

CASE REPORT

ADVANCED

CLINICAL CASE

The Simplified Extraction of Atrial Tumor With Targeted Loop Electricity (SEATTLE) Procedure



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ABSTRACT

The removal of intramyocardial masses has long been thought of as a surgical procedure and is generally reserved for patients with obstructive symptoms when the mass is thought to be benign. Thus, many patients who are incidentally diagnosed with intracardiac masses are either subjected to protracted follow-up with serial imaging awaiting tumor growth before surgical excision is ultimately offered. We report a novel procedure in which a 54-year-old man with an atrial myxoma underwent successful percutaneous resection using electrosurgery followed by removal with a novel endovascular retrieval system. This approach provides an alternative to either surgical excision or watchful waiting in patients with small- to medium-sized intracardiac tumors. (**Level of Difficulty: Advanced.**) (J Am Coll Cardiol Case Rep 2023;10:101758) © 2023 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 54-year-old man with a history of liver transplant for alcohol-related cirrhosis was referred to our structural heart disease clinic for consideration of transcatheter mass removal. Two years prior, the patient was discovered to have a 1.7×1.3 cm pedunculated right atrial mass on an otherwise unremarkable pre-liver transplant echocardiogram,

confirmed by cardiac magnetic resonance (**Figure 1A**). He underwent a comprehensive work-up and was treated with a course of oral anticoagulation without change. Given no symptoms nor obstructive physiology, the patient was ultimately cleared for surgery and underwent an uncomplicated liver transplant. He underwent cardiac surveillance over the ensuing 2 years with transthoracic echocardiograms showing a stable mass size; however, the patient remained anxious about the finding, leading him to pursue multiple opinions regarding options for mass removal.

LEARNING OBJECTIVES

- To understand the role of new transcatheter technologies in aiding the percutaneous extraction of small- to moderate-sized atrial tumors.

DIFFERENTIAL DIAGNOSIS

The differential diagnosis for pedunculated interatrial masses is narrow and includes thrombus,

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**ABBREVIATIONS
AND ACRONYMS****SEATTLE** = Simplified
Extraction of Atrial Tumors
with Targeted Loop Electricity

primary intracardiac tumor, and metastatic tumor. Given the lack of response to anti-coagulation and no identifiable extracardiac pathology, the mass was suspected to be a benign atrial myxoma.

