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CASE REPORT

ADVANCED

CLINICAL CASE

Aortic Rupture and Hemorrhagic Shock After Percutaneous Retrieval of an Embolized Left Atrial Appendage Occluder

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ABSTRACT

Left atrial appendage (LAA) closure may be complicated by occluder embolization. Percutaneous retrieval is preferred for devices embolized to large vessels. In this report, the successful percutaneous retrieval of an LAA occluder embolized to the abdominal aorta was followed by several complications, culminating in iatrogenic aortic rupture requiring endovascular repair. **(Level of Difficulty: Advanced.)** (J Am Coll Cardiol Case Rep 2022;4:486-490) © 2022 The Authors. Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

HISTORY OF PRESENTATION

A 72-year-old man with atrial fibrillation was scheduled for elective percutaneous left atrial appendage (LAA) closure. At admission, the patient was in stable condition, the electrocardiogram showed atrial fibrillation at 70 beats/min, and the transthoracic echocardiogram revealed a dilated left atrium. Two-dimensional transesophageal echocardiography ruled out atrial thrombosis and revealed a single-lobe LAA with functional impairment. An LAA depth of 15 mm and a mean landing zone width of 14 mm (min/max 12/16 mm) were measured.

LEARNING OBJECTIVES

- To recognize anatomical factors predisposing to device embolization after percutaneous LAA closure so as to decrease its occurrence.
- To be aware of serious complications of transcatheter retrieval of an embolized LAA occluder and to learn their correct management so as to reduce periprocedural mortality.

The procedure was performed with intracardiac echocardiographic guidance. After transseptal cross, the smallest (20-mm) Watchman FLX (Boston Scientific) device was deployed (**Figure 1A,** Video 1) after meeting the position, anchor, size, and seal criteria.

Two hours later, the patient complained of bilateral leg pain. Fluoroscopy showed that the occluder was embolized to the infrarenal abdominal aorta (AA) (**Figure 1B**). A percutaneous retrieval attempt was performed (Video 2). A long 12-F sheath was positioned in the AA through the right common femoral

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artery (CFA). Inasmuch as snare failed to advance around the occluder, the device was captured with a biopsy forceps. Despite several attempts, the occluder could not be totally collapsed into the sheath because the forceps slipped off on every attempt. Therefore, after the device was dislodged into the aortoiliac bifurcation, the forceps were used to keep the occluder partially collapsed into the sheath. Sheath, forceps, and device were then retrieved as a unit through the right CFA (**Figure 1C**). As a result, femoral access was lost and hemostasis was achieved with manual compression. Final angiography performed through the contralateral CFA showed no immediate complications.

One hour later, the patient experienced abrupt left leg pain. Doppler ultrasound showed signal attenuation of the left popliteal artery, and urgent angiography demonstrated thrombotic occlusion of the vessel. Percutaneous transluminal angioplasty (PTA) was performed with good flow restoration (Video 3).

One hour after PTA (**Table 1**), the patient reported sudden onset of abdominal pain. Examination revealed left abdominal quadrant tenderness to palpation without rebound, guarding, or rigidity. Bowel sounds were present throughout. Access sites examination was unremarkable. A few minutes later, the patient showed signs of hemodynamic collapse with confusion, shortness of breath, tachycardia (130 beats/min), and severe hypotension (systolic arterial pressure 50 mm Hg).

MEDICAL HISTORY

The patient's medical history was significant for diabetes, severe renal impairment, and a recent transient ischemic attack. His CHA_2DS_2-VASc (congestive heart failure, hypertension, age ≥75 years [doubled], diabetes mellitus, prior stroke or transient ischemic attack or thromboembolism [doubled], vascular disease, age 65 to 74 years, [sex category]) score was 4, and his HAS-BLED (hypertension, abnormal renal or liver function, stroke, bleeding history or predisposition, labile international normalized ratio, elderly [>65 years], drugs or alcohol) score was 2. Warfarin was offered for stroke prevention, but the patient refused anticoagulation therapy. Therefore, LAA closure was suggested.

DIFFERENTIAL DIAGNOSIS

Abdominal pain and hemodynamic instability raised suspicion of internal bleeding. Iatrogenic injury of the aortic wall and vascular access complication were supposed.

