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CASE REPORT

Combining Dialysis Access Technologies to Provide a Solution for a Complex Arteriovenous Access Problem

BY SCOTT S. BERMAN, MD, MHA, FACS

A 37-year-old African American woman with chronic kidney disease requiring hemodialysis presented to our institution. The etiology of her renal failure was multifactorial, including insulin-dependent diabetes mellitus, hypertension, and systemic lupus erythematosus. Additional significant comorbidities included morbid exogenous obesity with a body mass index of 37 kg/m^2 and active tobacco use. She is left handed and was initiated on hemodialysis 6 months prior to presentation using left-sided tunneled dialysis catheters (TDCs) by her nephrology team. She was deemed to not be a candidate for an autogenous arteriovenous fistula (AVF) due to inadequate upper extremity venous anatomy. Before transfer to our facility, she had recently completed a course of intravenous antibiotics for MRSA line sepsis, which also required removal of her left internal jugular vein TDC. Her current hemodialysis access consisted of a poorly functioning right femoral TDC.

TREATMENT OPTIONS

This challenging patient needed permanent hemodialysis access, preferably with an arteriovenous fistula or arteriovenous graft (AVG). She had already experienced the disadvantages of TDCs, including catheter sepsis and currently had a poorly functioning femoral TDC. Placement of a new upper body TDC should be a last resort in this type of patient, who has never had an upper extremity arteriovenous (AV) access. Repeat venous duplex imaging of her upper extremities verified inadequate venous anatomy for an AVF, although imaging of her arteries and veins was suboptimal due to her body habitus. Given these limitations, the initial treatment plan was to explore her right axilla (nondominant extremity) to directly evaluate the arterial and venous anatomy for suitability for an AVG. To further limit her exposure to TDCs, use of an early cannulation AVG (GORE® ACUSEAL Vascular Graft) was also part of the treatment strategy.

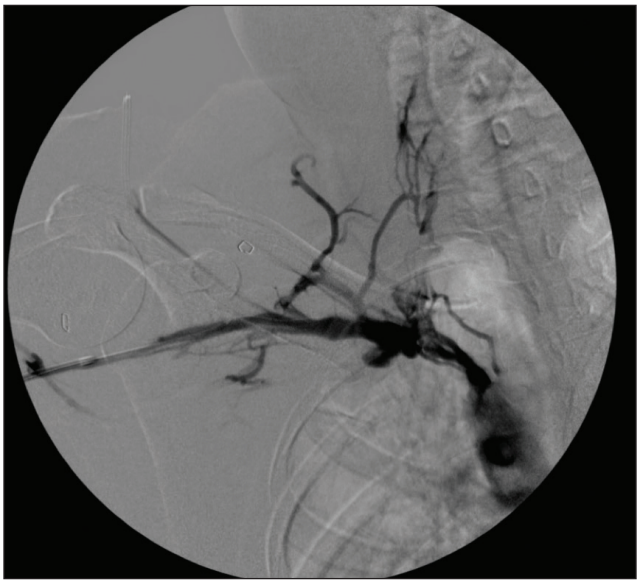

Figure 1. Venogram via a 5 Fr sheath in the basilica vein demonstrating diseased axillary, subclavian, and brachiocephalic veins.

PROCEDURAL DESCRIPTION

The procedure was performed in the hybrid endovascular operating room under general anesthesia. An axillary incision was used to gain exposure of the proximal brachial artery and the basilic-axillary vein junction. The axillary artery was soft and patent, but extremely small in diameter (3 mm). The junction of the basilic-axillary vein junction was sclerotic. Using a 5 Fr micropuncture sheath system, a venogram was performed (Figure 1). This demonstrated diffuse disease in the axillary and subclavian veins with a chronic, recanalized-appearing brachiocephalic vein emptying into a normal-looking superior vena cava. This finding was unexpected given the absence of any

