CASE REPORT

Endovascular Salvage of an Abandoned AV Graft

Restoring and maintaining access patency using the GORE® VIABAHN® Endoprosthesis.

BY DANIEL V. PATEL, MD

Hemodialysis vascular access is vital for the life of dialysis patients. Although arteriovenous (AV) fistulas and grafts are preferred over dialysis catheters, many patients still rely on catheters until access maturation. Those with challenging anatomy may further require prolonged catheter dependence if an access cannot be created or maintained, and this can lead to catheter infections and sepsis. Here we describe the salvage of an abandoned AV graft and show the particular advantages of the GORE® VIABAHN® Endoprosthesis in dialysis access management.

CASE PRESENTATION

A 63-year-old woman with end-stage renal disease, chronic obstructive pulmonary disease, and hypertension was seen for an exchange of her nonfunctioning dialysis catheter. Upon further history, it was revealed that she had previously been on peritoneal dialysis until failure of the peritoneal membrane. She had converted to hemodialysis 1 year before her presentation to our institution and had remained dependent on dialysis via a right internal jugular tunneled catheter.

Over the course of the previous year, repeated attempts at an AV access creation had failed. Her left arm options were exhausted, and she had a right upper arm brachial artery to brachial vein polytetrafluoroethylene (PTFE) graft created 4 months before presentation.

One month after creation, the graft thrombosed. An endovascular thrombectomy was performed at an outside institution with a 6 mm balloon angioplasty at the venous anastomosis of the graft. Although there was initial restoration of flow, the graft rethrombosed within 24 hours. A surgical thrombectomy was then performed, and no discernible etiology for thrombosis was identified. The patient subsequently had successful dialysis for two treatments before the graft rethrombosed again. Another surgical thrombectomy was performed, with brisk flow reestablished after antegrade and retrograde sweeps with a Fogarty catheter. Fluoroscopy did not reveal an etiology for the graft failure during the second surgical thrombectomy. Flow was initially reestablished, but the access rethrombosed again shortly thereafter. The patient had maintained a right internal jugular vein catheter for dialysis access through this time.

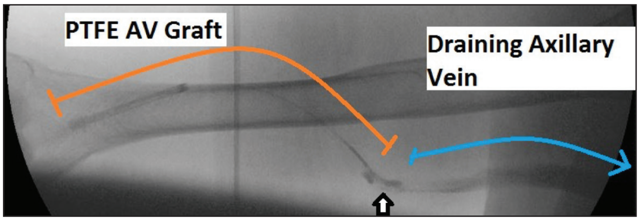

Figure 1. Pullback angiogram demonstrating thrombus and stenosis at the venous anastomosis (arrow).

Given failure of three separate thrombectomy attempts, the graft was abandoned at this point. Having exhausted upper extremity access options, the lower extremities were examined for a potential access. However, the patient had decreased pedal pulses bilaterally, and there was a concern for limb ischemia with femoral access.

When the patient presented to our center for her catheter exchange, she was contemplating placement of a femoral graft versus continued long-term catheter dependence. The catheter was exchanged without any issues.

The thrombosed graft was studied under Doppler ultrasound. The graft had organized thrombus present, and an apparent venous anastomosis stenosis was seen leading to a patent 9 mm axillary vein. At that time, the graft had been thrombosed for 3 months.

After a discussion with the patient and her nephrologist, we chose to attempt an endovascular salvage of the thrombosed graft, given the limited access options and continued catheter dependence. The thrombus volume appeared relatively small on Doppler through the graft. Given the apparently patent draining vein and intact graft, an endovascular salvage seemed feasible.

We initially cannulated the graft in a downstream direction. There was difficulty in passing a wire beyond the venous anastomosis, and an imaging catheter was used to pass a hydrophilic wire (0.035 inch Roadrunner wire,

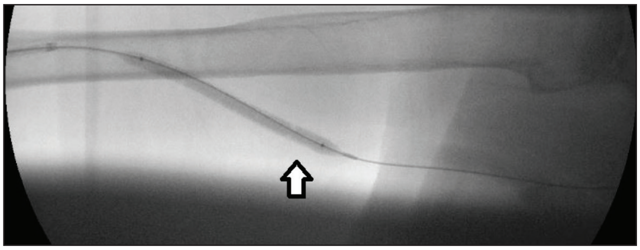

Figure 2. Angioplasty with a 7 mm x 8 cm balloon at the venous anastomosis stenosis (arrow) and thrombus.

