Percutaneous Sutureless Venous Anastomosis

A novel technique in the establishment of a venous graft anastomosis.

BY SHAHRIAR MOOSSAVI, MD, PHD, AND JOHN R. ROSS, MD

Hemodialysis vascular access dysfunction is the single most important cause of morbidity in the hemodialysis population. The annual cost of vascular access-related morbidity in the US exceeds $1 billion per year.[1]

Vascular access remains one of the major challenges in the care of hemodialysis patients. The aging population of incident hemodialysis patients, in addition to the improved survival of the dialysis patient, has made the creation of a long-term hemodialysis access even more difficult.[2] Especially challenging are patients with previous arteriovenous accesses, obese patients, or elderly patients with small veins. In these patients, the only appropriate outflow vein for an arteriovenous graft (AVG) may be centrally located. Many of these cases are left with a tunneled hemodialysis catheter that is categorized as "the last access." Every step that can decrease the need for a hemodialysis catheter is a major advantage in decreasing the hospitalization and mortality of patients. Changing a patient's access from a catheter to an arteriovenous access may decrease the patient's mortality risk by more than 50% compared with patients who continue to use a catheter.[3]

In this article, we describe the endovascular sutureless venous anastomosis to the centrally located outflow vein using a Viabahn endoprosthesis (Gore & Associates, Flagstaff, AZ) to create an upper-arm AVG in a patient with previously failed upper-arm arteriovenous access.

CASE REPORT

A 63-year-old woman with a long-standing history of diabetes mellitus, hypertension, and end-stage renal disease, who was currently on hemodialysis, was referred for further evaluation of a malfunctioning left upper-arm arteriovenous access. She also had a history of congestive heart failure. The patient had been initially started on hemodialysis approximately 4 years before her admission with a left lower-arm loop graft. After her first permanent access had failed, a left upper-arm graft had been placed. She had received multiple central lines, including tunneled hemodialysis catheters. She had repeated clotting of the upper-arm AVG and was also found to have a left subclavian vein stenosis. Eighteen months before the admission, this upper-arm AVG failed and was replaced with a left upper-arm arteriovenous fistula. At the time of this surgery, the cephalic vein had been found to be of adequate caliber; however, there was a high-grade stricture of the cephalic arch. The stricture was angioplastied with an 8-mm balloon; a brachiocephalic fistula was constructed, but the flow was noted to be suboptimal. At that time, a drop-down procedure into the axillary vein was performed, and the high-grade subclavian vein stenosis was angioplastied by a 12-mm balloon. The patient had been able to dialyze with the arteriovenous fistula until this admission. The creation of a new access in her left arm was a surgical challenge.

SURGICAL TECHNIQUE

After regional anesthesia in the form of intrascalene block, the patient's upper extremity was prepared and draped in the usual fashion. The proximal basilic vein was visualized using the portable ultrasound device. The basilic vein was cannulated with the 18-g stick needle under ultra-

Figure 1. Cannulation of the basilic vein under ultrasound guidance.

Figure 2. The guidewire is advanced into the central vein under fluoroscopy.

sound guidance (Figure 1). The 180-cm guidewire was threaded under fluoroscopy (Figure 2). The 18-g stick needle was exchanged for a 5-F introducer. Angiography was performed to visualize the central venous system. In this case, there was a near total subclavian occlusion, which was initially dilated with a high-pressure 12-mm X 4-cm ConQuest balloon (Bard Peripheral Vascular, Inc., Tempe, AZ) followed by a 14-mm X 2-cm ConQuest balloon (Figure 3).

