

CASE REPORT

CLINICAL CASE SERIES

Transcatheter Basket Retrieval System for Extraction of Intracardiac Vegetations and Thrombi

W. Wyatt Lindsey, MS,^{a,b} Kinjal Parikh, MD,^a Kathryn P. Reynolds, MD,^a Kristen E. Barbieri, MD,^a Catherine E. Tomasulo, MD^a

ABSTRACT

Device-assisted removal of intracardiac thrombi and vegetations remains a high-risk procedure given the potential for embolization. We report 4 cases in which the ONO transcatheter retrieval system was used for targeted extraction of intracardiac masses in patients of varying age, size, and clinical background. These cases demonstrate the ONO's versatility with a range of adjunctive devices, making it a strong option for patients requiring urgent, minimally invasive intervention or those not amenable to surgical or medical management. (JACC Case Rep. 2026;■:107654)

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Device-based removal of intracardiac thrombi and vegetations is increasingly common but remains high risk given the potential for embolization. The ONO transcatheter retrieval system (ONOCOR) is a catheter-based retrieval system designed to increase the speed and safety of intravascular foreign object removal. It consists of a 100-cm, 7.5-F catheter fused to a collapsible nitinol basket that does not obstruct blood flow when deployed. The basket expands to a maximum diameter of 35 mm and is compatible with 7-F and smaller snares. When retracted, the basket applies an external compressive force to capture and contain its target, reducing the risk of vascular injury by shielding the vessel wall. Use of this device has been documented in a wide variety of complex cardiac cases, including thrombectomy and retrieval of intravascular devices and intracardiac tumors. The ONO is particularly well suited for these procedures, as it enables controlled extraction while minimizing

TAKE-HOME MESSAGES

- The ONO transcatheter retrieval system is an effective tool for the removal of intracardiac masses, particularly large, fibrinous, or organized thrombi and vegetations.
- Compared with aspiration-based systems, the device is associated with reduced embolic risk and decreased blood loss.
- Its compatibility with other percutaneous devices enhances its procedural flexibility in complex procedures.

embolic risk. We present 4 cases of thrombus and vegetation removal using the ONO device, demonstrating its versatility and clinical utility.

CASE 1

A 47-year-old, 60.7-kg woman with a history of sub-aortic stenosis after having undergone resection with

From the ^aDivision of Cardiology, Inova Children's Hospital, Falls Church, Virginia, USA; and the ^bAlabama College of Osteopathic Medicine, Dothan, Alabama, USA.

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**ABBREVIATIONS
AND ACRONYMS****ICD** = implantable
cardioverter-defibrillator**RA** = right atrium**RVOT** = right ventricular
outflow tract**TEE** = transesophageal
echocardiography

a myomectomy and aortic valve repair, complicated by complete atrioventricular block requiring a cardiac resynchronization therapy-implantable cardioverter-defibrillator (ICD), was transferred to our hospital with *Streptococcus viridans* endocarditis. Echocardiography revealed a vegetation on the right ventricular ICD lead. Percutaneous removal of this vegetation with the ONO

device was pursued to minimize embolic risk during ICD lead extraction, avoid the need for surgical intervention, and address persistent infection after failed antibiotic therapy.

In the catheterization laboratory, transesophageal echocardiography (TEE) identified a large, mobile 10 × 6 mm globular vegetation in the right ventricular outflow tract (RVOT) approximately 25 to 30 mm beneath the pulmonary annulus (**Figure 1A**). Vascular access was obtained in the right femoral vein, and a 26-F DrySeal sheath (Gore) was placed and advanced to the inferior vena cava. A 13.8-F Passport steerable sheath (Baylis Medical) was advanced through the DrySeal sheath, directed into the RVOT, and aimed toward the vegetation. The ONO device was advanced and partially deployed in the RVOT, just below the pulmonary valve. Sequential 9-15 mm and 18-30 mm En Snare systems (Merit Medical) were introduced through a 6-F MPA catheter and a 7-F snare catheter within the ONO system and positioned against the vegetation (**Figure 2**). Multiple passes with the En Snare systems captured segments of the vegetation until it was no longer visualized on TEE (**Figure 1B**). Residual tissue was contained within

the removed ONO device and sheath. A second, smaller and nonmobile vegetation on the septal tricuspid leaflet was left in place. Final TEE confirmed no additional vegetations were present. Lead extraction was subsequently performed during the same procedure.