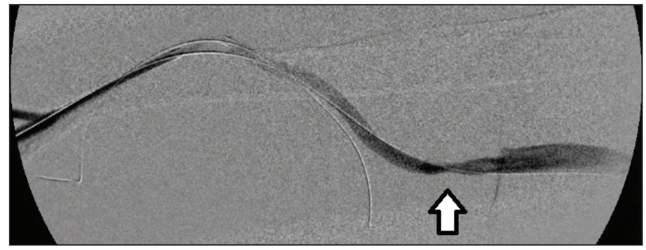

Figure 3. Recoil at the venous anastomosis after angioplasty.

Cook Medical) beyond the venous anastomosis and to the central veins. The patient was given 5,000 U of heparin and sedation. A pullback angiogram was performed, confirming a venous anastomosis stenosis and thrombus through the graft (Figure 1).

A 7 mm x 8 cm angioplasty balloon was advanced to the stenosis. The lesion was angioplastied open, and the rest of the graft thrombus was macerated with the balloon (Figure 2). Given the organized thrombus, a consideration was made to lace the graft with tissue plasminogen activator (tPA); however, the thrombus was initially easily macerated with the balloon, and tPA was not used in this case.

A second sheath was placed in an upstream direction, and a 4 Fr Fogarty thrombectomy balloon was used to aspirate the arterial plug. Several repeated intragraft angioplasties were performed with the 7 mm balloon to macerate remnant thrombus, and flow was restored to the graft. Despite angioplasty, ongoing recoil was seen at the venous anastomosis (Figure 3).

Given the recoil and repeated thrombosis history, the decision was made to place a stent graft at the venous anastomosis. The GORE VIABAHN Endoprosthesis diameter was selected based on the graft diameter. An 8 mm x 10 cm GORE VIABAHN Endoprosthesis was placed at the venous anastomosis. The distal end was placed within the graft, while the proximal portion extended to the draining axillary vein, which had measured 9 to 11 mm on Doppler.

During deployment, a small embolized fragment of thrombus was seen at the draining vein and venous anastomosis (Figure 4). This thrombus fragment was excluded from the access by placement of the stent graft, trapping the thrombus between the stent graft and the vessel wall. More proximally, the 8 mm diameter GORE VIABAHN Endoprosthesis floated in the larger vessel wall without vessel wall apposition. The distal end of the 8 mm stent graft was securely anchored in the graft, and the stent graft was postdilated with the 7 mm balloon (Figure 5). A strong thrill was present, and flow was restored in the access.

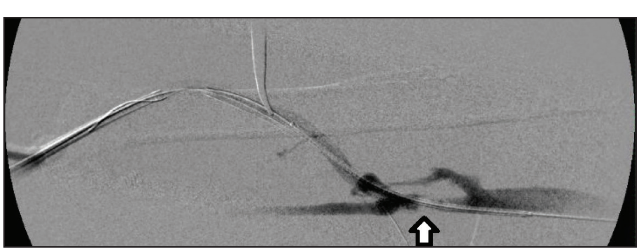

Figure 4. An 8 mm x 10 cm GORE® VIABAHN® Endoprosthesis lined up for deployment at the venous anastomosis stenosis. Note the thrombus fragment seen at the venous anastomosis (arrow).

Postprocedure, the graft was marked for cannulation. The patient underwent successful hemodialysis for 2 weeks, and the tunneled dialysis catheter was removed.

FOLLOW-UP

After restoration of flow, the patient had two further episodes of graft thrombosis. The first episode occurred 8 months after initial stent graft placement, and a second episode occurred 2 weeks afterward. This was initially managed with further endovascular thrombectomy and intragraft 7 mm balloon angioplasty. A more proximal calcified venous valve was identified as the culprit of recurrent stenosis during the second thrombectomy. A proximal overlapping 8 mm x 10 cm GORE VIABAHN Endoprosthesis was necessary to maintain access patency

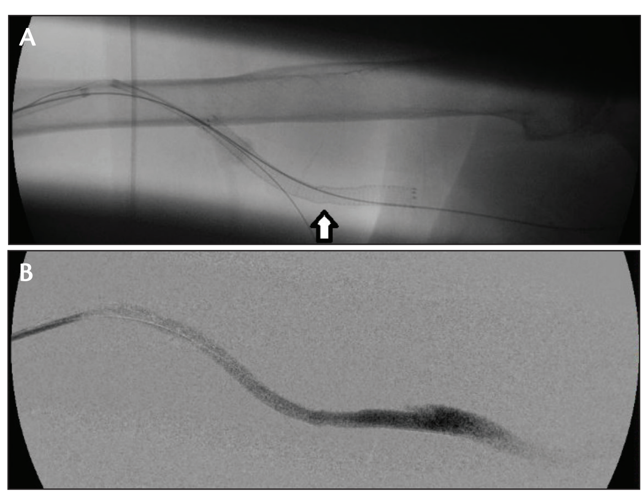

Figure 5. An 8 mm x 10 cm GORE® VIABAHN® Endoprosthesis deployed through the venous anastomosis (arrow indicates venous anastomosis) (A). Restoration of flow through the GORE® VIABAHN® Endoprosthesis (B).

