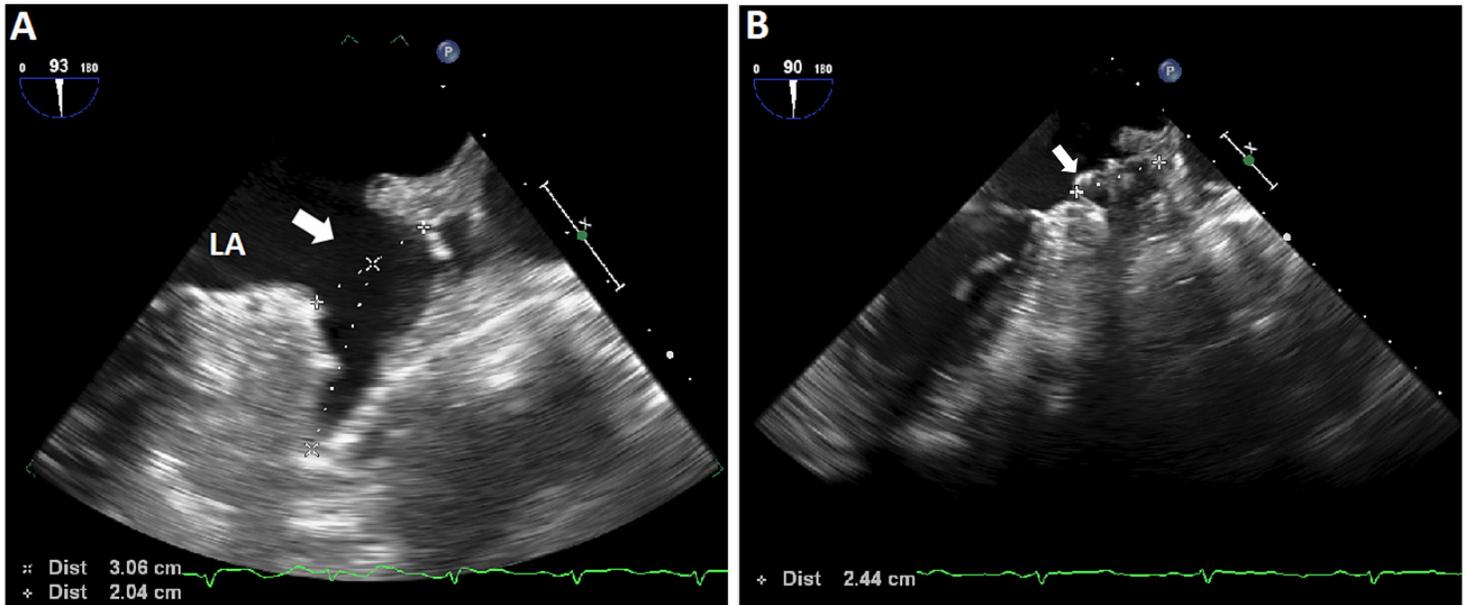


Figure 1:

LAA closure using Watchman device. A: Intraprocedural TEE imaging and measurement of the LAA at baseline. There is no evidence of sludge, thrombus or spontaneous contrast. B: The deployed Watchman device (arrow) measuring 2.44 cm in diameter (9.6% compression).

