Hemodialysis catheter-related right atrial thrombus treated with the FlowTriever system

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ABSTRACT

Tunneled catheters are frequently used in patients with end-stage renal disease who require hemodialysis access. Catheter-related atrial thrombus is a documented complication of prolonged catheter use. The incidence of catheter-related atrial thrombus is 2% to 29%, with a high mortality rate approaching 20%, raising concerns for serious complications and death in the absence of an established universal management plan. This case series demonstrates the successful use of a minimally invasive approach to treat patients with intracardiac thrombus and high perioperative risk factors using mechanical and aspiration thrombectomy with the FlowTriever system (Inari Medical). (J Vasc Surg Cases Innov Tech 2023;9:101318.)

Keywords: Catheter-related atrial thrombus; End-stage renal disease; Endovascular intervention; Hemodialysis catheter; Intracardiac thrombus; Mechanical thrombectomy

Tunneled catheters are frequently used in patients with end-stage renal disease who require hemodialysis (HD) access. Catheter-related atrial thrombus (CRAT) is a documented complication of prolonged catheter use because of endothelial damage within the right atrium (RA), activating the coagulation cascade, signaling platelets to aggregate, and thrombus to form.[1]

The incidence of CRAT is 2% to 29% and includes other complications such as pulmonary emboli, infection, arrhythmias, cardiac dysfunction, and embolization in patients with a preexisting patent foramen ovale, such as stroke.[1,2] The mortality rate is 18.3% and approaches 100% in untreated patients, raising concerns for a serious complication without an established universal management plan.[3,4] Previously reported therapeutic options include anticoagulation with catheter removal or replacement, systemic thrombolysis, and open thrombectomy.

Although management options have been discussed in the literature, no definitive consensus guidelines have been reported. Some patients have limited HD access options because of previous failures, which affect catheter removal. The many associated risks, such as bleeding with anticoagulation, thrombolysis, stroke, respiratory failure, myocardial infarction, and death, are often increased by the presence of comorbidities common to those who require chronic HD.

The FlowTriever system (Inari Medical) is intended to remove large thrombus burdens using a novel approach that avoids the morbidity and mortality associated with thrombolysis and open surgery and has been shown to decrease the intensive care unit (ICU) stay, with excellent outcomes.[5-7] Use of the FlowTriever system is currently indicated for minimally invasive removal of emboli and thrombi and is intended for use in the peripheral vasculature and for the treatment of pulmonary embolism.[4] FlowTriever catheters, a component of the system, are also intended for use in treating clot-in-transit in the RA.[5] The treatment is performed in a single session and eliminates the need for thrombolytic therapy.[5]

Our study focuses on two young Hispanic female patients with limited access to medical care who require chronic HD and had developed CRAT. Both underwent interventions successfully with the FlowTriever T24 aspiration catheter, first generation, which was the only generation available at the time. Review and approval by the institutional review board or an equivalent ethics committee of Northwell Health was not required because this study is a case series. The patients provided written informed consent for the report of their case details and imaging studies.

CASE REPORT

Patient 1. A 31-year-old woman presented with signs of sepsis and methicillin-resistant *Staphylococcus aureus* bacteremia. She had a significant medical history of ovarian cancer, morbid obesity, and end-stage renal disease, with an indwelling right internal jugular tunneled and cuffed HD catheter because of previously failed arteriovenous fistula creation. She was found to have an atrial thrombus extending from the superior vena cava (SVC), 3.2 cm × 1.8 cm, with a large base at the atriocaval junction. The infected catheter was removed, and the tip was cultured. The patient was deemed a high-risk candidate for open surgical thrombectomy, and the decision was made to intervene with percutaneous thrombectomy.

