

Late left atrial appendage closure device displacement and massive thrombus formation: a case report

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Background

Left atrial appendage (LAA) closure with the WATCHMAN device is an alternative to anticoagulation therapy for the prevention of stroke in selected patients with atrial fibrillation (AF). Infrequently, left atrial (LA) device-related thrombus formation occurs and it is poorly understood. Thrombus formation due to incomplete covering of the LAA is even rarer and may occur within the first few months after device implantation.

Case summary

Here, we present a case of a 68-year-old male patient with permanent AF, drug- and hepatitis induced liver cirrhosis (CHILD Score B), and prior aortic valve replacement. The patient had a history of percutaneous LAA closure using a WATCHMAN device. He developed massive peri-device leak and thrombus arising from the space between the device and appendage cleft 2 years after implantation. Because of the high bleeding risk with a HAS-BLED score of 5 points, surgery was chosen as the therapy of choice instead of long-term anticoagulation. The patient was discharged in good clinical condition and has been scheduled for a yearly follow-up.

Discussion

This case emphasizes the importance of choosing appropriately sized LAA occluder devices and planning for regular post-interventional follow-ups to minimize the risk of per-device leaks and thrombi.

Keywords

Atrial fibrillation • Left atrial appendage closure • Device-related thrombus • Cardiac imaging • Case report

Learning points

- There is no guideline recommendation on a long-term (>12 months) follow-up after left atrial appendage (LAA) device closure (WATCHMAN). There is also no guidance for thrombus prevention after LAA device closure beyond the initial 3–6 months.
- We describe the case of a 68-year-old male patient who developed massive peri-device leaks and thrombus arising from the space between the device and appendage cleft 2 years after implantation.
- This case emphasizes the importance of choosing appropriately sized LAA occluder devices and planning for regular post-interventional follow-ups to minimize the risk of peri-device leaks and thrombi.

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Introduction

Left atrial appendage (LAA) closure with the WATCHMAN device (Boston Scientific, Maple Grove, MN, USA) appears to be a promising procedure for the prevention of embolism in patients with atrial fibrillation (AF) who have a contraindication for oral anticoagulation.¹ Development of an LAA device-related thrombus is possible and occurs in 4.2% of all cases.² Furthermore, incomplete LAA closure with a mobile thrombus in between the pulmonary vein ridge and the edge of the device is rarely seen³ but occurs more frequently at earlier stages after device implantation.

We report on a patient who developed a massive peri-device leak and thrombus arising from the space between the device and appendage cleft 2 years after implantation.

Timeline

May 2014

Percutaneous left atrial appendage (LAA) closure (WATCHMAN device)
Post-interventional transoesophageal echocardiogram (TOE)

Appropriate closure of LAA

April 2016

Routinely performed transthoracic echocardiographic by the attending cardiologist
TOE after hospital admission

Mobile mass close to the mitral valve; suspected mitral valve endocarditis

Initiation of PTT-controlled heparin
Cardiac surgery

Mobile mass (40 mm × 15 mm in size) arising from the cleft of the LAA located by the pulmonary vein ridge and the LAA device

Thrombus was removed and the LAA closed surgically

May 2016

Hospital discharge

Patient in good clinical condition

June 2016

TOE

No further thrombus formation; complete closure of LAA

Case presentation

A 68-year-old man was examined in the outpatient department of our hospital by transoesophageal echocardiogram (TOE) because the attending cardiologist suspected mitral valve endocarditis. The patient's medical history revealed permanent AF, drug-, and hepatitis E-induced liver cirrhosis (CHILD Score B) being on vitamin-K-antagonist (VKA), a biological aortic valve replacement in 2011 and long-standing hypertension. Due to a history of cirrhosis-associated major gastric bleeding complications in February 2014, while being on VKA and rheumatoid arthritis with long-term glucocorticoid therapy, an LAA closure procedure was planned 3 months later in our hospital. At that time, the patient had a CHA₂DS₂-VASc score of 2 points (age 65–74 years +1 and hypertension +1) and a HAS-BLED score of 5 points (age, hypertension, abnormal liver function, labile International Normalized Ratio (INR), and prior major bleeding; each +1). Despite

ing aspirin 100 mg/day and clopidogrel 75 mg/day for 3 months, to which he was compliant.

