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CONGENITAL HEART DISEASE

HOW WE DID IT

Percutaneous Removal of an Embolized Atrial Septal Defect Device With a Novel Retrieval System

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ABSTRACT

OBJECTIVE Successful use of the ŌNŌ retrieval system for percutaneous removal of an embolized 44-mm GORE CARDIOFORM ASD Occluder from the right pulmonary artery.

KEY STEPS A 24-F GORE DRYSEAL sheath was positioned in the main pulmonary artery, and then the ŌNŌ retrieval system was advanced coaxially through a 12-F Flexor sheath. Through this system, a 4-F Judkins Left 3.5 catheter and a 10-mm Amplatz Goose Neck snare were used to capture the device pin. Slow retraction of the device into the basket and then into the DRYSEAL was performed to safely extract the device.

POTENTIAL PITFALLS Tricuspid valve chordal injury, pulmonary artery dissection, and hemodynamic instability with a retrieval system across the tricuspid and pulmonary valves are some of the potential complications of the retrieval of atrial septal defect devices.

TAKE-HOME MESSAGES Percutaneous retrieval of embolized large atrial septal defect devices can be safely achieved using a dedicated retrieval system such as the ŌNŌ system, providing an effective alternative to surgical removal. (JACC Case Rep. 2026;31:106569) © 2026 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/).

Embolization of an atrial septal defect (ASD) device is a rare but recognized complication of transcatheter ASD closure reported at an incidence of 0.1% to 0.7%.[1-3] The most frequent site of embolization is the right ventricle or branch pulmonary arteries.[4] Depending on the device orientation, embolization can present with hemodynamic instability or symptoms mimicking pulmonary embolism.

Retrieval options include transcatheter snaring, endovascular forceps, or surgical removal, depending on device location and orientation.[5-8] For the GORE

TAKE-HOME MESSAGES

- Percutaneous removal of embolized ASD devices can be impaired by the inability to align the device coaxially with a snare into a long sheath, requiring a surgical bailout.
- Dedicated retrieval systems such as the ŌNŌ system provide an alternative to traditional snare techniques, which may improve procedural success and limit the risks associated with extracting large embolized ASD devices.

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ABBREVIATIONS AND ACRONYMS

ASD = atrial septal defect

CT = computed tomography

GCA = Gore CARDIOFORM ASD

JL = Judkins Left

RPA = right pulmonary artery

CARDIOFORM ASD (GCA) Occluder (W. L. Gore & Associates), percutaneous retrieval requires precise coaxial alignment of the device pin with the sheath tip to allow smooth withdrawal into a large-bore sheath. In the setting of large embolized devices, defects with inadequate rims where surgical defect closure will be required, or when the device remains within a cardiac chamber or valve apparatus, increasing the potential for valve damage, surgical extraction is often preferred.[6-8]

The ŌNŌ retrieval system (ŌNŌCOR LLC) has been successfully used for the removal of various intracardiac and endovascular structures, including left atrial appendage occluders and ventricular septal defect occluders.[9,10] Here, we describe the first reported successful percutaneous removal of an embolized GCA Occluder using this novel retrieval system.