The right common femoral vein was used for access with a 24F DrySeal sheath (W.L. Gore & Associates) to accommodate the FlowTriever T24 aspiration catheter. After iliac and inferior caval

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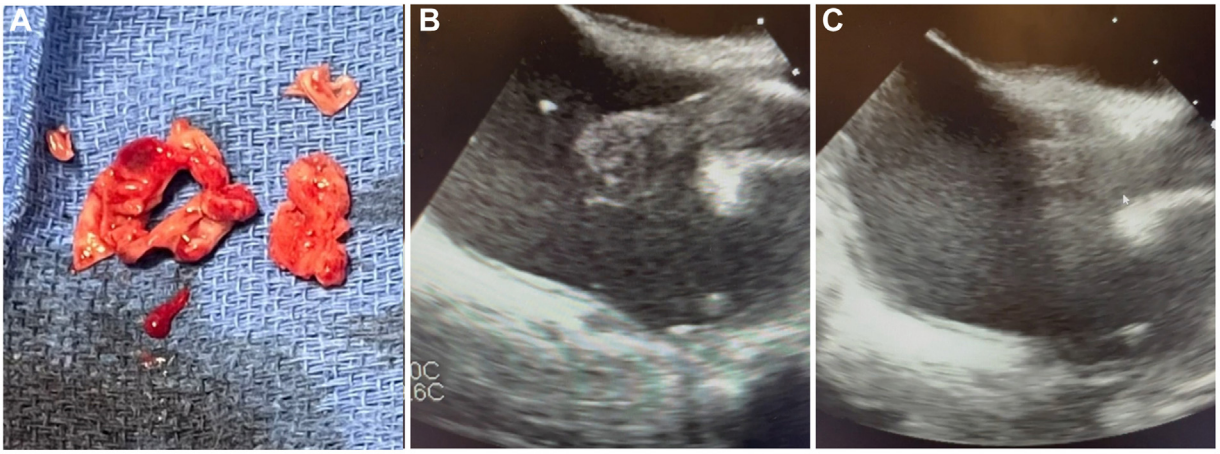

Fig 1. A, Aspirated material noted to be organized fibrin sheath and thrombus. **B,** Preprocedure echocardiogram showing thrombus in the right atrium (RA). **C,** After thrombectomy, echocardiogram showing confirmation of near-resolution of catheter-related atrial thrombus (CRAT).

venography, the DrySeal sheath was advanced into the inferior vena cava (IVC). Transesophageal echocardiographic monitoring was maintained throughout the case as the wire and catheter were advanced from the IVC to the SVC. Selective venography was performed, which demonstrated patent bilateral innominate veins, SVC, and IVC, with good outflow into the RA. The thrombus was visible on the intraoperative transesophageal echocardiogram. The FlowTriever T24 catheter was advanced to the level of the RA, and the catheter tip position was confirmed with transesophageal echocardiography. After three aspirations, the RA and SVC thrombus was successfully removed (Fig 1). The FlowSaver blood return system (Inari Medical) was used during the procedure, with an estimated blood loss of 80 mL. Regarding concern for auto-transfusion in the setting of bacteremia, Phan et al[8] reported the safe use of the FlowSaver in two patients with bacteremia, with follow-up of >1 year. The procedure time was 70 minutes, and the device time was 40 minutes. The final pathology report for the specimen demonstrated thrombus and acute fibrinous exudate. The thrombus was sent for culture, which was negative for growth.

The patient was transferred to the cardiothoracic ICU. The postprocedure echocardiogram confirmed a significant decrease in the atrial thrombus burden. She was discharged with anticoagulation therapy and antibiotics on postoperative day 10 with a new HD access in place. She developed no associated complications within 30 days. However, the patient did not follow-up in the office and was unable to be scheduled for arteriovenous access creation. Five months after the index operation, she presented to the emergency department with a recurrent tunneled dialysis catheter infection.

Patient 2. A 21-year-old woman with nephrotic syndrome and a chronic right internal jugular vein tunneled dialysis catheter was admitted with fluid overload and right arm swelling. Imaging demonstrated thrombosis of the right subclavian vein around the catheter extending into the SVC and a large RA thrombus associated with the catheter tip. She was also diagnosed with pulmonary emboli, with concern for potential recurrent embolization. The presence of metabolic acidosis and her overall poor condition made her a high-risk candidate for open thrombectomy. A decision was made to intervene with percutaneous aspiration thrombectomy.