In July 2015, the patient was diagnosed with an ischaemic stroke due to the occlusion of the right internal carotid artery and carotid endarterectomy performed. A TOE performed at the time showed no intracardiac thrombus. Systemic lysis was performed, which resulted in intracranial bleeding. As a result, the CHA₂DS₂-VASc score increased to 4 points (age 65–74 years +1, hypertension +1, and stroke +2; estimated risk 4%) and the HAS-BLED score increased to 6 points [age, hypertension, abnormal liver function, labile INR, prior major bleeding, and (NEW) stroke; each +1 point; estimated risk higher than 9.1%], respectively. After conservative treatment, the patient was discharged to outpatient care with only slight neurological deficits (insecure gait) and his daily life was not impaired. The patient again received DAPT for 3 months, but no oral anticoagulation.

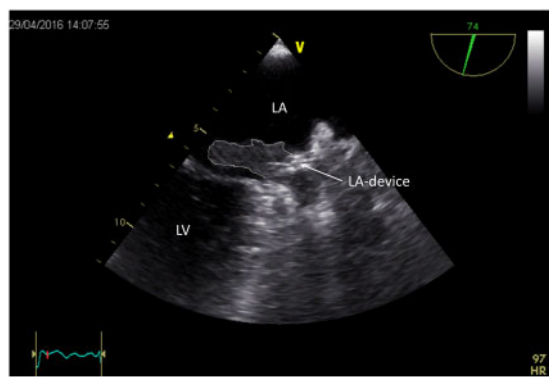


Figure 1 Transoesophageal echocardiogram showed large thrombus formation. Transoesophageal echocardiogram showed large thrombus (size: 40 mm × 15 mm) formation arising from a cleft of the left atrial appendage, reaching into the left atrium and is located between the pulmonary vein ridge and the left atrial appendage device itself. Pulsatory movement into left ventricular was also notable.

In April 2016, the patient was invited by the outpatient cardiologist for a routine transthoracic echocardiographic assessment, which included the evaluation of the prosthetic aortic valve function. Examination revealed a mobile mass towards the mitral valve, which was suspected to be potentially endocarditis-related. The size of the left atrium was only slightly larger than in 2014 (25 cm²). A TOE, which was performed shortly after hospital admission, confirmed this mobile mass (~40 mm × 15 mm in size) arising from a cleft of the LAA and located between the pulmonary vein ridge and the LAA device itself (Figure 1). The structure periodically prolapsed through the mitral valve leaflets and was of dense texture with only minor mobility. Anticoagulation with partial thromboplastin time (PTT)-controlled heparin (PTT 50–80 s) was initiated. The patient remained completely asymptomatic, without showing any clinical evidence of peripheral embolism or neurological event. Fever and elevation of serological inflammation markers were also absent. Because of the high bleeding risk with a HAS-BLED score of 5 points, surgery was chosen as the therapy of choice instead of long-term anticoagulation.

The patient was transferred to the cardiac surgery unit of a tertiary hospital and the device together with the thrombus was removed. Surgery was performed by a standard procedure with moderate hypothermia, utilizing a cardiopulmonary bypass manoeuvre, and by surgical closure of the LAA thereafter. *In situ* analysis showed that the closure did not cover the LAA completely and the device was only partially coated by the endothelium. A gap was identified between the device and the LAA from where the thrombus developed.

On Day 21 post-extirpation of the thrombus, the patient was discharged in good clinical condition on DAPT for the following 3 months. A TOE 6 weeks later showed no further thrombus formation and a completely closed LAA. In follow-ups at 6 and 12 months after surgery, transthoracic echocardiography was performed in an outpatient setting and did not reveal any clinically relevant findings.

At this point, the patient was in a stable clinical condition. Further follow-up is planned on a yearly basis.

