Endovascular salvage of a chronically thrombosed hemodialysis arteriovenous fistula

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ABSTRACT

For hemodialysis-dependent patients, maintaining functional access is a crucial lifeline. Thrombosed access should be salvaged as soon as possible to avoid complications of missed dialysis and to maximize the chance of success. Due to unfortunate circumstances, this patient's thrombosed arteriovenous fistula was not salvaged for 7 months. Despite the chronicity, endovascular salvage was achieved, with subsequent successful cannulation for maintenance dialysis. Contrary to conventional wisdom, chronically thrombosed arteriovenous fistulas can be salvaged through endovascular means with appropriate patient selection. (J Vasc Surg Cases Innov Tech 2024;10:101472.)

Keywords: Arteriovenous fistula; Endovascular procedures; Hemodialysis; Thrombosis; Thrombolysis

In Singapore, six new patients are diagnosed with end-stage renal failure everyday.[1] Most of them become hemodialysis dependent. An arteriovenous fistula (AVF) remains the dialysis access of choice. However, access thrombosis threatens this crucial lifeline.

At our institution, access salvage is shared between nephrologists, vascular surgeons, and radiologists. Patients are typically referred by their dialysis centers. After triage by a case coordinator, eligible patients are scheduled for a salvage procedure. Most patients undergo endovascular treatment within 2 days, unless precluded by other medical issues.

CASE REPORT

The patient is an 80-year-old man requiring hemodialysis via a left brachiocephalic AVF created 4 years before his presentation. The AVF had been intervention-free. The patient provided written informed consent for the report of his case details and imaging studies.

Seven months previously, the patient was admitted to another hospital for massive colonic bleeding requiring laparotomy and colonic resection. His AVF thrombosed shortly after. Due to the hemorrhagic shock, the hospital's vascular specialist deemed it unsafe to salvage the AVF. A left internal jugular tunneled dialysis catheter was placed for hemodialysis access.

Seven months later, the patient returned to our institution for follow-up. Clinically, thrill and bruit were absent in his AVF. The options of AVF salvage vs new access creation were discussed. Despite the risk of failure due to chronicity of the thrombus, he opted for endovascular salvage because he desired to avoid any open surgery after his recent ordeal.

The procedure was performed in our hybrid operating theater under local anesthesia. An initial digital subtraction angiogram (DSA) performed through an antegrade 6F sheath placed at the juxta-anastomotic segment (JAS) showed AVF occlusion (Fig 1). Alteplase, 2 mg, was injected via the sheath. Attempts at antegrade crossing with various guidewires and catheters were unsuccessful.

A second antegrade access was attempted at the venous–cannulation zone; however, a sheath could not be inserted due to the hard thrombus. The puncture needle was directed under ultrasound and advanced slightly. A Command-18 guidewire (Abbott Cardiovascular) was advanced through the needle for greater purchase. The needle was removed, and a 4F Berenstein catheter (Cordis) was tracked bareback over the wire. A DSA revealed the thrombosed main channel with minuscule collateral vessels (Fig 2, *A*). The guidewire was advanced gently across the thrombosed mid-arm cephalic vein, supported coaxially with the Berenstein and a 0.018-in. CXI catheter (Cook Medical). The intraluminal position was confirmed by angiography (Fig 2, *B*). The thrombosed segment was predilated with a 3 × 220-mm Sterling balloon (Fig 2, *C*; Boston Scientific), followed by placement of a 6F, 5.5-cm sheath and further dilation with a Mustang 5 × 80-mm balloon (Boston Scientific). Narrowing of the balloon at the most proximal aspect of the thrombus suggested a narrowing of the cephalic vein as the culprit lesion, which effaced at rated burst pressure. DSA showed restoration of the outflow (Fig 2, *D*).

A retrograde 6F sheath was placed at the proximal arm cephalic vein (third access). Attempts to cross retrogradely into the brachial artery were foiled by the hard thrombus in the arterial–cannulation zone aneurysm.

A fourth access was achieved by antegrade puncturing of the arterial–cannulation zone aneurysm. Under ultrasound guidance, the puncture needle was used to sharply cross toward the inter-cannulation zone (ICZ) for about 4 cm through the hard thrombus. Despite that, rendezvous between the third and fourth accesses failed, because they were in different planes within the thrombus.