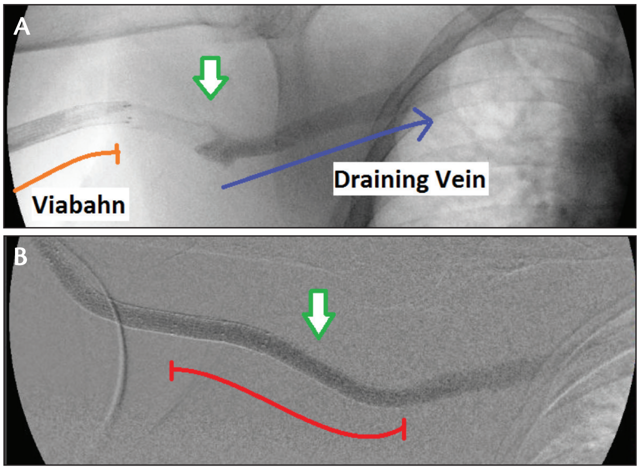

Figure 6. Recurrent thrombosis due to apparent proximal venous valve stenosis 8 months after previous salvage with a GORE® VIABAHN® Endoprosthesis (arrow indicates site of valve stenosis, with thrombus seen distally leading to the GORE® VIABAHN® Endoprosthesis) (A). After second proximal overlapping 8 mm x 10 cm GORE® VIABAHN® Endoprosthesis placement through the recurrent valve stenosis (B).

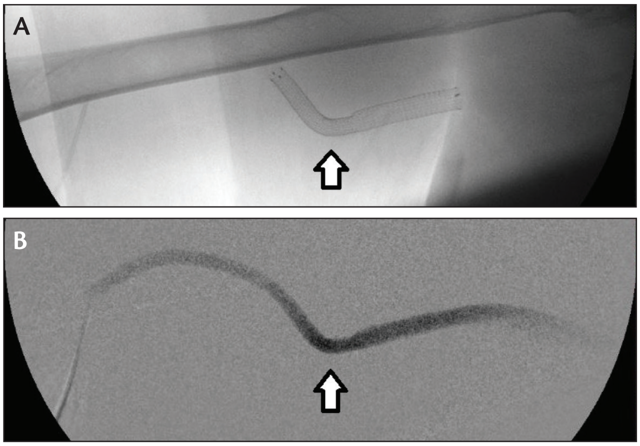

Figure 7. Angulation of the graft vein junction noted with removal of the wire (arrow indicates venous anastomosis) (A). Patent flow after GORE® VIABAHN® Endoprosthesis placement (B).

through this valve stenosis after failure of angioplasty to provide a durable result (Figure 6).

Placement of this second GORE VIABAHN Endoprosthesis stopped the cycle of recurrent thrombosis. To date, the patient has continued to use this graft for the last 12 months without any further dialysis catheter placement.

DISCUSSION

The Bard FLAIR study first showed the superiority of stent graft placement at the venous anastomosis versus treatment with balloon angioplasty alone in patent AV grafts.[1] The RENOVA trial demonstrated additional long-term advantages.[2] The GORE REVISE study reinforced the efficacy of stent grafts at the venous anastomosis and established the GORE VIABAHN Endoprosthesis as a durable treatment option. The REVISE trial went even further in demonstrating the superiority of the GORE VIABAHN Endoprosthesis over angioplasty during episodes of graft thrombosis.[3]

At the venous anastomosis, treatment with angioplasty alone often results in eventual restenosis with aggressive neointimal hyperplasia growth. In our experience, bare-metal stents offer limited further improvement and experience aggressive stenosis through bare-metal struts. With the advent of stent grafts, we now have a barrier to this neointimal hyperplasia growth—excluding this pathophysiology of stenosis from the venous anastomosis. Based on the evidence and our own experience, stent grafts have now become the standard of care for venous anastomosis stenosis in hemodialysis access. The decision to pursue an attempt at salvaging the graft in this case came from the recognition that earlier attempts did not involve stent graft placement.