CASE 2

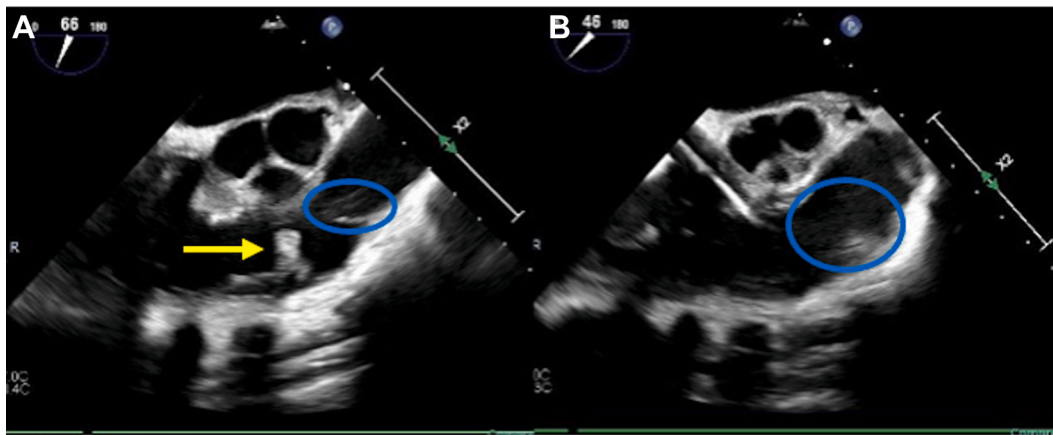
A 26-year-old, 77-kg man with Marfan syndrome and recent valve-sparing aortic root repair was referred for urgent thrombectomy after a postoperative echocardiogram showed a large right atrial (RA) thrombus. Medical and surgical management were unappealing given the patient's recent surgery and concern for blood loss, a delicate bleeding and clotting balance with thrombus formation despite apixaban and aspirin therapy, and a complicated postoperative course of symptomatic pulmonary embolism and persistent fever. Given these considerations, percutaneous thrombectomy using the ONO device was selected.

Preprocedural transthoracic echocardiography revealed an 18 × 10 mm globular RA thrombus adjacent to the tricuspid valve (**Figure 3A**). Vascular access was obtained in the right internal jugular vein and upsized to a 22-F DrySeal sheath. A 6-F MPA1 catheter and 25-mm Goose Neck snare (Medtronic) were positioned in the RA. The ONO system was advanced through the DrySeal sheath and partially opened in the RA, but initial attempts with the En Snare failed given poor alignment. A 15-F Watchman FXD Curve access system (Boston Scientific) was introduced,

VISUAL SUMMARY Case Series Overview

Case 1	A 47-year-old woman with subaortic stenosis after having undergone resection with a myomectomy and aortic valve repair, complicated by complete atrioventricular block requiring CRT-ICD. Echocardiography revealed a globular 10 × 6 mm vegetation on the right ventricular ICD lead. The ONO was introduced through a Passport steerable sheath, directed toward the vegetation, and deployed. Percutaneous removal was achieved by introducing En Snare systems through the ONO to capture and contain the vegetation within its basket for extraction.
Case 2	A 26-year-old man with Marfan syndrome and recent valve-sparing aortic root repair. Echocardiography showed a large, globular thrombus measuring 18 × 10 mm within the RA. The ONO was introduced through a Watchman FXD Curve access system and positioned near the thrombus. An AL1 guide catheter directed an En Snare system to withdraw the thrombus into the ONO's basket for complete removal of the thrombus.
Case 3	A 20-year-old man with repaired complete atrioventricular canal defect and complete heart block requiring an epicardial dual-chamber pacemaker. Echocardiography demonstrated a mobile, irregularly shaped vegetation measuring 25 × 18 mm on his Aveir leadless pacemaker. The ONO was introduced through a Passport steerable sheath and directed toward the vegetation. An En Snare system deployed through the ONO contained the vegetation within its basket and allowed successful extraction.
Case 4	An 8-year-old boy with Hodgkin's lymphoma underwent echocardiography, which revealed a large, mobile thrombus associated with a port-a-cath measuring 18 × 25 mm adhered to the RA free wall by a narrow stalk. An MPA catheter and Goose Neck snare were introduced through the ONO to capture and contain the thrombus within its basket. A Triever20 embolectomy catheter was used to remove the remaining less-organized portion of the thrombus. A small portion of the thrombus remained attached to the Eustachian valve and was managed medically.