The skin incision and preparation for the future arterial anastomosis were made in the usual manner. After the visualization of the acceptable arterial anastomosis site, the procedure continued at the future outflow. A 1-cm skin incision was made just distal to the introducer. The tunnel for the 6-mm Atrium Slider graft (Atrium Medical Corporation, Hudson, NH) was then marked on the skin. The tunneling of the graft was done in the usual manner. The 5-F introducer was exchanged for the 9-F, 13-cm SafeSheath hemostatic tear-away introducer system with infusion side port (Pressure Products, Inc., San Pedro, CA) to accommodate the Viabahn stent graft. The guidewire was threaded into the graft starting at the proximal venous end (Figure 4). If there is difficulty with the hydrophilic guidewire, a stiffer guidewire can be used. The Viabahn stent graft was placed over the guidewire, passing through the graft and advancing into the introducer to the axillary vein. The 9-F introducer was split, and the Viabahn shaft was straightened (Figure 5A-D). The position of the proximal graft end was marked with a hemostat under fluoroscopy. The position of the stent graft was verified under fluoroscopy, connecting the 4-cm distal portion of the graft (4 cm distal to hemostat) with the axillary vein (Figure 6). The flow of venous blood after the deployment of the stent graft was suggestive of the successful connection. Repeat angiography was performed to visualize the areas in need of angioplasty. A high-pressure 8-mm X 8-cm ConQuest balloon was insufflated at 20 to 25 atm to expand and improve the stent graft conduit. In this case, the follow-up angiogram showed elastic recoil of the central stenosis. A 14-mm X 6-cm Protege EverFlex Self-Expanding stent (ev3, Inc., Plymouth, MN) was placed to maintain the central system patent. After the repeat angiogram confirmed the acceptable result, the arterial anastomosis was established.

DISCUSSION

This case presents the fusion of surgical and endovascular techniques to create a long-term hemodialysis access in a case in which only the central veins remained an option. It presents a valuable, minimally invasive alternative to bypass grafting and re-creation of the outflow vein. Thrombosis of the central venous system due to catheters is a substantial cause of hemodialysis morbidity and mortality.[4] The sutureless anastomosis can help decrease the catheter contact time. An important factor to achieve maximal patency rate is to minimize damage to the vessel walls. Sutures induce vascular wall damage, which influences the healing of the anastomosis. With nonsuture techniques, a faster and less-traumatic anastomosis can be made. The use of rings, clips, adhesives, and laser welding has been reported in the literature. The disadvantages of these devices include rigidity and a noncompliant anasto-

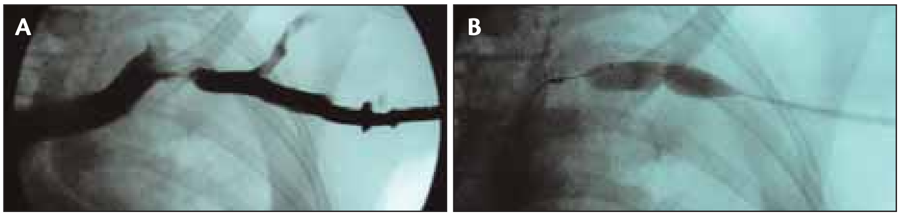

Figure 3. Dilatation of central stenosis with a high-pressure balloon.

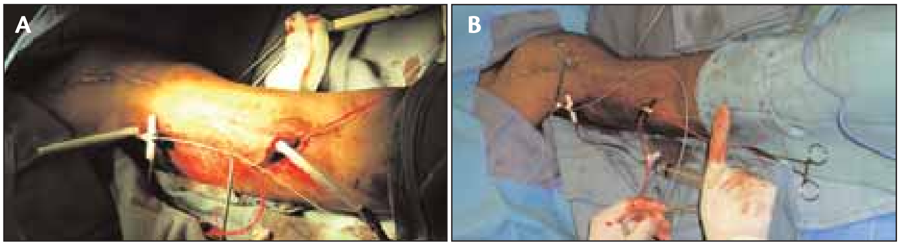

Figure 4. Tunneling the graft and threading the wire into the graft.