INVESTIGATIONS

Ephedrine bolus and fluids were administered to restore and maintain a mean arterial pressure of 65 mm Hg. Gas analysis revealed metabolic acidosis and severe anemia. Three units of blood were

ABBREVIATIONS AND ACRONYMS

AA = abdominal aorta

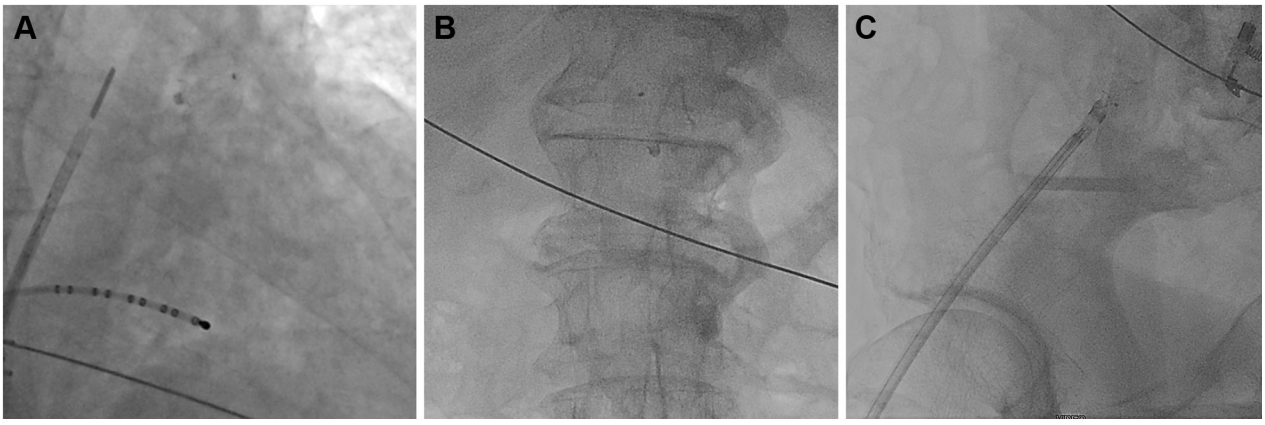
CFA = common femoral artery

LAA = left atrial appendage

MSCT = multislice computed tomography

PTA = percutaneous transluminal angioplasty

FIGURE 1 Watchman Deployment, Embolization, and Retrieval



(A) Device deployed in the left atrial appendage. **(B)** Device embolized in the abdominal aorta. **(C)** Device captured with a biopsy forceps and partially collapsed into the femoral sheath.

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TABLE 1 Timeline

LAA occluder deployment	−7 hours
LAA occluder embolization in the abdominal aorta	−5 hours
LAA occluder percutaneous retrieval	−3 hours
Acute thromboembolic occlusion of the left popliteal artery	−2 hours
Hemodynamic collapse	
MSCT scan showing aortic rupture and retroperitoneal hemorrhage	+10 minutes
Percutaneous repair of the aorta and surgical treatment of the right common femoral artery pseudoaneurysm	+2 hours
Rehabilitation program	+26 days
Hospital discharge	+49 days
Last follow-up: patient in clinically stable condition with sinus rhythm, still taking warfarin	+443 days

LAA = left atrial appendage; MSCT = multislice computed tomography

transfused, and urgent multislice computed tomography (MSCT) was performed (Video 4). Scanning revealed a high-attenuating fluid collection in the periaortic, left perirenal, and paracolic spaces (**Figure 2A**). The contrast "blush" within the hematoma suggested active hemorrhage originating from the posterior wall of the infrarenal AA (**Figures 2B and 2C**). Moreover, MSCT showed a round hemorrhagic structure at the level of the right CFA, with a short feeding tract communicating with the arterial lumen. The findings were consistent with an iatrogenic aortic rupture and a CFA pseudoaneurysm.

MANAGEMENT

An urgent endovascular procedure was performed under general anesthesia (Video 5). Angiography confirmed active bleeding from the infrarenal AA wall (**Figure 3A**). A stent graft was delivered through the left CFA and deployed in the AA with successful sealing of the parietal breach (**Figure 3B**). Subsequently, the right CFA pseudoaneurysm was surgically exposed and repaired by flattening the false aneurysm and closing the gap on the CFA.

DISCUSSION

Device embolization is a feared complication of transcatheter LAA closure and is reported in ≤2% of cases.[1] Usually, embolization occurs during or early after the procedure and is due to wrong sizing or misplacement of the device.[2-4] The left ventricle and aorta represent the most common sites of embolization, with small devices (<25 mm) more likely to exit the aortic valve.[2] We hypothesize that in the current case the mechanisms leading to embolization were the small LAA dimension and an incorrect positioning of the device. It should be noted that the implantation protocol used intracardiac echocardiography to assess the position, anchor, size, and seal criteria. Despite promising results,[5] this imaging technique has not yet been validated for guiding LAA closure in large prospective trials.

Retrieval strategies include surgical and percutaneous techniques. Usually, embolization into the left ventricle is best managed with surgery, whereas a percutaneous technique is preferred when embolization occurs in a great vessel.[1,2] The available array of percutaneous retrieval devices includes single- or triple-loop snares, baskets, and grasping forceps. A vascular sheath 2-F to 4-F larger than the occluder delivery sheath is recommended to allow enough space for device recapture.[1] Similarly to previous reports, we effectively captured the device using a biopsy forceps. Nevertheless, the retrieval was associated with serious complications.