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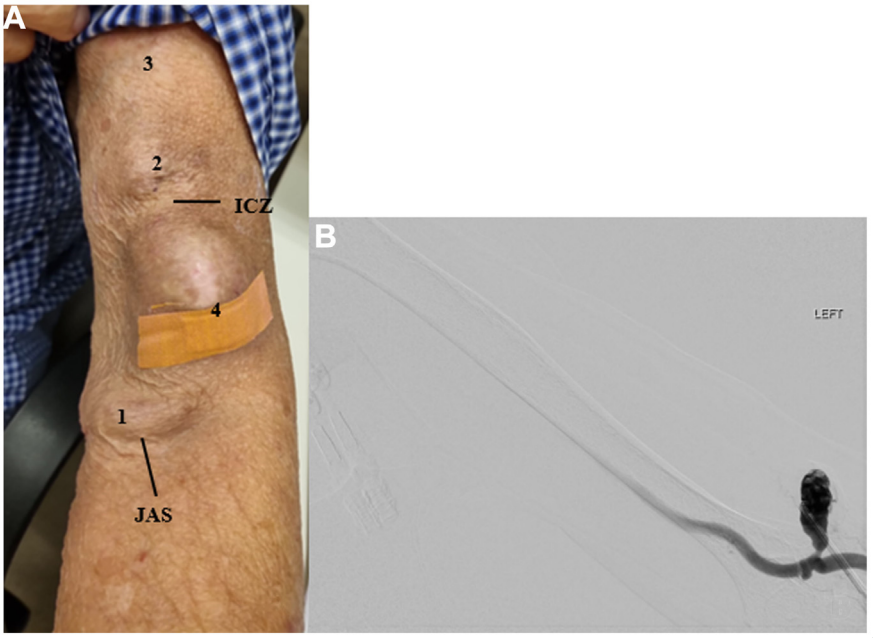

Fig 1. A, The access sites to the brachiocephalic arteriovenous fistula (AVF) are numbered as follows: *1,* first access (antegrade) at the juxta-anastomotic segment (JAS); *2,* second access (antegrade) at the venous–cannulation zone; *3,* third access (retrograde) at the proximal arm cephalic vein; *4,* fourth access (antegrade) at the arterial–cannulation zone aneurysm. **B,** Initial digital subtraction angiogram (DSA) through the first access site showing the thrombosed AVF with contrast refluxing into the left brachial artery.