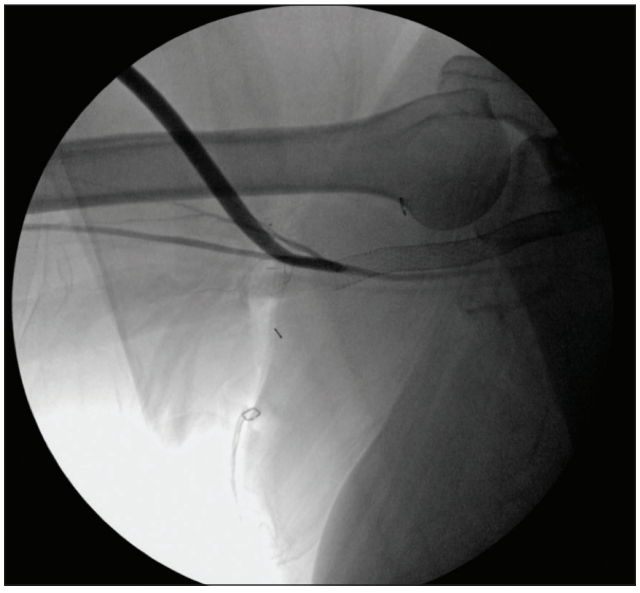

Figure 2. A 4 mm to 7 mm GORE® ACUSEAL Vascular Graft connected to the proximal brachial artery.

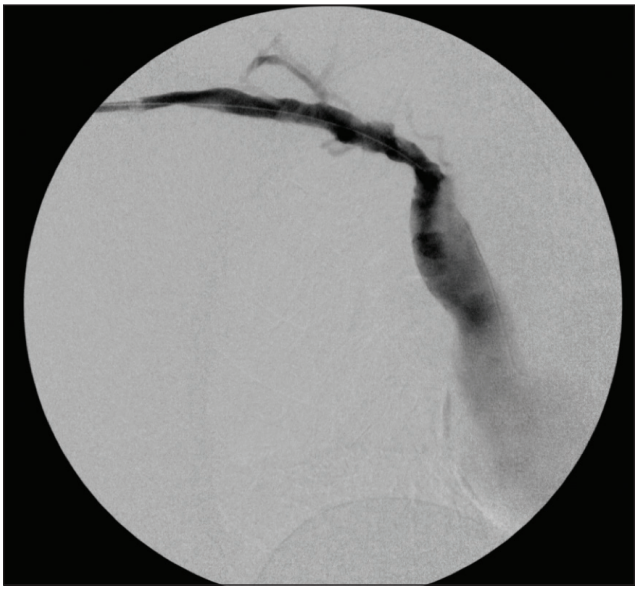

Figure 3. Venogram after 9 mm balloon angioplasty of the subclavian vein–brachiocephalic vein. Residual disease noted at the sheath entry site.

history of venous occlusive disease in the right upper extremity along with the absence of any clinical signs of upper extremity central vein occlusive disease. Given the small size of the brachial artery and the chronic occlusive disease in the axillary and subclavian vein, the treatment plan had to be altered to accommodate these challenges. It was decided to address the small brachial artery by using a 4 mm to 7 mm tapered GORE ACUSEAL Vascular Graft to create the AVG stick zone on the dorsolateral surface of the bicep. The 4 mm end of the GORE ACUSEAL Vascular Graft was anastomosed end-to-side to the proximal brachial artery (Figure 2). The axillary-subclavian vein disease would be treated using a GORE® Hybrid Vascular Graft, which incorporates a nitinol-reinforced segment (NRS) on one end of a 6 mm expanded polytetrafluoroethylene (ePTFE) graft.

After crossing all the venous occlusive disease with a guidewire, the microsheath was replaced with a 9 Fr sheath, and balloon angioplasty of the subclavian-brachiocephalic vein disease was accomplished with a 9 mm ultra-high–pressure balloon with a very acceptable result (Figure 3). The 9 Fr sheath was then exchanged for a 14 Fr peel-away introducer sheath. A GORE Hybrid Vascular Graft with a 9 mm x 10 cm NRS was threaded over a 9 mm angioplasty balloon and then introduced over the wire through the 14 Fr peel-away sheath, advancing the NRS segment under fluoroscopy beyond the point of disease in the subclavian vein. The NRS segment was deployed and immediately expanded with the preloaded 9 mm balloon. The procedure was completed by performing an end-to-end anastomosis between the GORE ACUSEAL Vascular Graft and the GORE Hybrid Vascular Graft through a counterincision just proximal to the antecubital fossa to create the apex of the upper arm loop AVG. A completion fistulagram demonstrated brisk flow through the AVG and a widely patent venous anastomosis created with the NRS of the GORE Hybrid Vascular Graft (Figure 4).

RESULTS

The patient had an uneventful recovery and was discharged home on postoperative day 3. She underwent dialysis through her right upper arm loop AVG using the GORE ACUSEAL Vascular Graft portion as the cannulation zone on postoperative days 1 and 3 and had her right femoral TDC removed on postoperative day 1. She has been dialyzing now for 2 months without incident. Recent duplex imaging of her right upper arm AVG demonstrated a flow rate of 2,500 mL/min with spiral flow noted throughout the graft (Figure 5).

