MINI-FOCUS ISSUE ON CORONARY, PERIPHERAL, AND STRUCTURAL INTERVENTIONS

CLINICAL CASE

Percutaneous Excision of Left Atrial Myxoma Using Transcatheter Electrosurgery

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ABSTRACT

Left atrial myxoma is the most prevalent primary cardiac tumor, known for its high risk of systemic embolization. Although surgical excision remains the standard treatment, options are limited for high-risk patients. This case report introduces a novel approach using transcatheter electrosurgery to address a left atrial myxoma via a transseptal approach in a patient ineligible for conventional surgery due to the heightened risk of intracranial hemorrhage associated with cerebral amyloid angiopathy. Despite encountering technical challenges, this innovative procedure represents a pioneering application of transcatheter surgery for managing left heart tumors. (JACC Case Rep. 2025;30:102718) © 2025 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 73-year-old man with history of diabetes, hypertension, coronary artery disease, and permanent atrial fibrillation (CHA2DS2-VASc = 4) was referred for left atrial appendage occlusion after spontaneous intracranial hemorrhage under non-vitamin K antagonist oral anticoagulant.

TAKE-HOME MESSAGE

- This case represents the first successful application of transcatheter electrosurgery for percutaneous excision of a left atrial myxoma in a patient considered unsuitable for conventional cardiac surgery, highlighting a less invasive treatment option for high-risk patients with left heart tumors.

Cerebral magnetic resonance imaging showed patterns indicative of cerebral amyloid angiopathy, prompting the decision not to resume oral anticoagulation.

INVESTIGATIONS

As part of left atrial appendage occlusion procedure planning, the cardiac computed tomography (CT) revealed an 18 × 13-mm mass in the left atrium, attached to the interatrial septum with a large stalk that was challenging to delineate clearly. Transesophageal echocardiogram revealed a round and large-stalked mass in the left atrium, attached to the anteroinferior aspect of the interatrial septum (septum primum) near the aortic valve (Figure 1). These findings were considered highly consistent with left atrial polypoid myxoma.

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ABBREVIATIONS AND ACRONYMS

CT = computed tomography

SEATTLE = simplified extraction of atrial tumor with targeted loop electricity

MANAGEMENT

The case was discussed within our local heart team. Considering the markedly elevated risk of systemic embolization, the decision was made to excise the cardiac mass. The patient was deemed ineligible for conventional cardiac surgery by the neurologist because of the high risk of intracranial hemorrhage associated with cerebral amyloid angiopathy, particularly with the use of high-dose heparin during surgery. The heart team had to think out of the box and ultimately came to the option of a transcatheter approach for tumor excision. Regarding the patient's consent, 2 treatment options were presented.

Although conventional cardiac surgery was offered, it was emphasized that neurology had highlighted a significant risk of intracranial hemorrhage. The alternative was a novel percutaneous procedure for myxoma excision. The patient chose the latter option after understanding the associated risks and the procedural inexperience.

To plan the procedure, we were guided by the Steinberg et al[1] publication detailing the simplified extraction of atrial tumors with targeted loop electricity (SEATTLE) technique, which outlines the removal of a right atrial myxoma using an endoscopic electrocautery snare and the ÔNÔ endovascular retrieval system (ÔNÔCOR Vascular). To the best of our knowledge, our procedure is the first utilization of transcatheter electrosurgery for percutaneous excision and ÔNÔ retrieval of a left atrial myxoma.