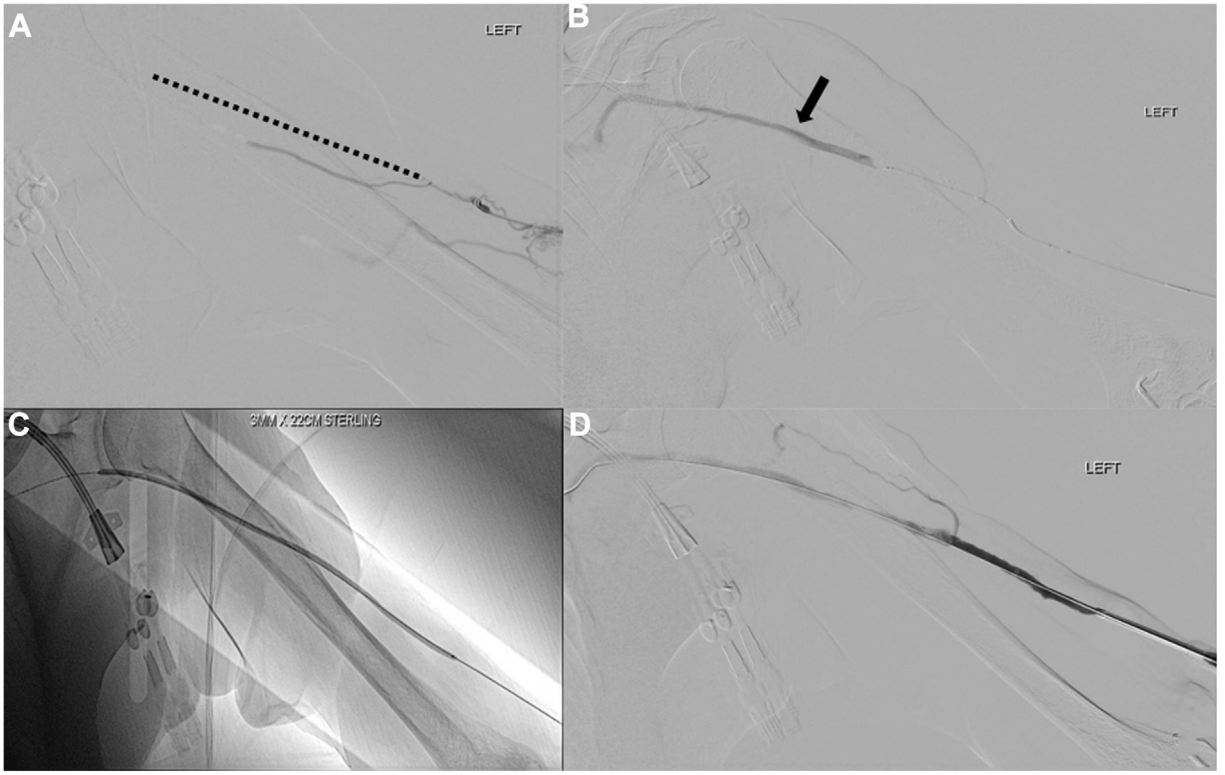

Fig 2. Crossing the thrombosed mid-arm segment of cephalic vein. **A,** The *dotted line* shows the expected course of the cephalic vein, which was thrombosed. **B,** Digital subtraction angiogram (DSA) after crossing the thrombosed segment showing patent cephalic vein beyond (*arrow*). **C,** Balloon angioplasty to create a track. **D,** DSA after placing a sheath showing the outflow track with some clots.

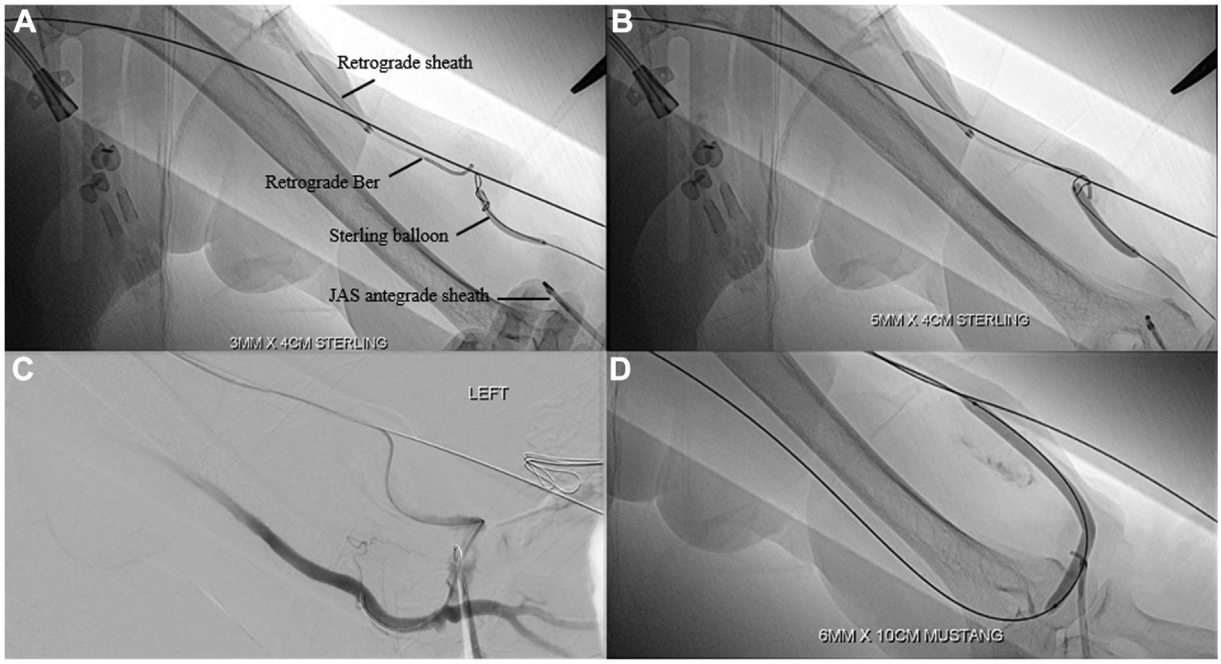

Fig 3. Crossing into the brachial artery. **A,** Through the fourth access at the arterial—cannulation zone aneurysm, a short 3-mm Sterling balloon was inflated within the aneurysm and inter-cannulation zone (ICZ) to create a track. **B,** Further dilation of the track with a 5-mm Sterling balloon. **C,** Final arrival in the brachial artery from the retrograde access. **D,** Balloon maceration of clots.

