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CASE REPORT

ADVANCED

CLINICAL CASE

Percutaneous Removal of Left Atrial Myxoma

The FLORIDA Procedure

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ABSTRACT

Surgical resection has been the treatment of choice for cardiac myxomas, but older age and comorbidities relegate many patients to observation. Pure percutaneous removal of left atrial myxomas is both intriguing and challenging. We report a successful percutaneous technique for removal of left atrial cardiac myxoma in a nonsurgical candidate. (**Level of Difficulty: Advanced.**) (J Am Coll Cardiol Case Rep 2023;24:102013) © 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/).

A 72-year-old man with cirrhosis was undergoing evaluation for liver transplantation. Physical examination revealed jaundice, with otherwise normal examination results. On routine surface echocardiography, he was found to have a mobile echodensity in the left atrium (LA).

MEDICAL HISTORY

The patient had a history of coronary artery disease, coronary artery bypass surgery, hepatitis C, and liver cirrhosis.

LEARNING OBJECTIVES

- To illustrate a percutaneous technique for the removal of LA myxomas.
- To demonstrate the safety and efficacy of the FLORIDA procedure for the removal of LA myxomas.

DIFFERENTIAL DIAGNOSIS

The differential diagnosis included cardiac tumors, infective endocarditis, and thrombus.

INVESTIGATIONS

Blood culture results were negative. Transesophageal echocardiogram (TEE) demonstrated a 1.4 × 1.0 cm round mobile echodensity attached to a stalk arising from the anterior aspect of the interatrial septum in the LA consistent with an atrial myxoma. Given the increased stroke risk with an LA myxoma, the transplantation selection committee recommended removal of the cardiac mass before listing for liver transplantation; the patent was denied surgical resection because of prohibitive risk.

MANAGEMENT

He was referred for consideration of percutaneous removal of the mass. The planned procedure used flow-mediated aspiration with the AngioVac system

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ABBREVIATIONS AND ACRONYMS

ECMO = extracorporeal membrane oxygenation

LA = left atrium

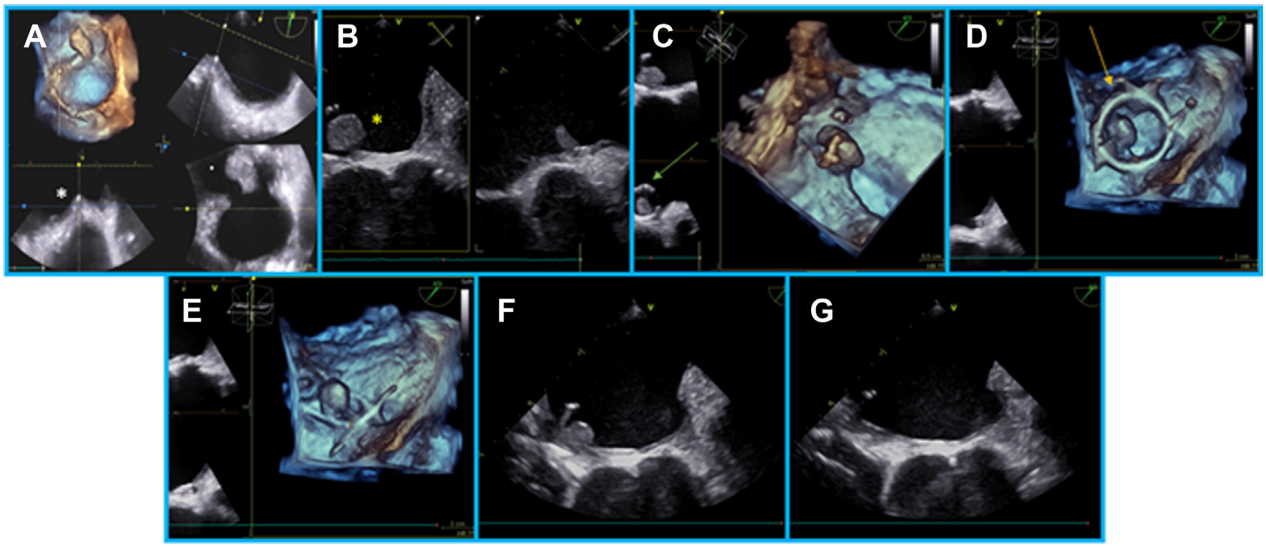
LUPV = left upper pulmonary vein

TEE = transesophageal echocardiogram

(AngioDynamics) via a transseptal approach. AngioVac uses an extracorporeal membrane oxygenation (ECMO) circuit to aspirate blood through a filter that traps any aspirated specimens. Blood is returned to the body via a cannula inserted through a separate vascular access.