Flexibility of the GORE VIABAHN Endoprosthesis

The ability of the GORE VIABAHN Endoprosthesis to bend and turn with the natural contours of the body is unmatched among other stent graft options. The REVISE trial uniquely demonstrated efficacy of the GORE VIABAHN Endoprosthesis at the antecubital fossa of forearm grafts, and the axilla is underappreciated as another site of flexion for upper arm graft venous anastomosis lesions.

Often, we study patients with a wire in place and with their arms extended on the procedure table. An angiogram of this patient, with the arm straight but without a wire, showed significant angulation at the venous anastomosis (Figure 7). It is possible that this unrecognized angulation contributed to the initial episodes of recurrent thrombosis. The ability of the GORE VIABAHN Endoprosthesis to conform and flex with patient movements while maintaining patency is a key advantage in this situation (Figure 8). This may minimize vessel kinking and potential for further neointimal hyperplasia.

GORE VIABAHN Endoprosthesis Sizing and Deployment Considerations

Slight oversizing of the anchored distal end of the stent graft allows for secure and reliable GORE VIABAHN Endoprosthesis placement without migration. The recommendation in the GORE VIABAHN Endoprosthesis instructions for use is for 5% to 20% oversizing. We regularly oversize GORE VIABAHN Endoprosthesis within ePTFE grafts. We anchor at least 2 to 4 cm of the GORE VIABAHN Endoprosthesis within the ePTFE graft and allow the proximal end to float in the outflow vein.

Figure 8. The unique flexibility of the GORE® VIABAHN® Endoprosthesis.

In this case, the proximal end of the 8 mm GORE VIABAHN Endoprosthesis freely floated within the 9 to 11 mm draining vein. The relative undersizing of the proximal portion allows for permissive mobility of the stent graft within the outflow vessel. This undersized proximal portion of the stent graft has minimal contact with the vessel wall, which potentially could decrease development of edge stenosis (Figure 9).

The technique of GORE VIABAHN Endoprosthesis deployment is key to stent graft placement from a smaller graft diameter to the larger-diameter outflow vein. We straighten out the deployment device and reduce all slack from the wire, which usually involves taking several steps back from the procedure table and having an assistant stabilize the shaft near the sheath insertion site. The markers on the edges of the GORE VIABAHN Endoprosthesis are easily visible under fluoroscopy, and the GORE VIABAHN Endoprosthesis may be precisely positioned within the graft and the outflow vein for deployment.

Occult Venous Anastomosis Stenosis

In the era of angioplasty alone for treatment of venous anastomosis lesions, we often achieved successful initial results with graft thrombectomy procedures. However, we did encounter cases with recurrent thrombosis, sometimes within hours after restoration of flow. These were often perplexing, especially when our initial angiographic results with angioplasty were excellent. We suspected a delayed recoil that was not appreciated during initial procedures, but this was challenging to prove.

In problematic cases of short-term recurrent thrombosis, we tried a variety of antiplatelet agents and anticoagulants, initiated hypercoagulable workups, and tried to limit any hypotension at dialysis to potentially manage or treat recurrent graft thrombosis. Many times, our attempts to address these issues were futile. This often resulted in a frustrating cycle of recurrent thrombectomy attempts until the decision was made to ultimately abandon an access and place a catheter for access.

With the data from the REVISE clinical study supporting the benefits of the GORE VIABAHN Endoprosthesis over

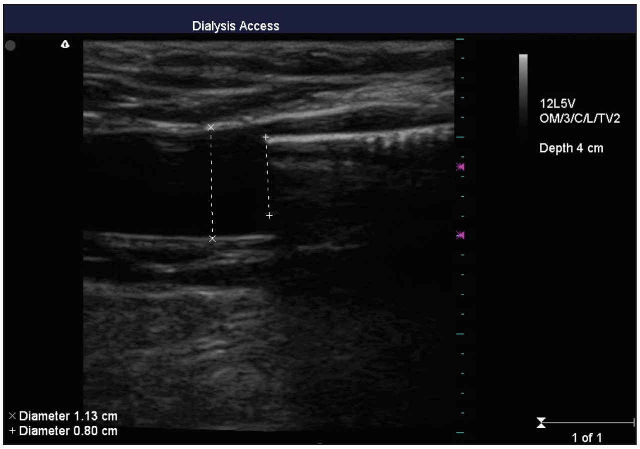

Figure 9. Ultrasound image demonstrating the 8 mm GORE® VIABAHN® Endoprosthesis floating in the larger draining outflow axillary vein. Note the lack of any stent graft edge wall apposition.

angioplasty in thrombosed grafts, we began to approach these lesions differently. We utilized the GORE VIABAHN Endoprosthesis at the venous anastomosis for these recurrent thrombosis cases, and we found that we could usually break the cycles of recurrent thrombosis. It stands to reason that we were able to eliminate all postangioplasty recoil with stent graft placement. This, along with exclusion of the neointimal hyperplasia, appears to be the key to maintaining patency.