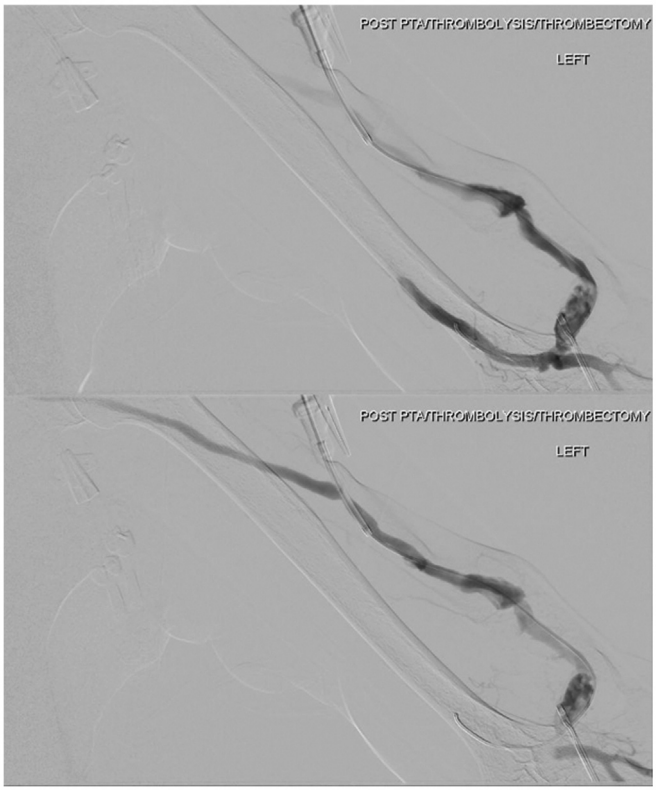

Fig 4. Two frames from the same final digital subtraction angiogram (DSA) showing restoration of flow in the arteriovenous fistula (AVF), albeit with residual clots in the juxta-anastomotic segment (JAS) and arterial—cannulation zone aneurysm.

Through the fourth access, short 3- and 5-mm Sterling balloons were advanced bareback over a Command-18 wire and inflated to carve a channel between the arterial—cannulation zone aneurysm and the ICZ (Fig 3, *A* and *B*). Subsequently, a 0.035-in. Glidewire (Terumo), supported by a Berenstein catheter, was successfully crossed from the retrograde sheath into the proximal brachial artery (Fig 3, *C*). A 5.5F over-the-wire Fogarty catheter (Edwards Lifesciences) was used to the arterial plug. A Mustang 6 × 100-mm balloon was used for clot maceration (Fig 3, *D*). Inflow was reestablished.

Further angioplasty of the JAS using a noncompliant Jade 7 × 60-mm balloon (OrbusNeich) led to improved thrill. The final angiogram showed smooth flow of contrast in the entire AVF, with some chronic clots remaining in the JAS and arterial—cannulation zone aneurysm (Fig 4). All hardware was removed, and the puncture sites were closed with sutures.

A 1-month course of enoxaparin at a therapeutic dose was initiated. Two weeks after the procedure, the AVF was successfully cannulated for dialysis, followed by removal of the tunneled dialysis catheter after another 2 weeks. Ultrasound at 1 month demonstrated patency, with brisk flow and a reduction in clot volume (Fig 5). At 3 months, the access remained patent.

DISCUSSION

Various strategies have been described for salvaging thrombosed AVFs, ranging from open thrombectomy to percutaneous methods. Pharmacotherapeutic—mechanical thrombolysis showed promising