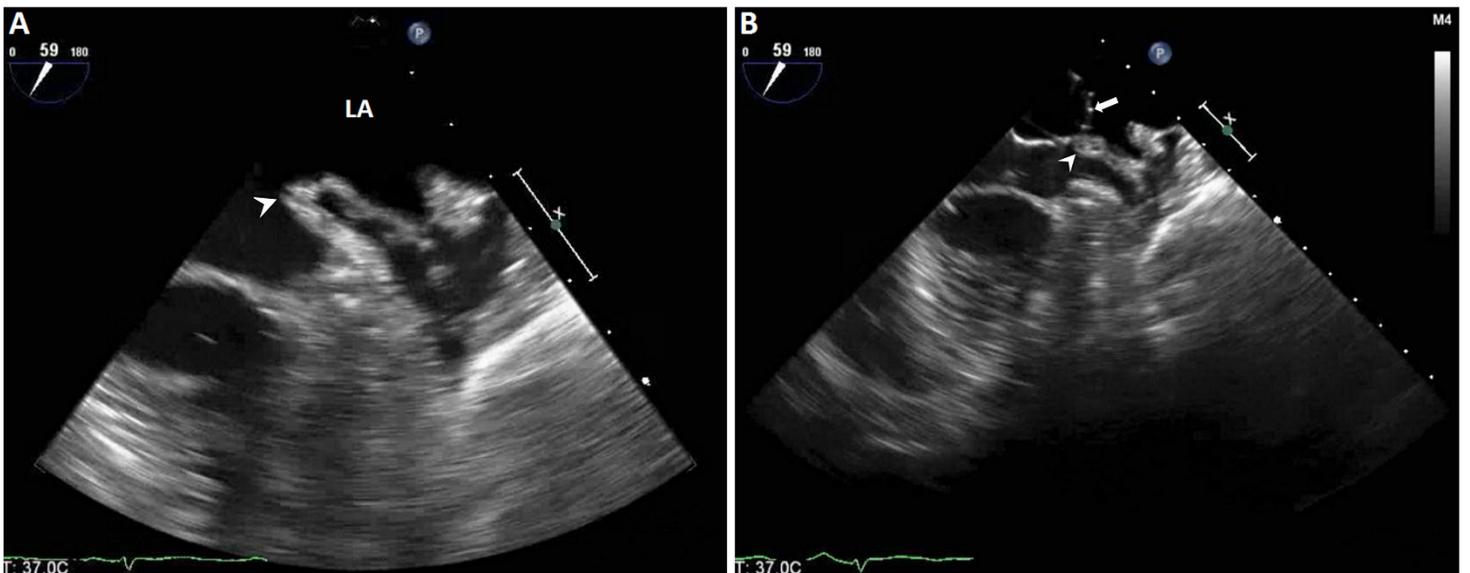


Figure 2:

Intraprocedural TEE imaging during recapture of the deployed Watchman device. A: A finger-like projection (arrow head) captured extending into the LA and represents LAA inversion. B: The Watchman device pedicles (arrow) fixated to the inverted LAA wall (arrow head). LA = left atrium.

During this process, the LAA luminal surface can potentially remain attached to the anchors and lead to inversion. Inversion of the LAA is generally rare. It has been reported in the majority of the cases following cardiac surgeries, mainly after corrective procedures of congenital cardiac anomalies,^[4-9] Rarely, LAA inversion is found without preceding history of cardiac surgery.^[10-15] Inverted LAA is often discovered incidentally on postoperative echocardiograms where it appears as left atrial elongated, pyramidal structure and frequently leads to further imaging investigation or surgical exploration.

The unexpected presence often leads to the suspicion of thrombus formation, vegetation growth, tumors, or even foreign bodies.

Understanding of the LAA anatomy and comparison with prior echocardiograms can greatly help identify this condition. In our case, the continuous TEE monitoring during recapture highlights a potential hidden complication of recapture, namely atrial appendage inversion secondary to the Watchman pedicle entrapment of endocardial tissue and possible appendage tear with continued sheath advancement.

Operators need to be aware of potential complications during recapturing appendage occlusion devices. Such complications can include appendage tear and acute obstruction of the mitral annular