Discussion

Here, we present the case of a 68-year-old male patient who, after having WATCHMAN device implanted in 2014, developed a mobile mass towards the mitral valve in 2016. Surgical exposure of the patient's WATCHMAN device revealed spatial displacement, as well as impaired endothelialization of the LAA closure; two factors that may have triggered the thrombus formation. The case reinforces the need for correct sizing of the implantation device to avoid peri-device gaps and the need to monitor these patients for thrombus formation over the long term.

Left atrial appendage closure (LAAC) is a valuable tool to prevent stroke in patients with increased risk of bleeding and the need for treatment of AF with anticoagulation therapy.¹ The intermediate- to long-term outcome is considered to be excellent once the procedural risk is overcome.³ Thrombus formation on LAAC devices is one of the most feared complications but is considered to be mainly device-related and originates from incomplete endothelialisation. In the PROTECT-AF trial, device-related thrombus formation (DRT) was observed in 4.2% of all cases.²

Peri-device gaps, as a potential source of DRT, are usually documented during regular TOE follow-up shortly after implantation. In the PROTECT-AF trial, the proportion of patients with at least one DRT positive TOE was 5.7%.² They mostly had a flow jet width of 5 mm or less. Many thrombi develop because of peri-device gaps that are located at the level of the disc, which generally represents a more benign course of leaks, and no flow into the lobes of the appendage can be noted.³ Although peri-device residual flow could potentially result in thromboembolism, there was no such event in the PROTECT-AF trial in patients with peri-device flow who stopped warfarin.

In the current report, the initial selection of the 33-mm WATCHMAN device represents the largest available diameter and indicates that our patient exhibits a large LAA anatomy. The regular 6- and 12-month echocardiography follow-ups revealed no signs of peri-leaks or thrombus formation while, at 2 years, the herewith-described thrombus was formed in the open cleft of the LAA, which may have originated from the deeper parts of the LAA space. We speculated that the closure device underwent a long-term displacement to one side of the LAA, which may be supported by the arising thrombus in a barely TOE-detectable peri-leak. This might also be maintained by aging processes, which result in alterations and changing dimensions in the LAA anatomy in the elderly.⁴

There are prior reports on longer-term occluder embolizations with both the Amplatzer Cardiac Plug/Amulet (St. Jude Medical Inc., Little Canada, MN, USA) and the WATCHMAN device.^{5–7} Of these, the report of Shamim *et al.*⁶ resembles our own case. Follow-up of a WATCHMAN implantation up to 1 year post the implantation procedure showed no evidence of DRT or peri-device flow. However, repeat TOE a decade later revealed a 21 mm × 18 mm DRT on the LA aspect of the device. The patient was prescribed apixaban 5 mg

p.o. BID. A TOE performed 111 days later demonstrated marked diminution in the DRT (9 mm in diameter).

European Heart Rhythm Association (EHRA)/European Association of Percutaneous Cardiovascular Interventions (EAPCI) consensus statement on LAA occlusion recommends follow-up imaging of patients using TOE.⁸ Suggested alternatives include chest X-ray (position only) or computed tomography. There are clear recommendations for follow-up intervals at 45 days, 3, 6, and/or 12 months, but there is no recommendation for a longer-term echo assessment. Many physicians cover this period with dual antiplatelet therapy for a duration of 3–6 months. The EHRA/EAPCI also mentions the possibility of late device dislodgement, but assume that most of these cases will be detected at a 45-day follow-up echo. Guidelines recommending treatment of DRT arising from an LAA closure device do not exist.^{8,9} However, DRT can be treated with warfarin until their dissolution. Further strategies may include heparinization or non-VKA oral anticoagulants, such as apixaban.⁶ Other therapeutic strategies considering thrombolysis may be helpful in certain clinical conditions¹⁰ but were rejected in our particular patient because peripheral artery embolism is a serious adverse event.¹¹

Nevertheless, the late occurrence of the thrombus remains incompletely understood. Factors that could have triggered a thrombotic event were not present in our patient. However, data analyses of the rates of long-term closure device displacement are lacking and this is a call-to-action for real-world multicentre prospective registries. In our case, the patient was asymptomatic. Nevertheless, fatal flushing of the thrombus or severe impairment of the mitral valve might have only been a matter of time.