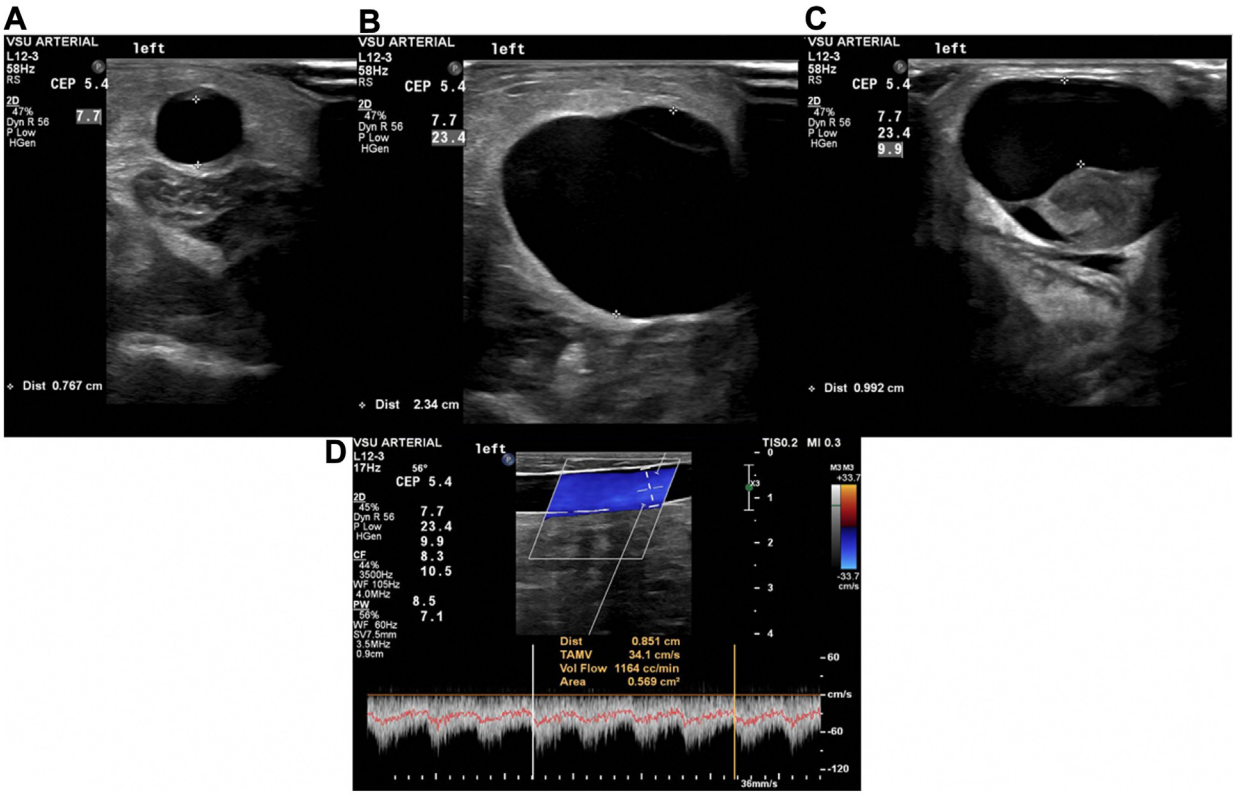

Fig 5. Duplex ultrasound 2 weeks after the procedure showing luminal patency (**A** and **B**), residual clot within a widely patent lumen (**C**), and volume flow of 1164 mL/min (**D**).

outcomes,[2,3] resulting in many centers adopting an endovascular-first approach.

Conventional teaching calls for salvage to be performed as soon as possible, with success rates decreasing rapidly after 2 weeks.[4,5] If access can be restored quickly, catheter insertion could be spared, thereby avoiding the risks of central vein stenosis and occlusion and blood stream infection. In addition, timely salvage of the access saves the patient from the complications of fluid overload, hyperkalemia, and hyperuricemia. Also, thrombus in the AVF hardens over time, causing endothelial damage and negative remodeling.

In our patient, his AVF had been thrombosed for 7 months. New access creation seemed more viable. If salvage were to be attempted, a hybrid approach might be better—open thrombectomy, followed by angioplasty to treat any underlying stenosis. However, the patient's inclination for full endovascular salvage meant we decided to attempt the procedure. In retrospect, a few factors contributed to the success.

First, his AVF had been intervention-free before its thrombosis. We suspect his AVF thrombosed because of the low-flow state during his hemorrhagic shock, with a possible single proximal upper arm cephalic vein stenosis. For many AVF circuits, recurrent stenosis at locations such as the cephalic arch, JAS, or ICZ has been a poor prognostic factor for long-term patency.[6] However, he did not have such a history, giving us more confidence that salvage could be successful.

Second, several endovascular techniques contributed to the technical success. Where guidewires failed to traverse, sharp needle recanalization under ultrasound guidance facilitated crossing. Where chronic clots obstructed the path, small-diameter balloons created tracks for subsequent wiring. Placing sheaths at strategic spots allowed us to obtain roadmaps for navigation and permitted us to cross the thrombus in segments.

Finally, anticoagulation treatment after the procedure helped to prevent early repeat thrombosis. On the final angiogram, chronic thrombus remained in the JAS and arterial—cannulation zone aneurysm. However, duplex ultrasound 2 weeks later showed a significantly reduced clot volume with a widely patent flow channel (Fig 5). As elucidated by Gan et al,[7] a course of enoxaparin therapy after de-clotting helps to preserve patency.

CONCLUSIONS

Despite being chronically thrombosed for 7 months, our patient's AVF was successfully salvaged endovascularly. While we await longer term patency outcomes, we believe that endovascular salvage is not contraindicated for chronically clotted AVFs if the appropriate maneuvers are used and can be attempted in carefully selected cases.

DISCLOSURES

None.

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