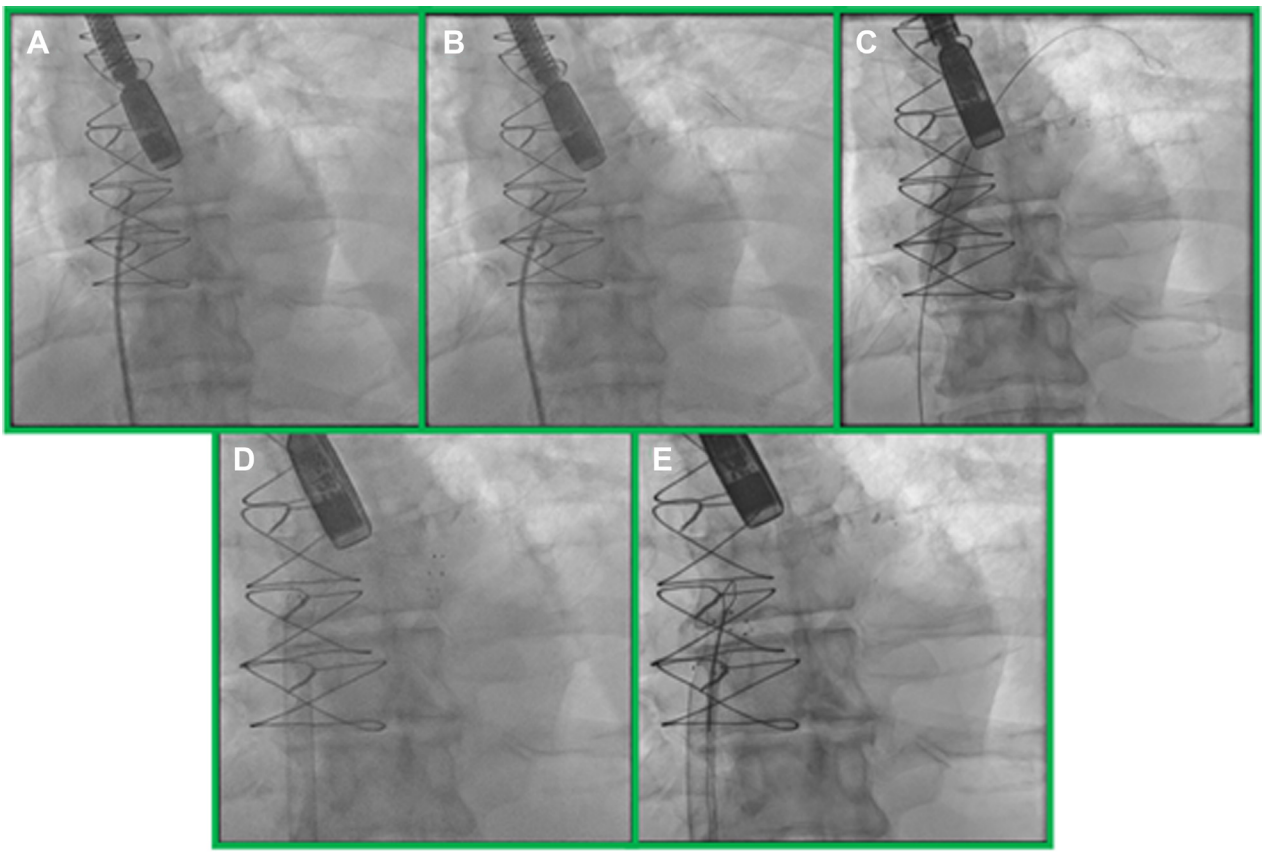
The patient underwent general anesthesia. A TEE probe was inserted for guidance. A Sentinel cerebral embolic protection system (Boston Scientific) was inserted from the right radial artery. A 26-F Gore DrySeal sheath was inserted in the right femoral vein. An 18-F return cannula was placed in the left femoral vein. Through the DrySeal sheath, an SL1 transseptal sheath and dilator with a BRK needle was inserted. The transseptal system was used to tent the fossa ovale in a midposterior position (**Figure 1A**). Using TEE multiplanar reconstruction of the interatrial septum, the distance from the tented fossa ovale to the stalk of the mass was measured to ensure enough distance for rotation and alignment of the AngioVac funnel toward the mass. To avoid interaction between the transseptal system and the mass, an upfront SafeSept (Pressure Products) wire through the BRK needle was used to perform transseptal puncture (**Figure 2A**), and the SafeSept wire was advanced into the left upper pulmonary vein (LUPV) (**Figure 2B**). The SL1 was advanced over the SafeSept wire into the LUPV, and the SafeSept wire was exchanged for an Amplatzer SuperStiff wire. The transseptal system was removed, and a balloon septostomy was performed using a 12-mm balloon (**Figure 2C**). The septostomy balloon was removed, and the AngioVac F22 cannula was connected to the perfusion circuit. The aspiration cannula was introduced through the DrySeal sheath over the stiff wire and into the LA (**Figures 1B, 1C, and 3A**). The stiff wire was removed, and the AngioVac inner cannula funnel was pulled back and rotated anteriorly facing the LA mass (**Figure 2D**). A 25-mm gooseneck snare was inserted through a Tuohy Borst adapter into an 5-F diagnostic multipurpose catheter, and both were inserted through the AngioVac inner cannula via its side port (**Figure 2E**). Aspiration was initiated at low circuit speed, applying modest aspiration, and halting the mobility of the mass (**Figure 3B**). The snare successfully encircled the stalk and tensioned (**Figures 1D, 1E, 3C, and 3D**, Video 1). The circuit speed was increased, generating greater suction while maintaining a strong and neutral tension on the snare around the stalk (**Figures 3E and 3F**). The stalk was successfully excised, and the mass was aspirated. Pathologic analysis of the mass confirmed myxoma (**Figures 1F, 1G, 3G, 4A, and 4B**, Video 2).