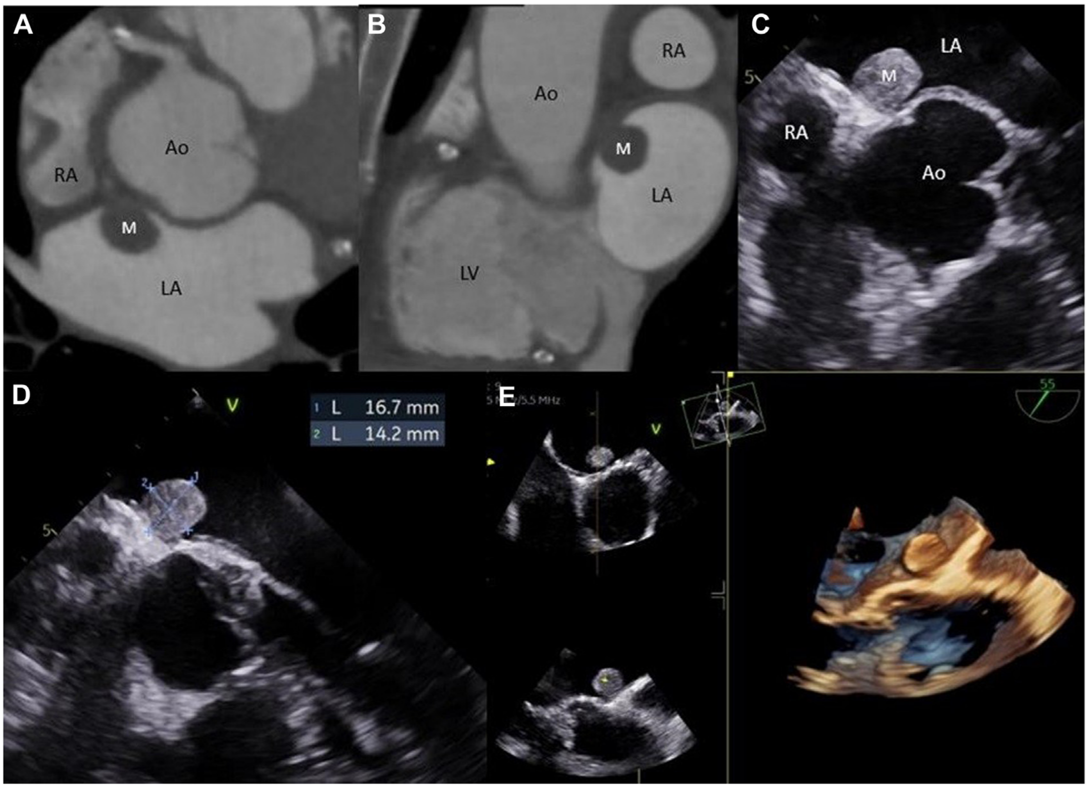
PROCEDURE PLANNING

In summary, the procedural plan was to access the left atrium with a large sheath and telescope the following catheters: a 12-F steerable Flexcath sheath, the ÔNÔ retrieval catheter, a 3-loop endovascular (EN) snare to capture the myxoma, and an electrocautery snare, outside of the steerable sheath but inside the left atrial sheath to sever and cut the large stalk. The ÔNÔ endovascular retrieval system (ÔNÔCOR Vascular) is an innovative catheter-based device designed to safely and effectively receive, align, compress, and percutaneously remove embolized devices (Figure 2). For lacerating and cutting the base of the tumor, we chose to use the electrocautery snare (Olympus), commonly used in gastroenterology for endoscopic removal of colorectal lesions. Transesophageal echocardiogram guidance, general anesthesia, and carotid embolic protection using two 7-mm Spider FX devices (Covidien, Mansfield) inserted from the left femoral artery were also planned. Other neuroprotective cerebral embolic protection devices could have been considered.

PROCEDURE

An SL 0 transseptal sheath was advanced through the right femoral vein with subsequent passage of a BRK 1. Under echocardiographic guidance, the transseptal system was positioned toward the posterior aspect of the fossa ovalis. As shown in CT images (Figure 1), the mass was attached to the anterior part of the interatrial septum near the aortic valve. Due to this anatomical position, a very posterior transseptal puncture was required to provide sufficient space for catheter manipulation. In addition, a transseptal puncture too close to the mass would complicate the complete deployment of the retrieval basket over the mass. Before septum puncture, precise tenting positioning relative to the mass was confirmed through anteroposterior and lateral views. After successfully crossing of the septum, an Amplatz Extra Stiff wire was advanced into the left upper pulmonary vein. The transseptal system was removed and the septum was dilated using a 14-F dilator. A 23-F, 63-mm-long delivery sheath (Micra introducer, Medtronic) was advanced over the stiff wire and positioned in the left atrium. A 12-F steerable catheter (FlexCath Advance, Medtronic) was advanced into the sheath to the left atrium. We planned a full 180-degree rotation of the steerable sheath within the atrium and "en face" deployment of the ÔNÔ device. However, because of the atrium's normal size, the radius of the steerable sheath, and the length of the partially deployed ÔNÔ device, this approach was not feasible (Figures 3A to 3C). After several attempts, successful manipulation was achieved by performing a simple anterior rotation of the access and steerable sheaths from the posterior position of the transseptal puncture. This adjustment enabled coaxial alignment of the retrieval basket with the mass, as demonstrated by the echocardiographic image (Figure 3E). Once correct alignment was achieved, utilization of the multipurpose catheter along the steerable sheath proved useful to guide the electrocautery snare over the tumor. Then, the EN Snare device was advanced into the lumen of the partially deployed ÔNÔ retrieval device to capture the tumor. Once tumor grasping was secured, the retrieval basket was advanced over the mass. The electrocautery snare was tightened and used at 60 W to cut the stalk. Finally, gentle mechanical traction on the EN Snare facilitated separation of the tumor from the interatrial septum, while retracting the retrieval basket allowed for smooth internalization of the tumor into the 23-F access sheath (Figure 4). At the end of the