CRT = cardiac resynchronization therapy; ICD = implantable cardioverter-defibrillator; RA = right atrium.

FIGURE 1 Transesophageal Echocardiography From Case 1 Demonstrating a Large Vegetation in the Right Ventricular Outflow Tract

(A) A large 10 × 6 mm globular mass (arrow) is seen approximately 25 to 30 mm proximal to the pulmonary valve (circled) annulus. (B) After multiple passes with the En Snare system, the vegetation is no longer visualized.

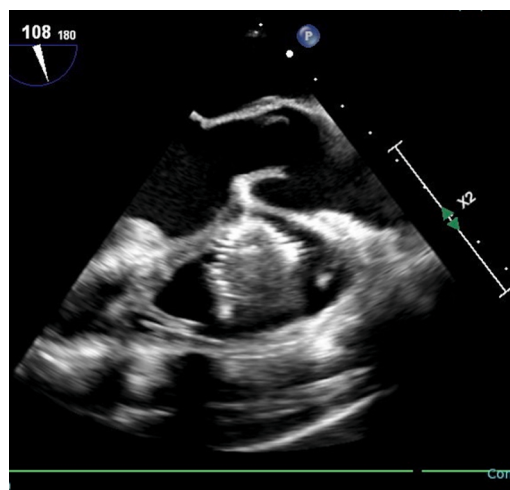
and the ONO system was advanced but again failed to align properly. Right femoral vein access was then obtained and upsized to a 24-F DrySeal sheath. A second 15-F Watchman FXD sheath was advanced into the RA, followed by the ONO device. A 6-F AL1 guide catheter was used to direct an 18-30 mm En Snare system over the thrombus, which successfully snared and withdrew the thrombus into the ONO system. All components, including the snared thrombus, were removed together through the sheath. The retrieved thrombus was fibrinous and approximately 20 mm in size (Figure 4). TEE confirmed no residual thrombus or increase in tricuspid regurgitation (Figure 3B).

CASE 3

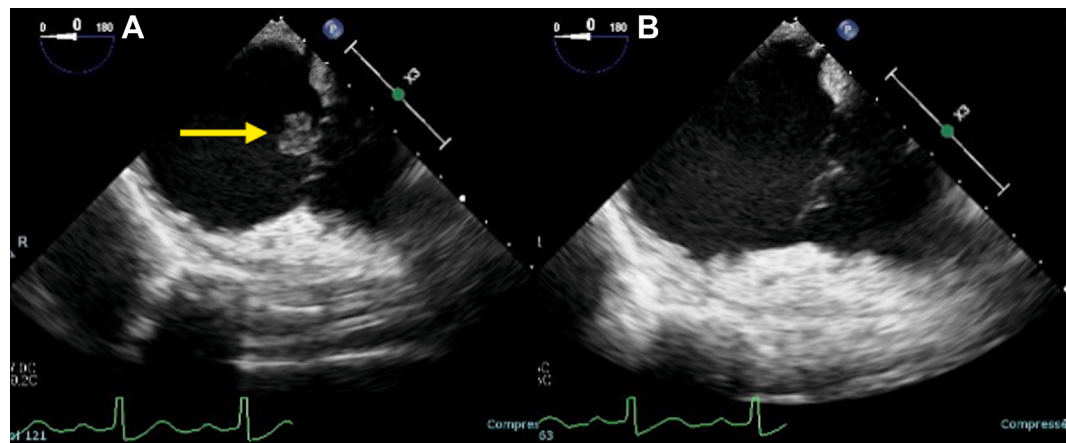
A 20-year-old, 85.1-kg man with a history of repaired complete atrioventricular canal defect and complete heart block requiring an epicardial dual-chamber pacemaker was found to have a vegetation on his third, newly implanted Aveir leadless pacemaker. Notably, his first 2 pacemakers had been complicated by methicillin-susceptible *Staphylococcus aureus* bacteremia. Given multiple failures of antibiotic therapy, the decision was made to place a temporary pacemaker followed by vegetation extraction with the ONO system, with subsequent leadless device removal.