FIGURE 1 Transesophageal Echocardiogram Imaging of the Left Atrial Myxoma and Its Removal



(A) A transeptal puncture (white asterisk) was performed at the midposterior position of the fossa ovalis. (B, C) The left atrial myxoma (yellow asterisk) was approached and enveloped by the inlet of the aspiration catheter (green arrow). (D, E) The gooseneck snare (orange arrow) was lassoed around the myxoma and closed around its stalk. (F, G) With increasing speed of the aspiration catheter, the myxoma was successfully severed at the stalk and aspirated.

FIGURE 2 **Fluoroscopic Imaging of the FLORIDA Procedure**



(A, B) The transeptal puncture. (C) Balloon septostomy after transseptal puncture. (D) The AngioVac device was advanced into the left atrium. (E) The gooseneck snare was advanced through the inflow cannula. FLORIDA = Flow-mediated LOop-assisted Removal of IntracarDiac mAsses.

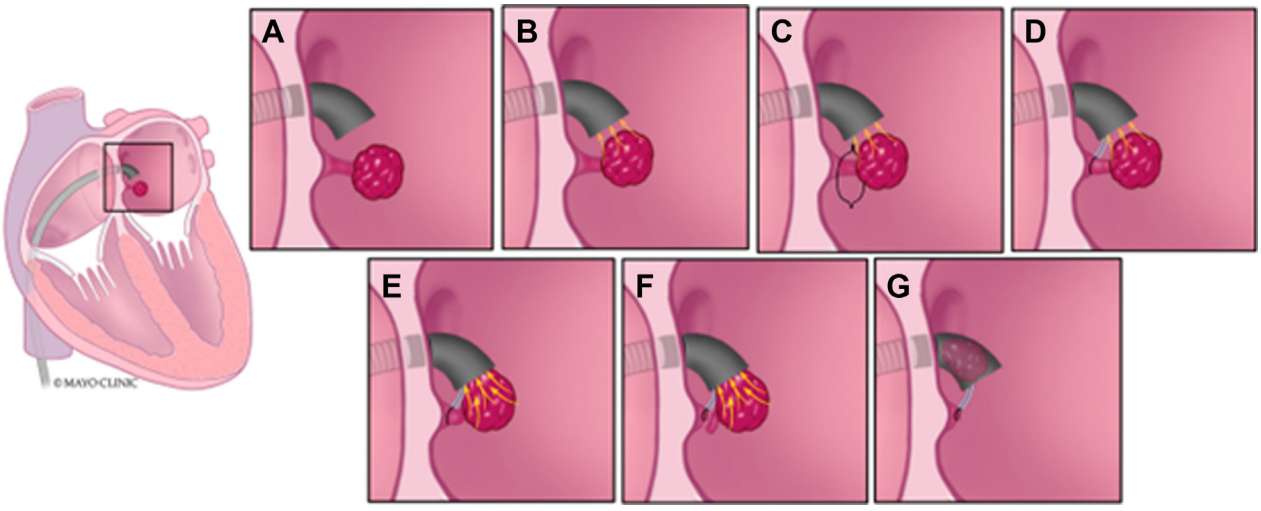
The patient tolerated the procedure with no complications. No debris was retrieved in the Sentinel device.