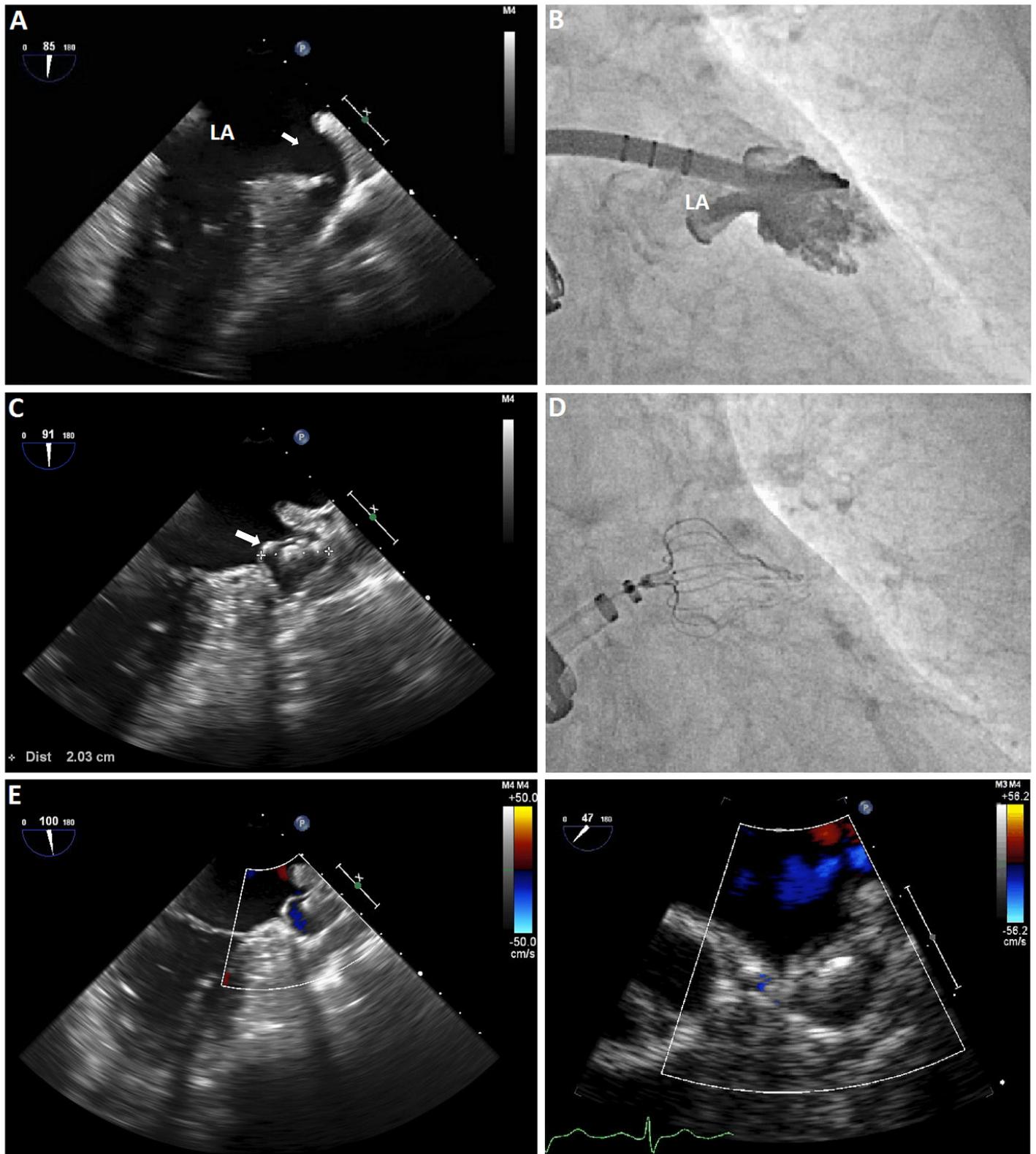


Figure 3:

Closure of the LAA with new Watchman device. A: TEE image of the LAA (arrow) after full device recapture and resolution of the inversion. **B:** Fluoroscopic appendogram revealing no contrast leakage ruling out perforation of the LAA wall. **C:** New Watchman device deployed and adequately seated in the LAA with a diameter of 20.3 mm (24.8% compression). **D:** Fluoroscopic image of the new Watchman device with adequate position and compression. **E:** Doppler TEE revealed adequate seal with no flow around or across the closure device. **F:** Six-week follow up TEE shows maintenance of adequate seal and no residual peri-device shunt.

inflow tract with hemodynamic compromise. We emphasize on the importance of careful balance between sheath advancement and traction on the device with continuous monitoring on TEE to detect possible inversion as soon as it develops.