TEE showed a mobile, irregular 25 × 18 mm echogenic mass attached to the leadless pacemaker, along the right ventricular septum, moving in and out of the RVOT without significant obstruction (Figure 5A).

Right femoral vein access was obtained and upsized to a 25-F 50-cm Aveir Introducer (Abbott), which was advanced to the inferior vena cava, followed by a 13.8-F Passport steerable sheath into the RVOT. The ONO device was deployed and pulled into the right ventricle, and an 18-30 mm En Snare system was advanced through it with 6-F AL1 and multipurpose

FIGURE 2 Transesophageal Echocardiography From Case 1 Revealing the ONO Retrieval System Deployed in the Right Ventricular Outflow Tract

The device is deployed just below the pulmonary valve and positioned against the vegetation.

FIGURE 3 Transesophageal Echocardiography From Case 2 Demonstrating a Thrombus in the Right Atrium

(A) A large 18 × 10 mm echogenic mass (arrow) is seen adjacent to the tricuspid valve. (B) Postprocedural imaging revealed no residual thrombus remaining in the right atrium.

catheters. Multiple passes removed segments of the vegetation, which were captured within the ONO system (Figure 5B). The leadless pacemaker was then successfully retrieved separately using another snare.

CASE 4

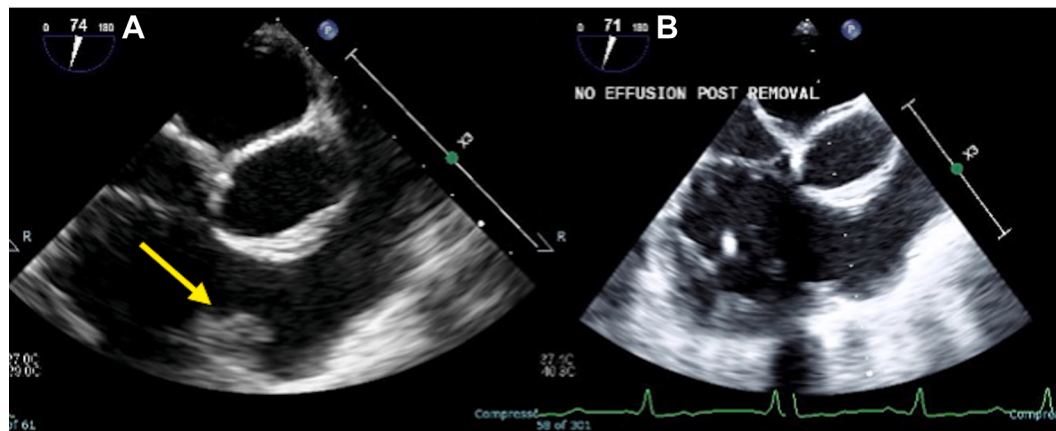
An 8-year-old, 24.2-kg boy with Hodgkin's lymphoma was found to have a large, mobile RA thrombus

associated with a port-a-cath (implanted port) during prechemotherapy echocardiography. Thrombolytic therapy was initiated but was discontinued after the patient developed anaphylaxis to alteplase. Surgical thrombectomy was deferred owing to oncologic risk and potential delay of chemotherapy. The decision was made to proceed with percutaneous thrombectomy using the ONO device.