DISCUSSION

This patient presented significant challenges for hemodialysis access, including the need for immediate access, the need to avoid TDCs, and disadvantaged anatomy that included small arterial inflow and diseased venous outflow. Before the GORE ACUSEAL Vascular Graft and GORE Hybrid Vascular Graft were available, management of this patient would have likely required the use of a standard PTFE AVG combined with a HeRO® Graft (Merit Medical Systems, Inc.) to overcome the venous outflow pathology. In addition, the lack of a US Food and Drug Administration (FDA)–approved early cannulation graft would have necessitated the patient to have further

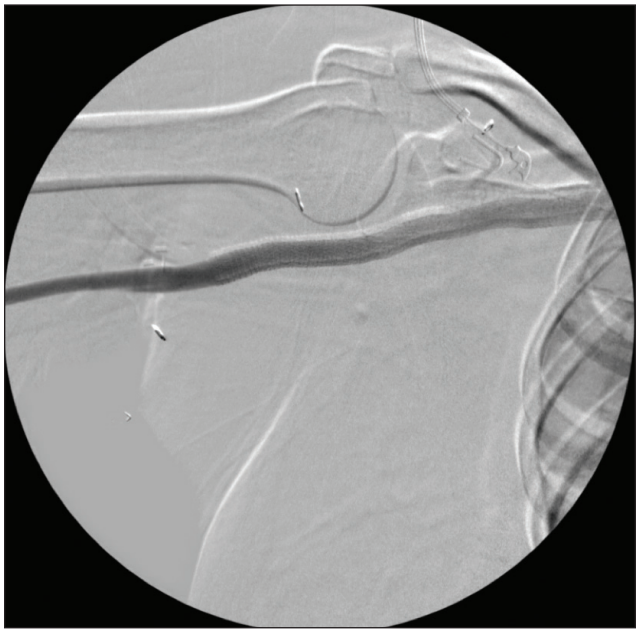

Figure 4. Completion fistulagram shows wide patency of the 9 mm x 10 cm nitinol-reinforced segment of the GORE® Hybrid Vascular Graft emptying into the proximal subclavian vein.

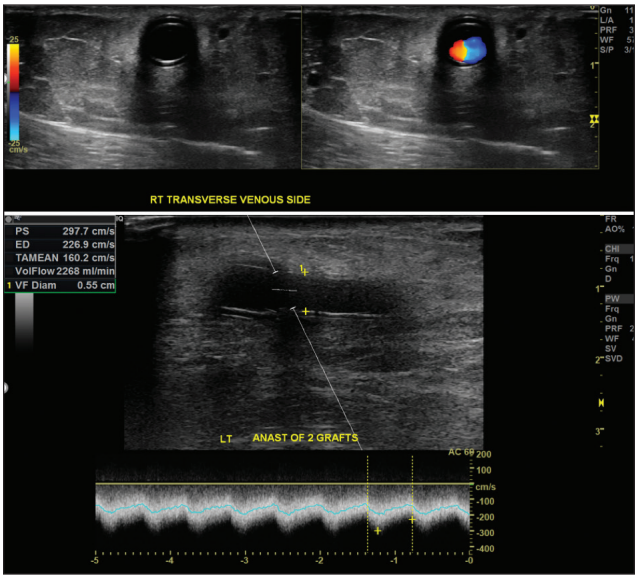

Figure 5. Postoperative duplex scan of the right upper arm loop arteriovenous graft demonstrating spiral flow with a flow rate of 2,200 mL/min.

TDC contact time while the upper extremity AVG healed. This time frame is quite variable, ranging from 2 to 6 weeks.

The GORE ACUSEAL Vascular Graft is the only FDA-cleared early cannulation graft for AV access in the United States. It was only logical to use this technology in this patient given her prior history of TDC complications. Use of the GORE ACUSEAL Vascular Graft eliminated the immediate risk of further TDC complications, as the patient's AVG could be used on the first postoperative day, and her TDC could be removed. The unexpected finding of venous outflow disease created a secondary challenge that highlights the advantage of the GORE Hybrid Vascular Graft. The 10 cm NRS segment allows for the simultaneous creation of a sutureless venous anastomosis and treatment of venous outflow disease using ePTFE-encapsulated self-expanding nitinol stent technology. Combining the GORE ACUSEAL Vascular Graft and the GORE Hybrid Vascular Graft took full advantage of the unique attributes of each device to specifically target this patient's need for early cannulation, a tapered graft to accommodate small arterial inflow, and a durable solution for her venous outflow disease. ■

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