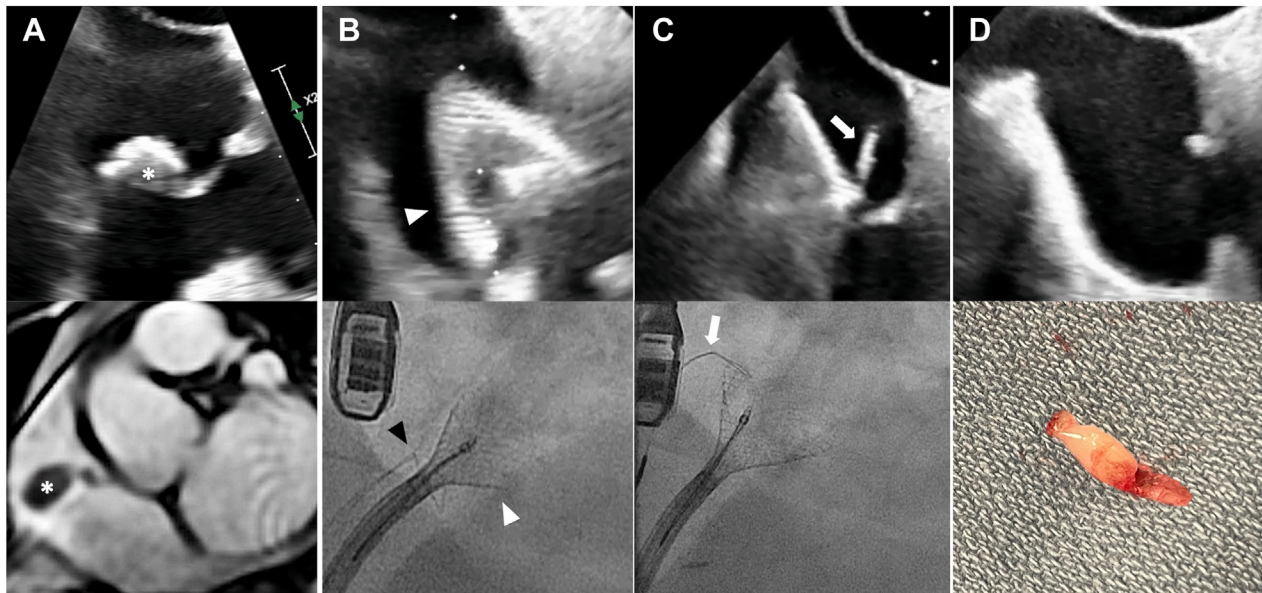
MANAGEMENT

Despite being asymptomatic, the patient sought multiple cardiovascular consultations during which he expressed a strong desire to pursue mass excision and a preference to avoid surgical intervention even though he was considered a low-risk surgical candidate by a consulting cardiothoracic surgeon. He was ultimately referred for consideration of a transcatheter approach to tumor removal.

We therefore devised a plan using concepts common to electrosurgery to lacerate the stem of the mass and turned to a newly developed technology, the $\hat{O}\hat{N}\hat{O}$ endovascular retrieval system ($\hat{O}\hat{N}\hat{O}$ COR Vascular) (Figure 2) to aid in retrieval of the tumor en masse. To ensure effective electrosurgical laceration of the stalk, we planned to use an endoscopic

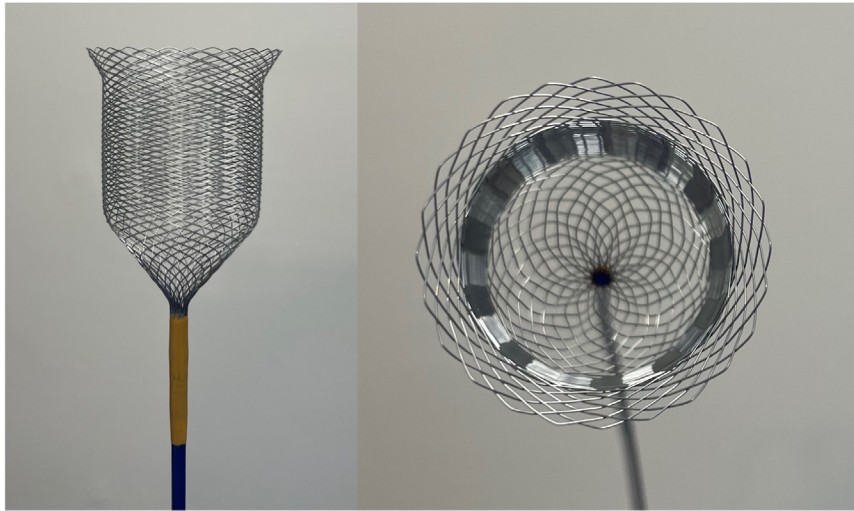
electrocautery snare (Olympus) that is typically used in the endoscopy suite to remove gastrointestinal polyps and purpose-built to convey electrical current.

The procedure was performed under general anesthesia and guided by transesophageal echocardiography. A 22-F sheath was advanced into the right femoral vein. A 13.5-F internal diameter Destino Twist steerable sheath (OSCOR Inc) was inserted through the loop of the electrocautery snare. The endovascular retrieval system was inserted through the steerable sheath and an 18- to 30-mm endovascular EN Snare catheter (Merit Medical) was inserted through the center lumen of the endovascular retrieval basket. This entire system was then inserted into the femoral venous sheath such that the endoscopy snare remained outside and encircling the steerable sheath (Figure 3). The right atrial mass was snared under transesophageal echocardiography guidance with the endovascular snare catheter while the expandable endovascular retrieval basket was advanced over the mass to help secure it in place (Figure 1B). The electrocautery snare was advanced

FIGURE 1 Step-by-step Excision and Removal of a Right Atrial Mass Using Electrocautery and the $\hat{O}\hat{N}\hat{O}$ Endovascular Retrieval System

(A) Transesophageal echocardiographic and cardiac magnetic resonance of a moderate-sized, pedunculated atrial mass (white asterisk) adherent to the roof of the right atrium. (B) The atrial mass was captured with the EN Snare and the $\hat{O}\hat{N}\hat{O}$ basket (white triangle) was advanced over the mass securing it in place, while the electrocautery snare (black triangle) remained at the base of the basket. (C) The electrocautery snare was advanced over the $\hat{O}\hat{N}\hat{O}$ basket (white arrow) to the base of the pedunculated mass. (D) Following electrocautery of the stalk, the mass was safely externalized using the $\hat{O}\hat{N}\hat{O}$ endovascular retrieval system.