TEE revealed an 18 × 25 mm mobile echogenic mass attached to the free wall of the RA by a narrow stalk (Figure 6A). The mass exceeded the diameter of both the tricuspid valve annulus (23 mm) and main pulmonary artery (19 mm), but there was no evidence of obstruction to the systemic veins, atrial septum, coronary sinus, or tricuspid valve. A 14-F DrySeal sheath within a 20-F DrySeal sheath was placed in the right internal jugular vein and positioned in the RA, through which the ONO device was advanced and deployed. A 35-mm Goose Neck snare was threaded through an MPA guide catheter and used to capture the thrombus. The ONO was advanced over the snared thrombus, and the mobile portion was successfully extracted. The removed thrombus had an organized and fibrinous structure upon inspection (Figure 6B). A Trier20 embolectomy catheter (Inari Medical) was then inserted through the DrySeal sheath to remove the remaining, less-organized portion of the thrombus. A significantly smaller portion of the thrombus still remained but was found to be firmly attached to the Eustachian valve after tension was applied using a Raptor grasping device. This remaining portion was deemed unlikely to

FIGURE 4 Photograph of the Removed Thrombus in Case 2 Now Partially Contained Within an 18-30 mm En Snare System Exiting From the ONO Basket

The thrombus measured approximately 20 mm in size and had a fibrinous structure.

FIGURE 5 Transesophageal Echocardiography From Case 3 Demonstrating a Large Vegetation Adhered to a Leadless Pacemaker

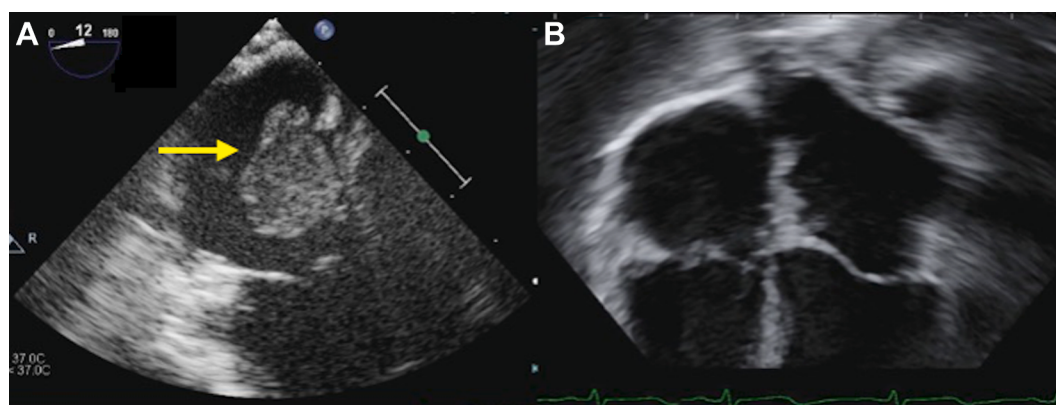
(A) A 25 × 18 mm irregularly shaped mass (arrow) is visualized along the right ventricular septum. (B) The mass is no longer seen after multiple passes with an En Snare system.

embolize and was therefore amenable to medical management. At the 6-week follow-up, echocardiography showed a stable thrombus. At 12 weeks, the thrombus appeared smaller and more echogenic, suggesting calcification. By 7 months, the thrombus had further reduced in size and appeared as a calcified remnant.

DISCUSSION

Intracardiac masses are associated with a range of clinical sequelae, including potentially fatal embolization and hemodynamic compromise. Right heart

thrombi, in particular, carry a mortality rate of 80% to 100%, mainly because of the risk of pulmonary embolism, although pediatric data remain limited.¹ Historically, treatment has involved either medical therapy or surgical intervention, both of which carry significant risk factors. As a result, percutaneous techniques have emerged as a promising alternative to both medical and surgical strategies. Compared with percutaneous thrombectomy, thrombolytic therapy carries a higher risk of hemorrhage, with an overall rate of 22%.² Furthermore, incomplete thrombus dissolution increases the risk of recurrent embolism. Reported mortality with thrombolytic