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Conclusion

Inverted LAA may result during LAA closure device position adjustment. The appearance of an intraatrial projection on TEE is very suggestive. Attention is needed to prevent further complications from the inverted LAA.

References

1. Reddy VY, Holmes DR Jr, Doshi SK, Neuzil P, Kar S. Safety of percutaneous left atrial appendage closure: results from the Watchman left appendage system for embolic protection in patients with AF (PROTECT AF) clinical trial and the continued access registry. *Circulation*. 2011;123:417–424.
2. Holmes DR Jr, Kar S, Price MJ, Whisenant B, Sievert H, Doshi SK, Huber K, Reddy VY. Prospective randomized evaluation for the Watchman left atrial appendage closure device in patients with atrial fibrillation versus long-term warfarin therapy: the PREVAIL trial. *J Am Coll Cardiol*. 2014;64:1–12.
3. Möbius-Winkler S, Majunke N, Sandri M, Mangner N, Linke A, Stone GW, Dähnert I, Schuler G, Sick PB. Percutaneous left atrial appendage closure: Technical aspects and prevention of periprocedural complications with the watchman device. *World J Cardiol*. 2015;7:65–75.
4. Aronson S, Ruo W, Sand M. Inverted left atrial appendage appearing as a left atrial mass with transesophageal echocardiography during cardiac surgery. *Anesthesiology*. 1992;76:1054–5.
5. Minich LL, Hawkins JA, Tani LY, Judd VE, McGough EC. Inverted left atrial appendage presenting as an unusual left atrial mass. *J Am Soc Echocardiogr*. 1995;8:328–30.
6. Toma DM, Stewart RB, Miyake-Hull CY, Otto CM. Inverted left atrial appendage mimicking a left atrial mass during mitral valve repair. *J Am Soc Echocardiogr*. 1995;8:557–9.
7. Chikwe J, Fischer GW, Adams DH. Inverted left atrial appendage. *J Am Coll Cardiol*. 2009;54:e7.
8. Leong MC, Latiff HA, Hew CC, Mazlan SL, Osman H. Inverted left atrial appendage masquerading as a cardiac mass. *Echocardiography*. 2013;30:E33–5.
9. Yoon GY, Yang DH, Kang JW, Song JK, Lee JW, Lim TH. Demonstration of inverted left atrial appendage using cardiac computed tomography: an unusual complication mimicking left atrial mass after cardiac surgery. *Circulation*. 2014;130:e66–7.
10. Ankersmit HJ, Kocher A, Frank H, Mohl W, Wolner E. Inverted left atrial appendage masquerading as myxoma. *Circulation*. 2000;101:E42–3.
11. Ankersmit HJ, Mohl W, Moser B, Kocher A, Ehrlich M, Grimm M, Horvat R, Wolner E. De novo inverted left atrial appendage: an unrecognized cause of left atrial mass with symptoms mimicking myxoma. *J Thorac Cardiovasc Surg*. 2001;121:1211–3.
12. Choudhury A, Narula J, Kumar P, Aggarwal S, Kiran U. Inverted left atrial appendage: a complication of de-airing during cardiac surgery. *Can J Anaesth*. 2015;62:1119–20.
13. Motoyasu M, Sakuma H, Iwasaki H, Onishi K, Okinaka T, Isaka N, Takeda K, Nakano T. A case of inverted left atrial appendage mimicking a tumor. *J Comput Assist Tomogr*. 2003;27:501–4.
14. Nunes MC, Gelape CL, Bráulio R, de Azevedo Figueiredo F, de Carvalho Bicalho Carneiro R, Barbosa FB, de Melo Barbosa M. Inverted left atrial appendage presenting as a large left atrial mass. *J Echocardiogr*. 2010;8:30–2.
15. Gecmen C, Candan O, Guler A, Aung SM, Karabay CY, Baskan O, Cihan D. Unusual left atrial mass: inverted left atrial appendage caused by massive pericardial effusion. *Echocardiography*. 2011;28:E134–6.