FIGURE 1 CT and Transesophageal Echocardiographic Imaging of the Left Atrial Myxoma



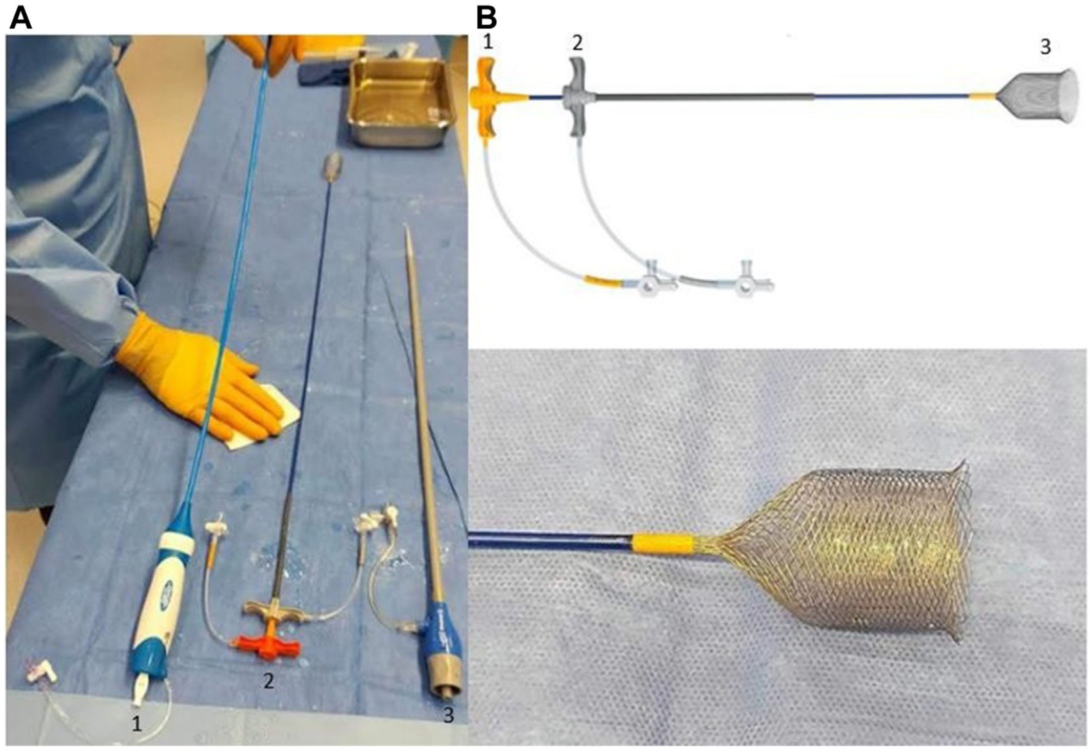
CT images (A and B), 2D-TEE (C and D), and 3D-TEE (E) showing a round mass in the left atrium, attached to the anteroinferior aspect of the interatrial septum near the aortic valve, with a large stalk that was difficult to clearly delineate. Ao = aorta; CT = computed tomography; LA = left atrium; LV = left ventricle; M = myxoma; RA = right atrium; TEE = transesophageal echocardiography.

procedure, no vascular or cardiac structural complications were observed. The total procedure duration was 150 minutes, with a fluoroscopy time of 65 minutes. Nevertheless, macroscopic debris was found bilaterally within the embolic protection devices deployed in the common carotid arteries. Finally, the tumor was submitted for histopathological examination, which confirmed the diagnosis of cardiac myxoma.