Ultrasound-guided access to the right common femoral vein was achieved, and an Intri24 introducer sheath (Inari Medical) was advanced into the IVC at the atriocaval junction, followed by the FlowTriever T24 aspiration catheter. Multiple aspirations were performed, which, however, failed to aspirate thrombus from the medial chamber wall and dialysis catheter tip. A 20F curved FlowTriever catheter, or the T20 curved catheter, was advanced into the RA adjacent to the thrombus, and 80% of the thrombus was then aspirated successfully (Fig 2). The T20 Curve device is designed for targeted aspiration and improved navigation in challenging anatomies not suitable for the straight FlowTriever catheter. The FlowSaver device was used during the procedure, resulting in 100-mL estimated blood loss. The procedure time was 75 minutes, and the device time was 45 minutes. The final pathology report for the specimen demonstrated an organized blood clot. The tunneled catheter was then removed intraoperatively, and the patient was transferred to the cardiothoracic ICU in stable condition. She was discharged on postoperative day 4 with oral anticoagulation and was seen at 30 days of follow-up and again 6 weeks later during an office visit with hematology and reported no adverse events.

The patient has not required new dialysis access for continuation of HD. Nephrology reported that she experienced a degree of renal recovery and stability, likely because of the acute on chronic nature of her renal insufficiency. On review of the recent nephrology outpatient notes, she experienced recurrence of nephrotic syndrome and has been refusing arteriovenous access and HD.

DISCUSSION

Within the current literature, no definitive treatment algorithm is available for the management of CRAT, which has a potential mortality of 18%, with mortality

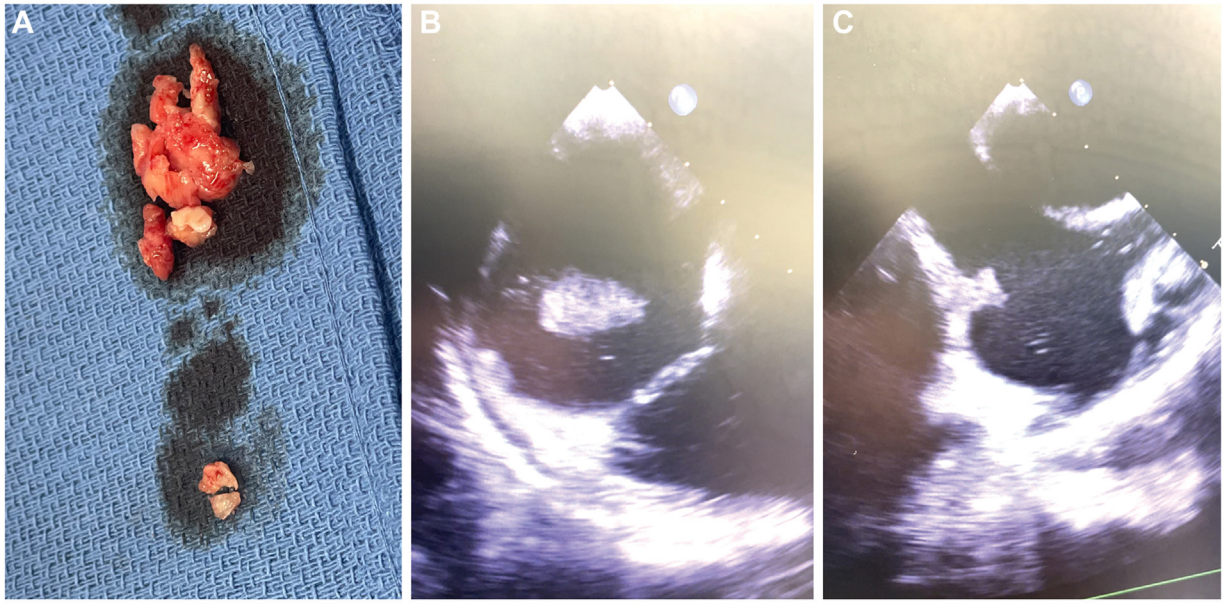

Fig 2. A, Extracted thrombus with a chronic, fibrinous appearance. **B,** Preprocedure echocardiogram showing thrombus burden. **C,** Postprocedure echocardiogram confirming resolution.

as high as 40% for non-HD patients.[8] This series demonstrates two successful cases with 0% morbidity and mortality within 30 days of intervention.