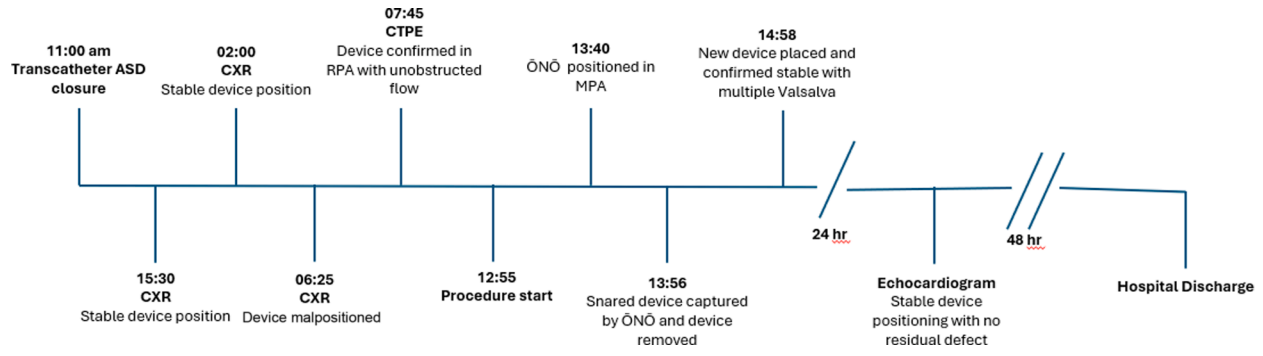
CASE SUMMARY

A 42-year-old woman with a history of alcoholic liver cirrhosis with portal hypertension, esophageal varices, chronic pancreatitis, diabetes, and a newly diagnosed large ASD was referred for transcatheter ASD closure under intracardiac echocardiographic guidance. Baseline hemodynamic data were notable for a right ventricular systolic pressure of 1/3 systemic, appropriately low right ventricular end-diastolic pressure of 6 mm Hg, a mean pulmonary artery pressure of 16 mm Hg, and a pulmonary capillary wedge pressure of 7 mm Hg, thus providing a transpulmonary gradient of 9 mm Hg. Her baseline pulmonary/systemic flow ratio was 1.9:1. A stop-flow technique was used for balloon sizing of the defect at 25.3 mm, and the patient underwent successful placement of a 44-mm GCA Occluder (**Figure 1A**). Approximately 12 hours after the procedure, the patient experienced chest pain and significant nausea and vomiting. Initial imaging noted a stable device as compared with postprocedure chest radiography (**Figures 1B and 1C**), but she then developed hypoxia and hypotension. An urgent computed tomography (CT) pulmonary embolism protocol demonstrated that the ASD device had embolized to her right pulmonary artery (RPA) (**Figures 1D to 1F**). CT demonstrated thrombus on the device but preserved flow to the distal RPA branches. Given her high surgical risk, a percutaneous retrieval approach was pursued. Despite CT evidence of thrombus around the embolized device, no additional anticoagulation was initiated before the procedure, given the need for large-bore vascular access, the requirement for full anticoagulation during the retrieval, and the rapid timeline for transfer to the catheterization laboratory.