FIGURE 6 Transesophageal Echocardiography From Case 4 Demonstrating a Large Thrombus Associated With a Port-a-Cath Within the Right Atrium

(A) An echogenic 18 × 25 mm mass (arrow) is seen attached to the free wall of the right atrium by a narrow stalk. (B) The mobile portion of the thrombus was successfully extracted using the ONO and is no longer seen in the right atrium.

therapy is approximately 13.7%.³ Surgical embolectomy is highly invasive and often requires cardiopulmonary bypass. For thrombi extending from the right atrium to the pulmonary arteries, surgical embolectomy carries an intraoperative mortality rate of up to 7%, with an overall surgical mortality rate of 18.3%.^{3,4}

Percutaneous techniques have emerged as an alternative treatment modality to thrombolysis and surgery, although there are currently no formal guidelines regarding their use in the management of intracardiac masses. Many reports have described the removal of intracardiac masses using suction-based devices, such as the AngioVac and AlphaVac.^{5,6} Compared with these devices, the ONO results in less blood loss and is more adept at extracting large, well-organized masses. The ONO retrieval system represents a newer approach, designed to safely remove large, organized intracardiac masses with minimal blood loss, offering an alternative treatment modality to surgery and a valuable option for patients who have failed medical therapy.

Here, we present a series of cases demonstrating the ONO system's application across diverse cardiovascular pathologies in patients of varying ages and sizes. The device was successfully used to extract intracardiac thrombi and vegetations in patients who had failed antibiotic and anticoagulant therapy, underscoring its utility across multiple clinical scenarios.

In all cases, the ONO system effectively removed organized, fibrinous masses from the right heart without subsequent embolism. This is largely owing to its basket design, which allows for en bloc removal of large thrombotic material while capturing fragments to reduce embolic risk. Notably, one case (case 4) involved the removal of a thrombus larger than both the tricuspid valve annulus and the main pulmonary artery. Had this embolized, it would have likely severely impaired pulmonary perfusion, potentially resulting in fatal complications.

Another advantage of this thrombectomy system is its compatibility with a wide range of interventional tools. In each of the cases we describe, the ONO was integrated with various sheaths and catheters. Specifically, in cases 1 and 3, the device was used through a Passport steerable sheath to

compensate for the ONO's lack of deflectability. Using the 2 devices in concert enabled precise targeting and successful removal of intracardiac vegetations, increasing procedural efficiency and success.

The ONO's clinical versatility is further demonstrated in its ability to remove intracardiac masses from both native and non-native structures. Cases 1, 2, and 4 involved the removal of masses from native structures in distinct anatomic locations, while case 3 addressed a vegetation attached to a leadless pacemaker. Vegetations attached to intracardiac devices carry a high embolic risk given increased mobility, and removing masses from non-native structures poses an even greater risk because of their unstable attachment. The ONO's ability to effectively remove such masses with minimized risk of embolic complications underscores its utility in managing both structural and device-related pathology. Removing vegetations before manipulating intracardiac devices reduces embolic risk, even when the mass is not directly attached to the device. In these cases, using the ONO lowers the embolic risk compared to device extraction with vegetations in place.

Overall, the ONO retrieval system is a valuable tool for transcatheter removal of intracardiac masses. Its successful use in our 4 challenging cases highlights several key advantages of the ONO retrieval system: effective and prompt removal of intracardiac masses; avoidance of cardiothoracic surgery; avoidance of prolonged, potentially ineffective medical therapy; and the ability to preserve management of the patients' coexisting conditions (ie, need for pacemaker or chemotherapy). These advantages, along with its ability to integrate with other percutaneous devices and adapt to varied patient anatomies, supports its role in complex cardiovascular care of all ages.

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ADDRESS FOR CORRESPONDENCE: Dr Catherine E. Tomasulo, Division of Cardiology, Inova Children's Hospital, Falls Church, 3300 Gallows Road, Falls Church, Virginia 22042, USA. E-mail: catherine.tomasulo@inova.org.

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