First, 1 hour after the procedure, acute thromboembolism of the left lower limb occurred. We hypothesize that the trauma caused during withdrawal of the partially captured device across the left common iliac artery promoted local thrombosis and subsequent thromboembolism. Urgent PTA was needed for limb salvage.

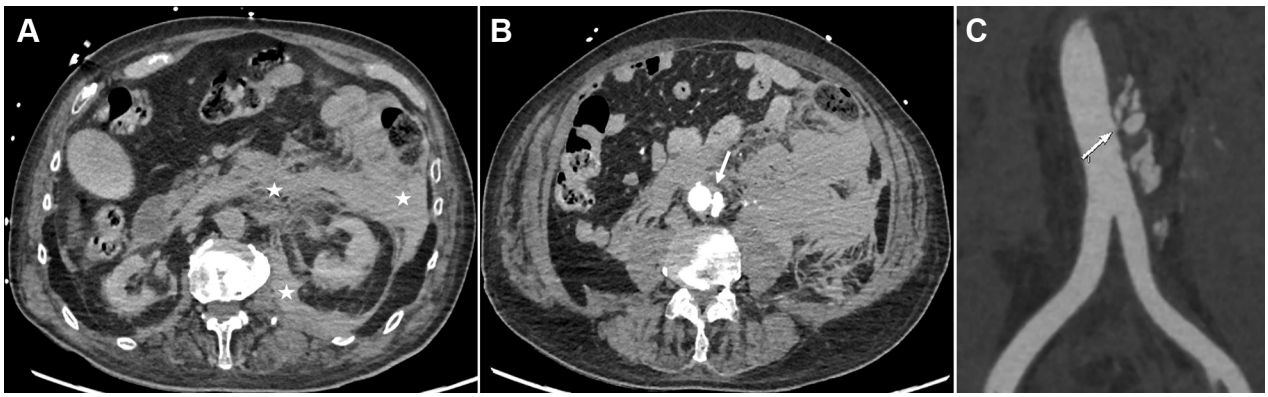
Second, 3 hours after the procedure, the patient experienced life-threatening hypovolemic shock due to aortic rupture and retroperitoneal hemorrhage, requiring immediate endovascular repair. We postulate that after embolization the device fixation barbs were anchored to the aortic wall. Grasping and retrieval of the device may have caused an intimal tear leading to vessel wall dissection. It is likely that heparinization during PTA worsened the AA lesion, causing progression of the vascular injury to the adventitial lamina and aortic rupture. This temporal sequence may explain the absence of aortic bleeding at the angiographic assessment performed immediately after the retrieval procedure.

Finally, an iatrogenic pseudoaneurysm of the CFA required surgical repair. It is plausible that the 12-F sheath, which was smaller than the occluder delivery sheath (14-F) and did not allow complete collapse of the device during withdrawal, contributed to the vascular damage. A larger sheath (16-F to 18-F) could have avoided this complication, but it was not available at the time of the procedure. Moreover, preclosure of the femoral access using a suture-mediated device could have further prevented the formation of the pseudoaneurysm.

FOLLOW-UP

The patient had a long stay in the intensive care unit and was discharged 49 days after the procedure to

FIGURE 2 **Abdominal Multislice Computed Tomography**



(A) High-attenuating fluid collection in the periaortic, left perirenal, and paracolic spaces **(stars)**. **(B, C)** Aortic bleeding site **(arrow)**.

receive aspirin and warfarin, a treatment he has since accepted. At 1-year follow-up visit, his clinical condition was stable.

CONCLUSIONS

With the increasing number of LAA closure procedures for stroke prevention, this case reminds us that this "preventive" treatment is not free of serious complications, which are even more worrisome in case of a borderline indication (e.g., patient refusal to take oral anticoagulant therapy). Appropriate patient selection, LAA morphology assessment, device sizing, and correct placement play a key role in reducing the risk of device embolization. Moreover, operators need to

FIGURE 3 **Aortic Repair**

(A) Aortic rupture with extravasation of contrast material **(arrow)**. (B) Sealing of abdominal aorta extravasation after implantation of a stent graft.

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familiarize themselves with retrieval techniques, which may be associated with serious complications and often require a multidisciplinary approach including cardiothoracic and vascular surgery. This case highlights that aortic rupture is now a recognized complication of embolized LAA occluder percutaneous retrieval and needs to be part of "disaster planning." Indeed, early identification and timely management are crucial for patient survival.

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KEY WORDS atrial fibrillation, complication, hemorrhage, aorta, hemostasis, occlude, thrombosis

APPENDIX For supplemental videos, please see the online version of this article.