PROCEDURAL STEPS

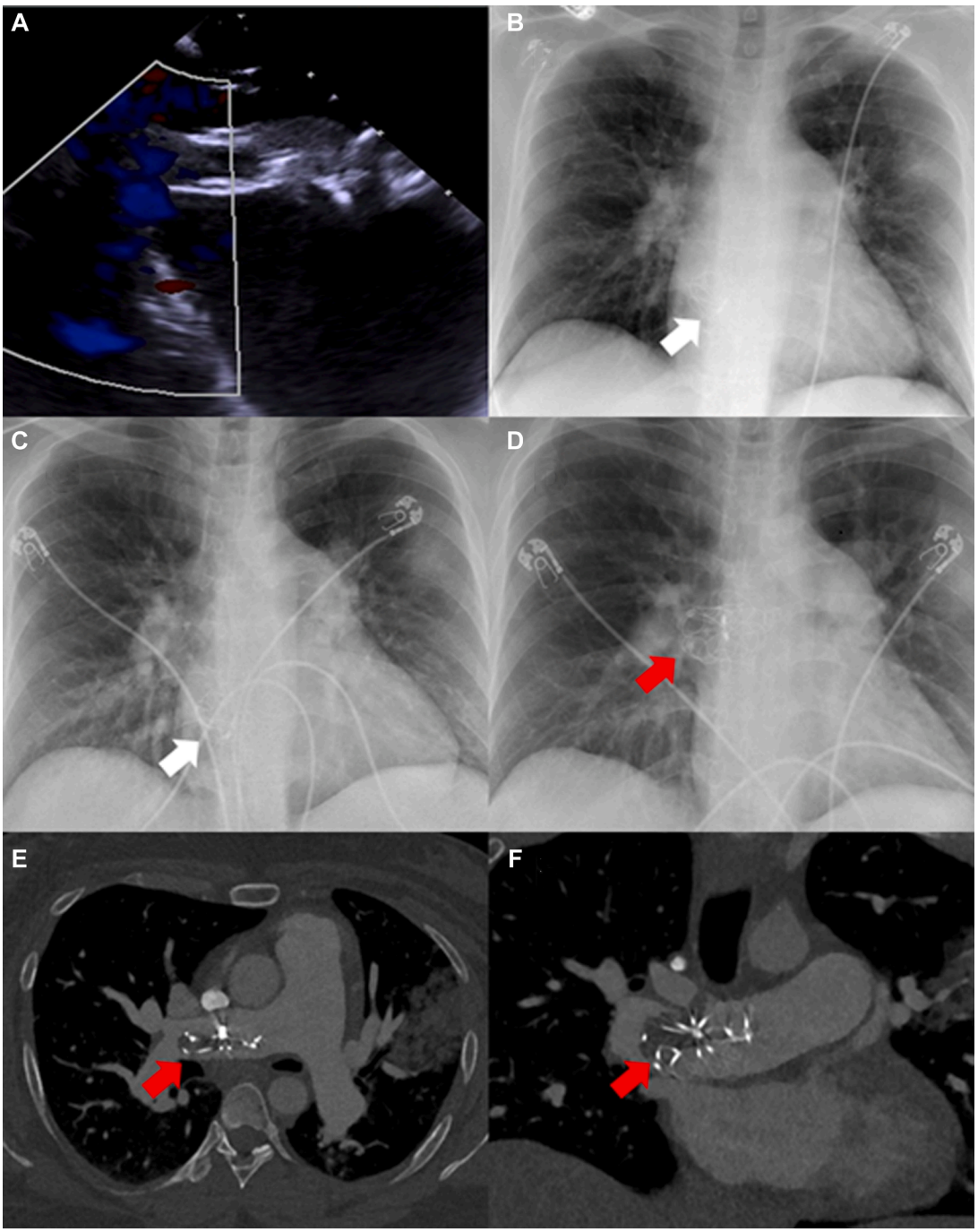
The patient was brought to the catheterization laboratory in stable condition and placed under general anesthesia. Access was obtained in the right femoral vein with a 24-F GORE DRYSEAL sheath (W. L. Gore & Associates), which was positioned in the main pulmonary artery. After access, 5,000 U of heparin was administered to maintain the activated clotting time of >250 seconds. The ŌNŌ retrieval system was advanced coaxially through a 12-F Flexor sheath

VISUAL SUMMARY **Chronological Clinical Course After ASD Device Embolization and Successful Retrieval**