OUTCOME AND FOLLOW-UP

During the procedure, the patient developed rapid atrial fibrillation necessitating electrical cardioversion. One unit of packed red blood cells was transfused intraoperatively to address catheter-related blood loss and maintain stable hemodynamic status. A balloon-sealed introducer such as a DrySeal sheath may have performed better given that 2 catheters were separately advanced through the sheath. At the end of the procedure, the patient was admitted to the cardiac care unit for monitoring and was successfully extubated without complications. The initial neurological examination was reassuring and did not reveal any deficits. Thirty-six hours post-procedure, the patient experienced acute neurological decline with disorientation, aphasia, and right-hand paresis. An urgent head CT scan was performed and compared with one conducted a year earlier. The scan revealed ischemic lesions in the white matter of the right frontal and left parietal lobes of unknown duration and not seen on the previous scan. No new hemorrhagic lesions were detected. The diagnosis of periprocedural stroke was made with mild neurological dysfunction indicated by a National Institutes of Health Stroke Scale score of 3. The clinical course was favorable with complete symptom resolution within 48 hours.

FIGURE 2 Key Materials Used During the Procedure



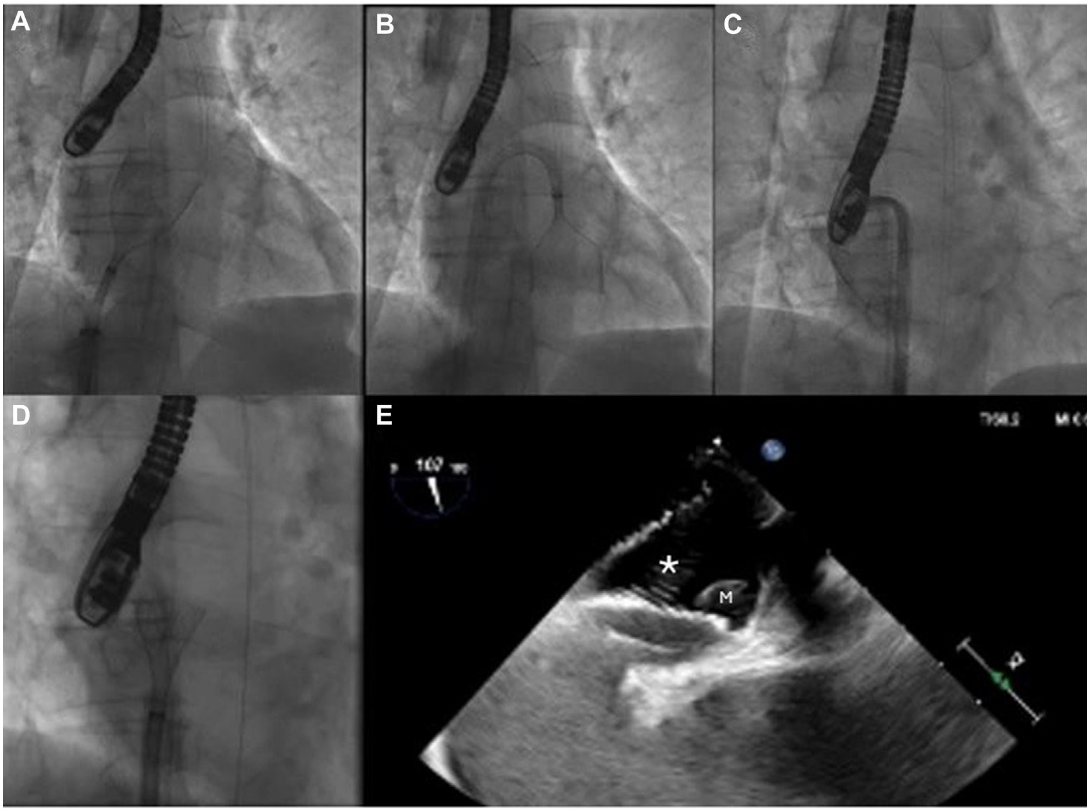
(A) Key catheters used: (1) 12-F inner-diameter steerable sheath (FlexCath Advance, Medtronic). (2) The ÔNÔ endovascular retrieval system (ÔNÔCOR Vascular). (3) 23-F long delivery sheath (Micra introducer, Medtronic). (B) The ÔNÔ endovascular retrieval system (ÔNÔCOR Vascular): (1) 7.5-F inner-diameter flexible trackable catheter compatible with 7-F snare catheters and smaller (minimum 100 cm length). (2) Tear-away sheath allows introduction into any retrieval sheath 12-F or larger. (3) 35-mm basket compatible with vessels as small as 10 mm.