FIGURE 2 Novel Endovascular Retrieval System



The endovascular retrieval system is constructed out of a woven nitinol basket with a 7-F inner lumen allowing introduction of a snare. This device can be introduced within a sheath 12-F or larger.

over the endovascular retrieval basket and endovascular snare to the base of the tumor (Figure 1C). The tumor stalk was severed by retracting the electrocautery loop into its protective housing while delivering a 50-W pulse using a Bovie pencil, freeing the tumor from the right atrial wall (Figure 1D). The tumor and endovascular retrieval basket were simultaneously withdrawn into the steerable sheath. The total procedural time was 43 minutes, and fluoroscopy time was 7.8 minutes. There were no hemodynamic perturbations during the procedure and the patient was extubated post procedure and discharged in stable condition 2 hours post hemostasis. The mass was sent for pathologic evaluation and confirmed to be an atrial myxoma.

DISCUSSION

Primary cardiac tumors are rare and often benign.¹ However, over time, these tumors may grow, leading to intracardiac obstruction, impingement on valve function, and constitutional symptoms.^{2,3} At present, surgical excision of intracardiac tumors is the only broadly accepted method for removal,⁴ but this is often reserved for patients experiencing significant symptoms. Until now, there have been few alternatives to surgical removal or watchful waiting. Konecny, et al⁵ reported on their approach to transcatheter removal of a right atrial myxoma in 2014 using radiofrequency ablation and mass extraction

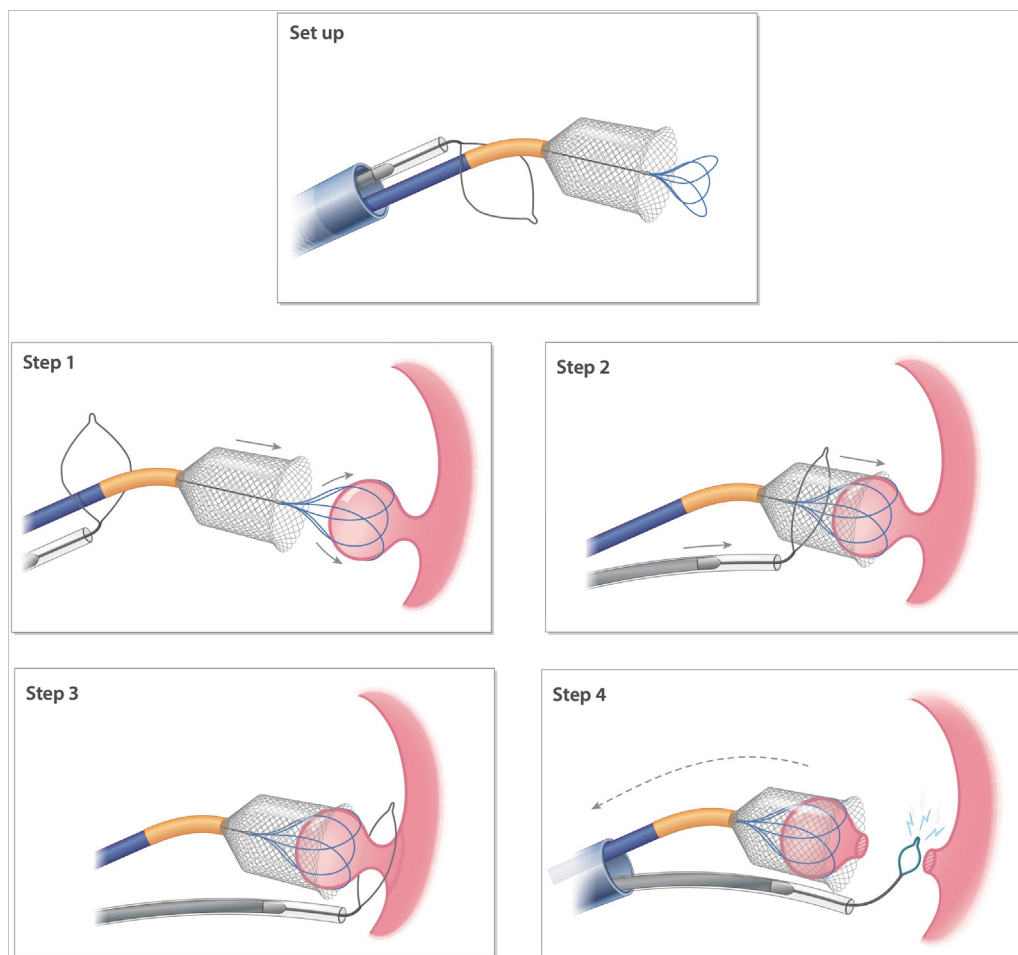
with a gooseneck snare retracted through a large sheath. This technique required multiple ablative attempts, resulting in disruption of the mass and fragment embolization. To date, there have been no subsequent reports of successful transcatheter removal of intracardiac masses, highlighting the challenges of this feat.