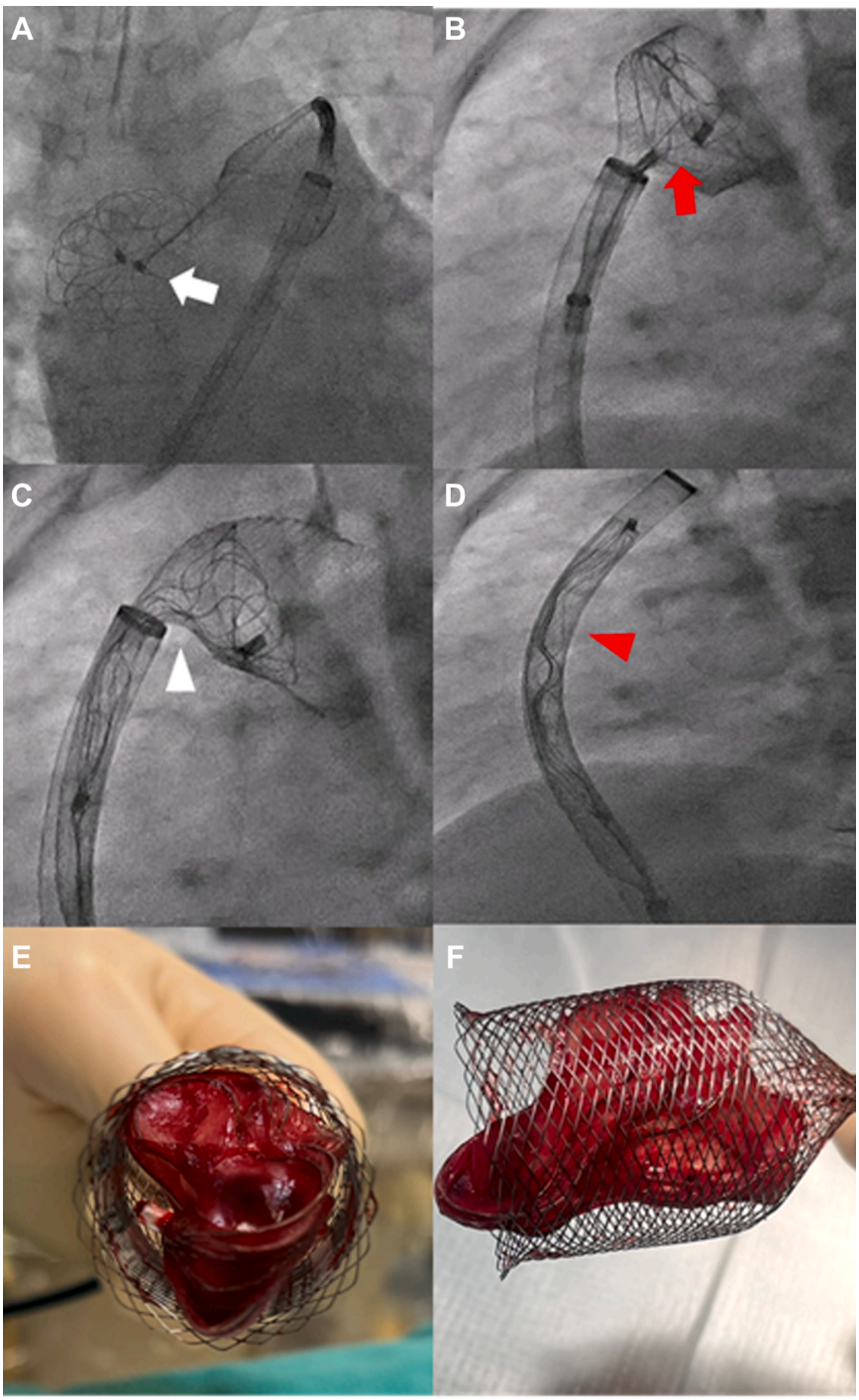
Key clinical events, diagnostic evaluations, and interventions surrounding the patient's presentation and management. Note the rapid time from positioning of the ŌNŌ retrieval system to device snaring and retrieval. ASD = atrial septal defect; CXR = chest radiography; CTPE = computed tomography pulmonary angiogram; MPA = main pulmonary artery; RPA = right pulmonary artery.

FIGURE 1 **Multimodality Imaging Before Device Retrieval**



(A) Intracardiac echocardiography after deployment of the 44-mm GORE CARDIOFORM ASD Occluder in the atrial septum. (B) Four-hour postprocedure chest radiography (CXR) (white arrow). (C) CXR at the time of nausea and vomiting showing stable device positioning (white arrow). (D) CXR after hypotension and hypoxia demonstrating device embolization (red arrow). (E and F) Axial and coronal computed tomography imaging with a device (and associated thrombus) in the right pulmonary artery (RPA) (red arrows). The left pulmonary artery is unobstructed, and there is flow around the device to the distal RPA branches.

FIGURE 2 Intraprocedural Fluoroscopic Imaging and Device Extraction



Step-by-step obtained fluoroscopic images of device retrieval into the ŌNŌ retrieval system. (A) Snaring of the device pin using a 10-mm Amplatz Goose Neck snare and a 4-F Judkins Left 3.5 catheter (white arrow). (B) Pulling the device into the ŌNŌ retrieval basket, with the device locking loop intact (red arrow). (C) Unlocking and elongation of the device into the ŌNŌ retrieval basket (white arrowhead). (D) Elongation and extraction of the device (red arrowhead). (E and F) Extracted device within the ŌNŌ retrieval basket.