DISCUSSION

Myxomas represent the predominant type of primary cardiac tumor. More than 70% arise within the left atrium, and approximately 18% originate from the right atrium. These tumors typically develop at the interatrial septum near the fossa ovalis.[2] The clinical manifestations of myxomas depend on their size, location, and mobility. There are no specific symptoms for myxomas, and patients may remain asymptomatic. Notably, left atrial myxomas frequently present with systemic or peripheral embolization.[3] Studies indicate that cardiac myxomas have an embolism risk of 30% to 40% with most of these events affecting the central nervous system. Furthermore, tumors ≤4.5 cm and soft, gelatinous tumors were identified as independent risk factors for embolism.[3] Therefore, surgical excision has traditionally been the preferred treatment for myxomas emphasizing the need for prompt removal upon diagnosis.[3,4]

Historically, there have been limited alternatives to surgical removal for patients considered to have a prohibitively high surgical risk. Konecny et al[5] were the first to report their approach for the transcatheter removal of a right atrial myxoma in 2014. Steinberg et al[1] recently published a paper describing the SEATTLE (Extraction of Atrial Tumors with Targeted Loop Electricity) technique, which outlines the removal of a right atrial myxoma using an endoscopic electrocautery snare and the ÔNÔ endovascular retrieval system (ÔNÔCOR Vascular). For the percutaneous removal of left atrial myxomas, Umadat et al[6] reported a single case using the FLORIDA (Flow-mediated LOop-assisted Removal of IntracarDiac mAsses) procedure with the AngioVac system. Initially, low aspiration was used to stabilize the mass and facilitate positioning of the snare around the stalk. Subsequently, aspiration flow was increased, and the snare was tightened to sever the stalk, allowing for tumor aspiration. Importantly, the

FIGURE 3 Coaxial Alignment of the Retrieval Basket With the Mass



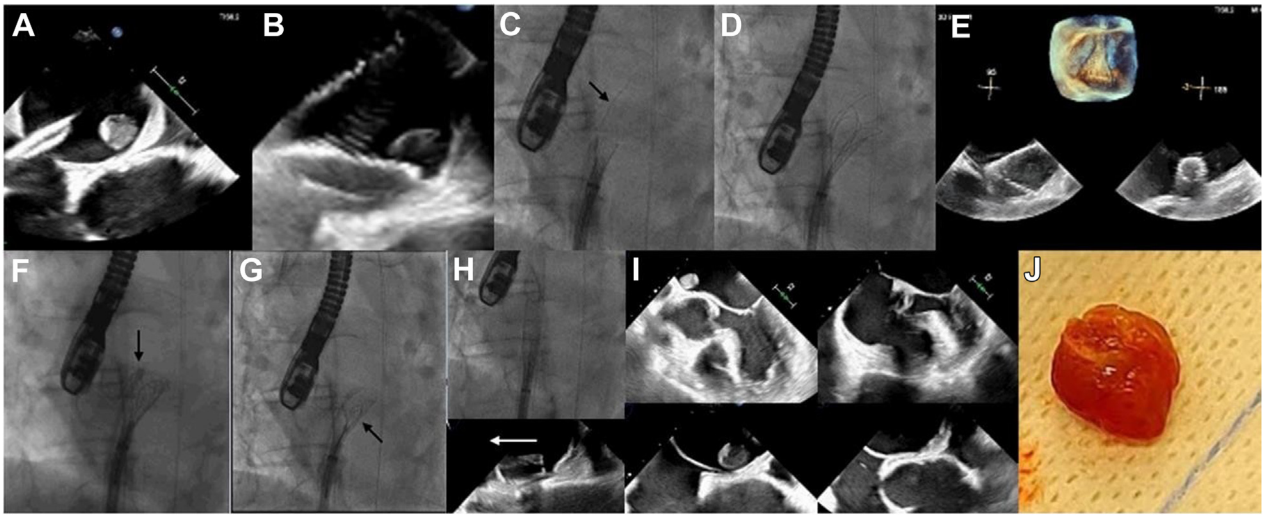
(A to C) Multiple failed manipulations of the access and steerable sheaths to achieve coaxial alignment of the retrieval basket with the mass. (D and E) Optimal coaxial alignment with the mass achieved through simple anterior rotation of the access and steerable sheaths, as demonstrated by the echocardiographic image. *The deployed ÔNÔ endovascular retrieval system. M = myxoma.

authors also noted in their article that the maximum funnel diameter of the 22-F AngioVac is 14 mm.[6] In this presented case, cardiac CT measured the mass at 18 × 13 mm. Considering that myxomas are minimally compressible and the maximum diameter of the AngioVac system, we opted for an alternative to avoid potential complications. Specifically, we were concerned that the mass might exceed the effective aspiration capacity of the AngioVac system and that there could be a risk of systemic embolization.