Our procedure leverages advances in the field of transcatheter electrosurgery, which has allowed operators to incise intracardiac structures through catheters with excellent precision.⁶ Additionally, the challenge of safe extraction was addressed using an endovascular retrieval system newly approved by the U.S. Federal Drug Administration, which consists of a 35-mm wide nitinol basket catheter with a 7-F central lumen allowing the introduction of a snare.

We recognize that percutaneous mass extraction does not permit tumor removal with clean margins and may result in tumor regrowth over time. Therefore, ongoing imaging surveillance on an intermittent basis should be considered for patients, which is common practice for patients undergoing surgical mass excision.

CONCLUSIONS

The Simplified Extraction of Atrial Tumors With Targeted Loop Electricity (SEATTLE) procedure offers a safe, effective, and potentially reproducible method

FIGURE 3 Step-by-step Illustration of the SEATTLE Procedure

An endoscopic electrocautery snare is advanced over the endovascular retrieval system housed within the steerable sheath. The electrocautery snare, endovascular retrieval system, and steerable sheath are advanced through a large venous sheath. An endovascular snare is inserted into a 7-F JR4 catheter and advanced through the center lumen of the endovascular retrieval system (set up). The endovascular snare is advanced over the tumor, securing it in place (step 1). The endoscopic electrocautery snare is advanced over the endovascular retrieval basket and endovascular snare up to the base of the tumor stalk (steps 2 and 3). The base of the tumor is severed using the electrocautery snare while the tumor remains secured within the endovascular retrieval basket using the endovascular snare (step 4). SEATTLE = Simplified Extraction of Atrial Tumors with Targeted Loop Electricity.

for removing intracardiac tumors. This approach provides an alternative to either surgical excision or watchful waiting in patients with small- to medium-sized intracardiac tumors.

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Dr Steinberg has served as a consultant for Medtronic, Abbott, and Gore Medical. Dr McCabe has served as a consultant for Boston

Scientific, Medtronic, Edwards Lifesciences, and CSI. All other authors have reported that they have no relationships relevant to the contents of this paper to disclose.

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REFERENCES

1. Reynen K. Frequency of primary tumors of the heart. *Am J Cardiol.* 1996;77(1):107.
2. Poterucha TJ, Kochav J, O'Connor DS, Rosner GF. Cardiac tumors: clinical presentation, diagnosis, and management. *Curr Treat Options Oncol.* 2019;20(8):66.
3. Li H, Guo H, Xiong H, Xu J, Wang W, Hu S. Clinical features and surgical results of right atrial myxoma. *J Card Surg.* 2016;31(1):15-17. <https://doi.org/10.1111/jocs.12663>
4. Salcedo EE, Cohen GI, White RD, Davison MB. Cardiac tumors: diagnosis and management. *Curr Probl Cardiol.* 1992;17(2):73-137.
5. Konecny T, Reeder G, Noseworthy PA, Konecny D, Carney JA, Asirvatham SJ. Percutaneous ablation and retrieval of a right atrial myxoma. *Heart Lung Circ.* 2014;23(11):e244-e247.
6. Khan JM, Rogers T, Greenbaum AB, et al. Transcatheter electrosurgery: JACC State-of-the-Art Review. *J Am Coll Cardiol.* 2020;75(12):1455-1470.

KEY WORDS atrial myxoma, electrosurgery, endovascular excision, endovascular retrieval, intracardiac mass