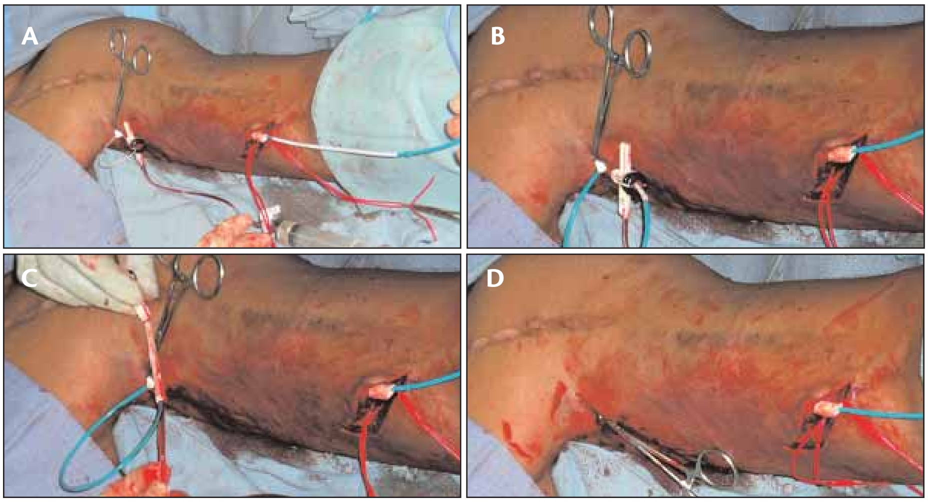

Figure 5. The Viabahn stent is back-loaded over the wire into the graft (A). The Viabahn is advanced into the SafeSheath introducer (B). The SafeSheath is peeled away (C). The Viabahn is straightened in preparation for deployment (D).

mosis with rings; toxicity, leakage, and aneurysm formation with adhesives; cost; reduced strength in larger-sized vessels; and demand for surgical skills with laser welding.[5]

Graft thrombosis is the cause of 80% of all vascular access dysfunction in dialysis grafts, and, in more than 90% of thrombosed grafts, the underlying pathology is a stenosis caused by venous neointimal hyperplasia at the venous anastomotic site or in the proximal vein.[1] The most important hemodynamic parameter in the pathogenesis of neointimal hyperplasia is the increased turbulence and low shear stress.[1] The sutureless venous anastomosis may have other advantages, including a less-turbulent flow in the anastomosis area compared to the traditional sutured venous graft anastomosis. The flaring and low wall tension of the nitinol stent allow a smooth transition into outflow vein. The thermal memory of the nitinol stent may account for the reduction in the angle of the anastomosis and the continued expansion of outflow at the end of the stent, which could lead to decreased turbulence at the venous anastomosis.[6]

Use of an axillary vein as the venous outflow has been reported to be associated with improved outcomes in a study of 284 patients with polytetrafluoroethylene grafts during a 4.5-year time frame.[7]

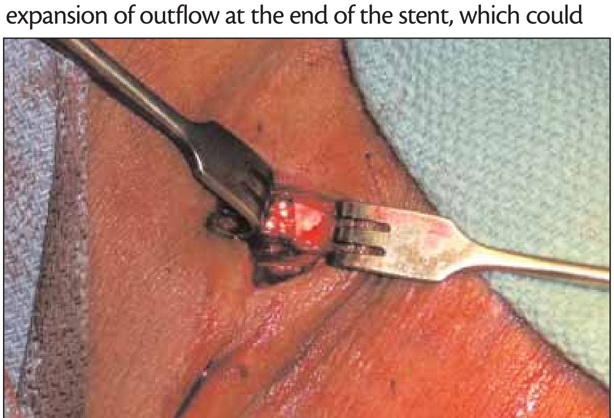

Figure 6. Close-up of the sutureless stent graft anastomosis.

CONCLUSION

In our initial series, the primary patency rate for access salvage was 100% at 3 months and 82% at 6 months. There was no bleeding or leakage at the site of stent placement. In these patients, the procedure was started with a cut-down identification of a small vein in the axilla.[8] This case demonstrates the ultrasound guidance endovascular technique, which is less traumatic and shortens the operation time and venous manipulation. We believe this procedure adds a valuable alternative for reaching the central venous system for establishing a long-term dialysis access. Further studies are needed to evaluate the long-term outcome. ■

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