Oral and systemic anticoagulation, surgical thrombectomy, and thrombolysis are reported treatment options for CRAT.[9] Currently, no benefit has been reported compared with open surgery, endovascular thrombectomy, or medical therapy alone. It has been noted that CRAT can be treated with anticoagulation alone; however, the thrombus size could determine the overall success of nonoperative interventions.[9] In the absence of contraindications for intervention, thrombi >2 cm should be treated with surgical thrombectomy.[10] No definitive thrombus size threshold has been established to support either open or suction thrombectomy. Both of the present patients had atrial thrombi >2 cm. However, comorbidities increased our patients' risk of operative morbidity and mortality, resulting in the decision to proceed with a minimally invasive option, with the excellent outcomes reported.

Our patients had several social determinants of health affecting their care. Both patients were young, Hispanic women whose families had recently immigrated to the United States. Both were native, Spanish-speakers and did not know English. This language barrier between the treating team and patients likely restricted the patients' understanding of their disease processes and treatment options. The dedicated use of certified translators helps bridge this communication gap, builds trust between patients and their care teams, and improves healthcare usage and compliance.[11] Additionally, routine outpatient follow-up for catheter care in dialysis centers and follow-up for permanent arteriovenous access creation is critical to the future prevention of catheter-related complications. It is also important to acknowledge that transportation, paid time off, and suitable medical insurance are not commonly available for new immigrants in low-income communities. Understanding these barriers is vital to improving access to care and minimizing future healthcare disparities.

CONCLUSIONS

The FlowTriever system offers an alternate treatment modality for patients with catheter-related intracardiac thrombus and high perioperative risk factors, without the associated risks of thrombolysis or median sternotomy. Furthermore, these patients have heightened our awareness of the potential barriers to healthcare for underrepresented minorities undergoing HD. Our findings support the continued need for local outreach to increase compliance with outpatient follow-up and reduce the incidence of HD access complications within immigrant communities.

DISCLOSURE

None.

REFERENCES

1. Yang H, Chen F, Jiao H, et al. Management of tunneled-cuffed catheter-related right atrial thrombosis in hemodialysis patients. J Vasc Surg 2018;68:1491-8.
2. Akanya DT, Parekh J, Abraham S, Uche S, Lancaster G. Catheter-related right atrial thrombus requiring surgical embolectomy. Cureus 2021;13:e17641.
3. Stavroulopoulos A, Aresti V, Zounis C. Right atrial thrombi complicating haemodialysis catheters. A meta-analysis of reported cases and a proposal of a management algorithm. Nephrol Dial Transplant 2012;27:2936-44.

4. Rose PS, Punjabi NM, Pearse DB. Treatment of right heart thromboemboli. Chest 2002;121:806-14.
5. FlowTriever System. Inari medical, https://www.inarimedical.com/flowtriever/. Accessed January 27, 2023.
6. Buckley JR, Wible BC. Surviving PE: in-hospital mortality and related outcomes for elevated risk acute PE treated with mechanical thrombectomy vs routine care. J Intensive Care Med 2021;37:877-82.
7. Toma C, Jaber W, Weinberg MD. Acute outcomes for the full US cohort of the FLASH mechanical thrombectomy registry in pulmonary embolism. EuroIntervention 2022;18:1201-12.
8. Phan F, Kaufman J, Lantz G, et al. Novel use of a thrombus aspiration system to facilitate transvenous lead extraction for large vegetations. HeartRhythm Case Rep 2023;9:501-5.
9. Hussain N, Shattuck PE, Senussi MH, et al. Large right atrial thrombus associated with central venous catheter requiring open heart surgery. Case Rep Med 2012;2012:1-4.
10. Negulescu O, Coco M, Croll J, Mokrzycki MH. Large atrial thrombus formation associated with tunneled cuffed hemodialysis catheters. Clin Nephrol 2003;59:40-6.
11. Pandey M, Maina RG, Amoyaw J, et al. Impacts of English language proficiency on healthcare access, use, and outcomes among immigrants: a qualitative study. BMC Health Serv Res 2021;21:741.

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