Nevertheless, we present a pioneering use of transcatheter electrosurgery for addressing a left heart tumor via a transseptal approach. The procedure was planned according to the SEATTLE procedure. We aimed to replicate this approach in the left atrium using similar equipment with modifications to accommodate the myxoma's anatomical position. Achieving precise alignment of the removal system with the myxoma through a transseptal puncture in the left atrium was more challenging compared with the right atrium. Success depended on 2 key techniques: accurate transseptal puncture to maintain an optimal distance from the tumor and precise rotation of the delivery sheath at the interatrial septum to achieve coaxial alignment with the tumor. Once aligned, electrosurgical laceration allowed for precise and effective tumor excision, while the endovascular retrieval system facilitated safe and straightforward removal of the mass.

Unlike the SEATTLE procedure, we advanced the electrocautery snare through a multipurpose catheter outside the steerable sheath. This modification made it easier to guide the electrocautery snare over the mass in the left atrium. This step was completed before capturing the mass with the EN Snare and retrieval basket. Similar to the SEATTLE procedure, the primary role of the EN Snare, in conjunction with the ÔNÔ retrieval basket, was to securely manage the

FIGURE 4 Step-by-Step Percutaneous Excision of Left Atrial Myxoma Using Transcatheter Electrosurgery



(A) Orientation of the delivery sheath toward the mass through anterior rotation. (B) Optimal coaxial alignment of the retrieval basket with the mass. (C) Retraction of the retrieval basket and encirclement of the mass by the electrocautery snare. (D) Grasping of the mass by the EN Snare. (E) Advancement of the retrieval basket over the mass. (F) Tightening of the snare and electrocautery of the tumor's base. (G) Gentle traction on the EN Snare to separate the tumor from the interatrial septum. (H) Retraction of the retrieval basket to allow smooth internalization of the mass into the steerable sheath. (I) TEE images before and after percutaneous excision of the tumor. (J) Round, gelatinous, and compact tumor consistent with a polypoid myxoma. EN = endovascular; other abbreviation as in Figure 1.

tumor and mitigate the risk of macroembolization during the electrocautery snare operation. The grip strength of the EN Snare was precisely adjusted to be firm yet controlled, ensuring a secure hold on the tumor and maintaining stability during electrocautery. Following the use of the electrocautery snare, gentle traction was applied to the EN Snare to facilitate the internalization of the tumor into the retrieval basket. Overall, the firm grip provided by the EN Snare was a key factor in the successful outcome of the procedure, as it allowed for precise control and safe removal of the tumor. However, we acknowledge that the manipulation of the tumor with the EN Snare could have potentially led to systemic embolization of fragments.

It is important to emphasize the technical difficulties encountered in achieving coaxial alignment of the retrieval system with the tumor, which contributed to an extended procedural time. In a normal-sized left atrium, limited space makes it difficult to maneuver the deflectable catheter and deploy the ÔNÔ device coaxially over the tumor. After several attempts, optimal alignment was finally achieved by performing a straightforward anterior rotation of both the access and steerable sheaths from the posterior position of the transseptal puncture. The procedural learning curve is expected to reduce procedural time.

The primary concern in the percutaneous removal of left atrial myxomas remains the risk of embolism. Although the endovascular retrieval system effectively prevents macroembolization of the tumor, the manipulation of the catheter and the maneuvering of the tumor during snaring still pose a risk of fragment embolization. The use of the Spider FX device in the common carotid arteries as embolic protection has shown limitations and partial effectiveness in this procedure. We have proposed 2 hypotheses to explain the presence of debris in the embolic protection devices. The first and most plausible hypothesis is that the debris consists of emboli resulting from the manipulation of the tumor, particularly during its snaring and separation from the septum. The second hypothesis is that the debris may have formed in situ within the embolic protection devices, especially if we assume that these devices are not well-suited for prolonged procedures. Utilization of a dedicated cerebral protection device like the Sentinel cerebral embolic protection device could have been more effective, using larger baskets to capture embolized material. From a broader perspective, improving cerebral protection systems is essential to expanding the application of transcatheter electrosurgery in left heart procedures.

CONCLUSIONS

Percutaneous excision of left atrial myxoma using transcatheter electrosurgery is safe and feasible; however, it currently cannot replace conventional surgery and should be limited to patients at high surgical risk due to periprocedural embolic concerns. Future advancements in transcatheter electrosurgery for left heart procedures should be accompanied by improvements in cerebral protection systems.

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