Expanding our GORE VIABAHN Endoprosthesis use more consistently at patent and thrombosed venous anastomosis lesions, we've noted longer graft patency rates and reduced incidence of access thrombosis, which reflects the findings in the REVISE trial.

Approach to Abandoned Grafts

This patient originally presented for a tunnelled dialysis catheter exchange. As part of comprehensive patient care, it is important to determine why a patient relies on catheter access. If there are no immediate plans for an AV access, we often help to facilitate mapping and planning for an access. This requires collaboration with the dialysis staff and the referring physicians, and ultimately can help to diminish catheter dependence for dialysis patients.

Most abandoned grafts are not reinvestigated for salvage. Small studies in the literature have shown occasional resuscitation of chronically thrombosed "dead" or "mummy" grafts.[4,5] Often, the thrombus strongly organizes and cannot be passed with wires. Thrombosed pseudoaneurysms further complicate this, as chronic, adherent thrombus may be impossible to pass. Collapsed grafts with minimal luminal diameter are also a sign of compromised graft patency, and these are generally not candidates for salvage.

In this case, we had a relatively little-used graft with limited previous cannulation. There was apparent integrity of the graft without collapse, and the thrombosed lumen was easily visualized with Doppler. There were no pseudoaneurysms present, and the vessel just proximal to the venous anastomosis appeared patent. Although organized thrombus was present, the overall thrombus volume was minimal in the graft.

Usually, resuscitation of abandoned grafts is a futile endeavour. However, in cases where there appears to be relatively little thrombus burden, otherwise-intact outflow veins, and preserved graft integrity, consideration can be made to attempt an endovascular salvage. Key here is the ability to pass a guidewire through the venous anastomosis. Stent grafts may be beneficial in achieving a more durable patency at the venous anastomosis, and they may have the added advantage of excluding organized thrombus from the access outflow.

Long-Term Considerations With Venous Anastomosis Stent Grafts

To manage long-term access patency with stent grafts, it is important to recognize the pathophysiology of venous anastomosis neointimal hyperplasia. With the placement of stent grafts at the venous anastomosis, the proximal edge of the newly placed stent graft now becomes the new venous anastomosis. This may potentially instigate further development of upstream neointimal hyperplasia, with the more proximal draining vein now being closer in proximity to the high flows from the access.

Although larger vein diameters more proximally seem to have less incidence of thrombosis, upstream stenosis may still develop. Venous valves can also be prone to stenosis, as demonstrated in this case. Usually, this can be managed with angioplasty alone, but further proximal stent graft placement may be necessary to maintain patency.

In our experience, we have not encountered significant development of in-stent restenosis with the GORE VIABAHN Endoprosthesis. The end-to-end ePTFE lining acts as a barrier to neointimal hyperplasia. The technique of placing a freely floating proximal end of the GORE VIABAHN Endoprosthesis in a larger diameter outflow vein may also further minimize edge stenosis and in-stent occlusion.

Although higher up-front costs may be associated with stent-graft placement versus angioplasty, the long-term benefits of durable access patency outweigh the costs of repeated angioplasties and thrombectomy procedures.[6] It stands to reason that further savings can be realized with avoidance of potential catheter infections and hospitalizations, as well as further surgical access placements and revisions.

A Breakthrough in Dialysis Access Care

With stent graft usage in dialysis access, endovascular salvage of failing accesses can now succeed where angioplasty alone has failed. Although salvage of long-abandoned grafts is rare, the techniques and approaches described here can apply to conventional dialysis graft thrombectomy procedures.

In this patient, an abandoned access was salvaged, and the catheter was removed. Secondary patency has been maintained for well over a year and counting for a patient who had limited other access options. This would have been unachievable in the era when balloon angioplasty was the only treatment choice.

The flexibility and full end-to-end ePTFE lining of the GORE VIABAHN Endoprosthesis makes it a key component for success when dealing with endovascular management of dialysis access. This has been nothing short of revolutionary for our patients, extending the lifespan of AV accesses and minimizing catheter dependence. We truly are in a new era of dialysis access management. ■

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