DISCUSSION

Myxomas are present in 0.03% of the population and may cause symptoms in ≤67% of patients.[1,2] There is a 29% risk of stroke, and resection is indicated even if the patient is asymptomatic.[3] Surgical excision has been the mainstay of treatment, with excellent long-term results.[4] There are limited options for patients at high surgical risk. Percutaneous removal of right-sided cardiac myxomas have been previously described. Steinberg et al[5] described the SEATTLE technique to remove a right atrial myxoma using a basket device and a snare. Konecny et al[6] also pioneered a technique to remove a right-sided cardiac myxoma using a radiofrequency ablation catheter.

The FLORIDA procedure uses the AngioVac system to align the aspiration funnel with the LA myxoma on the interatrial septum. Once the funnel is aligned, flows are turned on low to allow continuous aspiration, which can be helpful to prevent embolization. This also limits the mobility of the mass and helps deliver the snare around the stalk. The snare is introduced through the AngioVac side port and lassoed around the stalk of the myxoma. The continuous aspiration speeds are increased, and the snare can be tightened or electrified to sever the stalk. This technique overcomes the 2 major challenges with percutaneous removal of LA myxomas: catheter reach and the risk of systemic embolization.

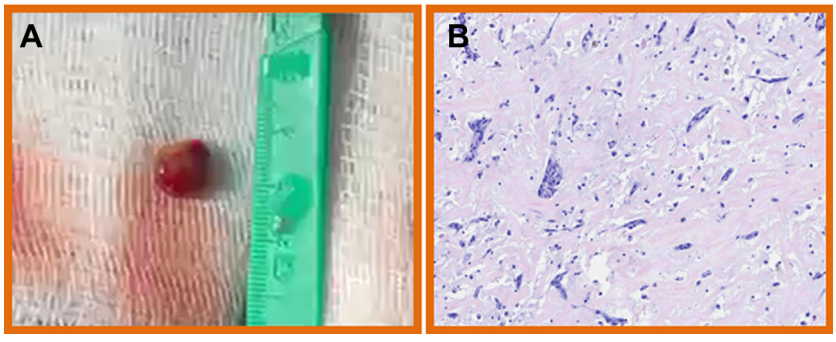
FIGURE 3 Diagram of the FLORIDA Procedure



(A) The AngioVac inner funnel cannula was introduced into the left atrium. (B) Low aspiration speed was used to stabilize the myxoma. (C, D) The gooseneck snare was introduced through the inner cannula, looped around the stalk of the myxoma, and tightened slightly. (E) The aspiration speed was ramped up. (F) The gooseneck snare was tightened further. (G) The myxoma was severed by its stalk and collected. FLORIDA = Flow-mediated LOop-assisted Removal of IntracarDiac mAsses.

This technique is not suitable for locations without enough distance between the transseptal puncture and the stalk, or in cases of myxomas >2 cm in diameter,. given that myxomas tend to be minimally compressible and the F22 Angiovac maximal funnel diameter is 14 mm. It should be noted that the introduction of the snare can lead to entry of air into the system. This can be mitigated by tightening the Tuohy Borst adapter at the end of the aspiration catheter, placing another Tuohy Borst adapter at the end of the snare catheter, and testing at low speeds. Hypotension may also occur but can be mitigated by having blood return to an artery. Finally, the rate of recurrence of the myxoma is unknown with this procedure, given that a residual myxoma stalk may be present. However, in cases of recurrent atrial myxomas such as Carney syndrome, percutaneous removal of such lesions may be preferable over repeated surgical interventions. It is also possible to mitigate the risk of myxoma recurrence by radiofrequency ablation of the stalk after removal of the myxoma, as has been previously done.[6]

FIGURE 4 Gross Specimen and Pathology Slide



(A) The aspirated specimen. (B) Histological staining confirmed a myxoma.

FOLLOW-UP

The patient was relisted for liver transplantation.

CONCLUSIONS

The FLORIDA procedure offers a feasible and pragmatic percutaneous option for the removal of LA myxomas in nonoperative candidates.

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KEY WORDS echocardiography, treatment

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