EQUIPMENT LIST

24-F GORE DRYSEAL sheath (W.L. Gore & Associates)
10-mm Amplatz Goose Neck snare (Medtronic)
12-F Flexor sheath (Cook Medical)
ŌNŌ retrieval system (ŌNŌCOR LLC)
4-F Judkins Left 3.5 catheter (Merrit Medical)
44-mm GORE CARDIOFORM ASD Occluder (W. L. Gore & Associates)

(Cook Medical) within the DRYSEAL. A distal RPA wire position beyond the embolized device was obtained using a 4-F Judkins Left (JL) 3.5 catheter (Merit Medical). A 10-mm Amplatz Goose Neck snare (Medtronic) was advanced through the JL catheter, and the pin of the 44-mm GCA Occluder was captured (**Figure 2A**). The snare and JL complex attached to the GCA Occluder was pulled into the ŌNŌ retrieval system basket with ease (**Figure 2B**). The basket provided the tensile strength to unlock and elongate the device, allowing the device to be pulled into the DRYSEAL (**Figures 2C and 2D**, Video 1). The entire complex was removed from the body while protecting intracardiac structures through the DRYSEAL (**Figures 2E and 2F**, Video 2).

After device retrieval, under intracardiac echocardiographic guidance, a 30-mm Amplatzer Septal Occluder (Abbott Cardiovascular) was successfully used to close the defect. The Amplatzer device was chosen for closure at this time, as it was felt that with a floppy inferior vena cava rim, the stiffer device would provide more stability, and the 30-mm device has a 44-mm left atrial disk diameter. Given embolization of the previous device associated with vomiting, multiple high-pressure Valsalva maneuvers were performed both before and after device release, which revealed a stable device. The patient tolerated the procedure well and was later discharged from the hospital. A follow-up echocardiogram before discharge revealed a well-positioned device, confirming atrial septal tissue between the disks inferiorly with no residual defect, no tricuspid regurgitation, and no evidence of a pericardial effusion.

POTENTIAL PITFALLS

INTRACARDIAC DAMAGE. Prior reports of embolized GCA Occluder retrieval have highlighted the risks of pulmonary artery or tricuspid valve injury during extraction.[6-8] The ŌNŌ retrieval system's coaxial design nested within a 12-F sheath inside a large-bore DRYSEAL provides mechanical protection for intracardiac structures, reducing the likelihood of valvular or endocardial trauma during retrieval.

HEMODYNAMIC INSTABILITY. The positioning of a 24-F sheath across both the pulmonary and tricuspid valves can set up significant pulmonary and tricuspid regurgitation, leading to a period of decreased cardiac output. The ŌNŌ retrieval system, which removes the necessity for coaxial alignment of the pin with the sheath tip, allows rapid snaring and extraction of the device, minimizing the time the sheath is across the right heart. The rigid tensile basket provides countertraction along the long axis of the device, which allows controlled elongation and unlocking. Nesting the ŌNŌ within an extraction catheter before entering the DRYSEAL allows extraction of the device while maintaining protection of intracardiac structures by the DRYSEAL.

CONCLUSIONS

This case highlights the critical importance of having a dedicated percutaneous retrieval system, such as the ŌNŌ retrieval system, for rapid, effective management of embolized ASD devices. The ŌNŌ retrieval system offers a protective, coaxial extraction method that minimizes the risk to cardiac structures and provides an effective alternative to surgical retrieval for patients with high operative risk.

ETHICS STATEMENT. In accordance with our institution's institutional review board (IRB) guidelines, ethical approval and informed consent were waived for this case report, as it involves a single patient with no identifiable information and does not meet the criteria for human subjects research requiring IRB review.

FUNDING SUPPORT AND AUTHOR DISCLOSURES

Dr Zampi has served as a consultant for W. L. Gore & Associates and Medtronic; and is a data safety monitoring board member of Encore Medical and a clinical events committee member of Starlight. All other authors have reported that they have no relationships relevant to the contents of this paper to disclose.

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KEY WORDS atrial septal defect, chest pain, imaging, occluder, right heart catheterization

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