Finally, this case occurred in 2014, a time where major guidelines did not see sufficient data for direct oral anticoagulant use in patients with valvular AF. The American Heart Association (AHA)/American College of Cardiology (ACC)/Heart Rhythm Society (HRS) 2014 guidelines,¹² as well as the 2016 European Society of Cardiology (ESC)/European Association for Cardio-Thoracic Surgery (EACTS) guidelines,¹³ recommended VKA for mitral stenosis and artificial heart valves but constitute a 'gap in evidence' for direct oral anticoagulants (DOACs). More recently, the EHRA 2018 guidelines on DOAC use in AF¹⁴ recommend DOACs for bioprosthetic valves except in the first 3 months post-operation. Even for mechanical valves, there is an increased willingness to consider DOACs.¹⁵ As such, the patient would likely receive one of the better studied DOACs today.

Conclusion

Thrombus formation arising from a peri-device gap can occur years after implantation of WATCHMAN devices. We recommend enhanced vigilance for the correct selection of the device size. Newer techniques, such as intracardiac echocardiographic guidance or 3D TOE, might help in these cases and have been recently proven to be feasible. Moreover, post-procedural echocardiography follow-ups analysing long-term displacements of the devices should be taken into account in patients with larger LA appendage anatomy.

Lead author biography



Dr Benjamin Sasko was educated at the Universities of Pecs (Hungary) and Hamburg (Germany). He received internal medicine and cardiology training at Marienhospital (Ruhr University Bochum). As of today, he is a consultant at the Department of Cardiology, Brandenburg Medical School in Brandenburg, Germany. He is currently focusing on interventional cardiology and associated clinical research.

Supplementary material

Supplementary material is available at *European Heart Journal - Case Reports* online.

Slide sets: A fully edited slide set detailing this case and suitable for local presentation is available online as **Supplementary data**.

Consent: The author/s confirm that written consent for submission and publication of this case report including image(s) and associated text has been obtained from the patient in line with COPE guidance.

Conflict of interest: none declared.

References

- Fountain RB, Holmes DR, Chandrasekaran K, Packer D, Asirvatham S, Van Tassel R, Turi Z. The PROTECT AF (WATCHMAN Left Atrial Appendage System for Embolic PROTECTion in Patients with Atrial Fibrillation) trial. *Am Heart J* 2006;**151**:956–961.
- Main ML, Fan D, Reddy VY, Holmes DR, Gordon NT, Coggins TR, House JA, Liao L, Rabineau D, Latus GG, Huber KC, Sievert H, Wright RF, Doshi SK, Douglas PS. Assessment of device-related thrombus and associated clinical outcomes with the WATCHMAN left atrial appendage closure device for embolic protection in patients with atrial fibrillation (from the PROTECT-AF Trial). *Am J Cardiol* 2016;**117**:1127–1134.
- Wolfrum M, Attinger-Toller A, Shakir S, Gloekler S, Seifert B, Moschovitis A, Khattab A, Maisano F, Meier B, Nietlispach F. Percutaneous left atrial appendage occlusion: effect of device positioning on outcome. *Catheter Cardiovasc Interv* 2016;**88**:656–664.
- Kaminski R, Kosinski A, Brala M, Piwko G, Lewicka E, Dabrowska-Kugacka A, Raczak G, Kozlowski D, Grzybiak Met al. Variability of the left atrial appendage in human hearts. *PLoS One* 2015;**10**:e0141901.
- Schroeter MR, Danner BC, Hunlich M, Schillinger W. Uncommon delayed and late complications after percutaneous left atrial appendage closure with Amplatzer((R)) Cardiac Plug. *Clin Res Cardiol* 2014;**103**:285–290.
- Shamim S, Magalski A, Chhatrivala AK, Allen KB, Huber KC, Main ML. Transesophageal echocardiographic diagnosis of a WATCHMAN left atrial appendage closure device thrombus 10 years following implantation. *Echocardiography* 2017;**34**:128–130.
- Tower-Rader A, Wazni O, Jaber WA. Intradivice leak on late follow-up after Watchman implantation. *CASE (Phila)* 2018;**2**:192–196.
- Meier B, Blaauw Y, Khattab AA, Lewalter T, Sievert H, Tondo C, Glikson M, Lip GYH, Lopez-Minguez J, Roffi M, Israel C, Dudek D, Savelieva I; ESC Scientific Document Group. EHRA/EAPCI expert consensus statement on catheter-based left atrial appendage occlusion. *Europace* 2014;**16**:1397–1416.
- Masoudi FA, Calkins H, Kavinsky CJ, Drozda JP, Gainsley P, Slotwiner DJ, Turi ZG. 2015 ACC/HRS/SCAI left atrial appendage occlusion device societal overview. *J Am Coll Cardiol* 2015;**66**:1497–1513.
- Aboyans V, Lacroix P, Ostyn E, Cornu E, Laskar M. Diagnosis and management of entrapped embolus through a patent foramen ovale. *Eur J Cardiothorac Surg* 1998;**14**:624–628.

11. Kobayashi M, Tanaka R, Yamashiro K, Ueno Y, Kato E, Miura S, Daida H, Hattori N. Pre-existing mobile cardiac thrombus and the risk of early recurrent embolism after intravenous thrombolysis: a case report. *J Stroke Cerebrovasc Dis* 2015; **24**:e161–e163.
12. January CT, Wann LS, Alpert JS, Calkins H, Cigarroa JE, Cleveland JC, Conti JB, Ellinor PT, Ezekowitz MD, Field ME, Murray KT, Sacco RL, Stevenson WG, Tchou PJ, Tracy CM, Yancy CW, Jr. 2014 AHA/ACC/HRS guideline for the management of patients with atrial fibrillation: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines and the Heart Rhythm Society. *J Am Coll Cardiol* 2014; **64**:e1–e76.
13. Kirchhof P, Benussi S, Kotecha D, Ahlsson A, Atar D, Casadei B, Castella M, Diener H-C, Heidbuchel H, Hendriks J, Hindricks G, Manolis AS, Oldgren J, Popescu BA, Schotten U, Van Putte B, Vardas P, Agewall S, Camm J, Baron Esquivias G, Budts W, Carerj S, Casselman F, Coca A, De Caterina R, Deffereos S, Dobrev D, Ferro JM, Filippatos G, Fitzsimons D, Gorenek B, Guenoun M, Hohnloser SH, Kolh P, Lip GYH, Manolis A, McMurray J, Ponikowski P, Rosenhek R, Ruschitzka F, Savelieva I, Sharma S, Suwalski P, Tamargo JL, Taylor CJ, Van Gelder IC, Voors AA, Windecker S, Zamorano JL, Zeppenfeld K. 2016 ESC Guidelines for the management of atrial fibrillation developed in collaboration with EACTS. *Eur Heart J* 2016; **37**:2893–2962.
14. Steffel J, Verhamme P, Potpara TS, Albaladejo P, Antz M, Desteghe L, Haeusler KG, Oldgren J, Reinecke H, Roldan-Schilling V, Rowell N, Sinnaeve P, Collins R, Camm AJ, Heidbüchel H, Lip GYH, Weitz J, Fauchier L, Lane D, Boriani G, Goette A, Keegan R, MacFadyen R, Chiang C-E, Joung B, Shimizu W; ESC Scientific Document Group. The 2018 European Heart Rhythm Association Practical Guide on the use of non-vitamin K antagonist oral anticoagulants in patients with atrial fibrillation. *Eur Heart J* 2018; **39**:1330–1393.
15. Fauchier L, Philippart R, Clementy N, Bourguignon T, Angoulvant D, Ivanov F, Babuty D, Bernard A. How to define valvular atrial fibrillation? *Arch Cardiovasc Dis* 2015; **108**:530–539.