The creation of long-term hemodialysis access remains a significant challenge, especially in patients with multiple previously failed arteriovenous accesses, those with central venous stenosis due to previous catheter use, morbidly obese patients, and the elderly. According to the 2011 United States Renal Data System Annual Report, 571,000 patients in the United States received treatment for end-stage renal disease (ESRD) in 2009, and since 2000, the incidence rate of ESRD has grown by 12% in patients who are 75 years of age and older. As we continue to treat an older ESRD population with multiple comorbidities, an increase in the use of synthetic arteriovenous grafts (AVGs) may be required despite the Fistula First Breakthrough Initiative.

Anastomotic stenosis of AVGs due to intimal hyperplasia is the major cause of failure in vascular access grafts used for hemodialysis, and there is a strong relationship between hemodynamic factors and the formation of intimal hyperplasia. A conventional end-to-side venous anastomosis subjects the vessel wall to turbulent, nonlinear flow at the toe and heel of the anastomosis and where the flow impinges on the native vein wall—locations that have been shown to correspond to areas of the development of intimal hyperplasia. In addition, spatial and temporal gradients in wall shear stress have been found at sites in which intimal hyperplasia tends to develop. The new Gore Hybrid vascular graft (W. L. Gore & Associates, Flagstaff, AZ) (Figure 1) addresses the common failure of outflow stenosis, potentially reducing the number of interventions required to maintain AVG patency. This benefit, as well as the unique deployment system of the device, which allows for access to challenging anatomy, makes expanded polytetrafluoroethylene (ePTFE) grafts a more...

Figure 1. The Gore Hybrid vascular graft is an ePTFE vascular prosthesis that has a section that is reinforced with nitinol. The NRS is partially constrained to allow for easy insertion and deployment into a vessel.
attractive therapy for arteriovenous access creation, especially in the aging dialysis population.

The Gore Hybrid vascular graft is an ePTFE graft with a nitinol-reinforced section (NRS) (Figure 1), and the continuous luminal surface is covalently bonded with the Carmeda bioactive surface (Carmeda AB, Upplands Väsby, Sweden), which consists of a stable, covalently bonded, reduced-molecular-weight heparin. Deployment of the NRS into a vessel results in a sutureless end-to-end anastomosis and can be performed with an over-the-wire, minimally invasive percutaneous technique.

The "endoluminal anastomosis" created with the Gore Hybrid vascular graft optimizes the hemodynamic profile at the outflow anastomosis, resulting in a reduction in intimal hyperplasia. Computational fluid dynamics studies with this device have shown improvement in hemodynamics and a decrease in variation of wall shear stress at the NRS of the device, as compared to a standard end-to-side anastomosis.8 An in vivo porcine study has also demonstrated a reduction in stenosis and thrombosis with the Gore Hybrid vascular graft as compared to a conventional end-to-side anastomosis.9

We and others have reported on the creation of an arteriovenous anastomosis with either a vascular graft and a stent graft alone in a manner that is similar to that of the Gore Hybrid vascular graft.10-13 Our experience with a percutaneous sutureless anastomosis using a vascular graft and a stent graft to create conduits for long-term hemodialysis access spans over 175 patients and 10 years; we continue to observe excellent safety and effectiveness results from this procedure.

With the Gore Hybrid vascular graft now available, we can use a single device with a continuous lumen to create a sutureless venous anastomosis in a percutaneous fashion. The Gore Hybrid vascular graft also incorporates a low-permeability film within the wall of the graft that acts as a barrier to ultrafiltration and provides seroma resistance. This article describes a percutaneous approach for creating an endoluminal anastomosis with the Gore Hybrid vascular graft and the initial outcomes in 83 patients.

**CASE REPORT**

A 70-year-old woman with a history of hypertension, diabetes mellitus, obesity, and ESRD presented with a malfunctioning right upper arm looped arteriovenous ePTFE graft. Flow in the graft was pulsatile, and the patient was not able to undergo adequate dialysis. Angiography showed retrograde flow within the AVG and a complete occlusion within the loop graft near the outflow anastomosis (Figure 2). The occlusion could not be crossed with a wire.

The adequate outflow axillary vein was located deep within the axilla and would have been a challenging site for surgical creation of a new outflow anastomosis. Due to its ability to create an endoluminal anastomosis in a percutaneous fashion, the Gore Hybrid vascular graft was chosen to bypass the occlusion and create a new sutureless outflow venous anastomosis.

**Percutaneous Technique**

After regional anesthesia, the patient’s upper arm was prepared and draped in the usual fashion. The failed ePTFE loop graft was cannulated with an 18-gauge needle (Figure 2A), and a 180-cm guidewire was threaded...
through the prior AV loop graft under fluoroscopy. The needle was exchanged for a 7-F introducer, and angiography was performed to visualize the occlusion in the failed ePTFE loop graft (Figure 2B). The axillary vein was visualized proximal to the occlusion using a portable ultrasound device (Figure 3A), and the axillary vein was cannulated under ultrasound guidance (Figure 3B).

A guidewire was threaded into the axillary vein under fluoroscopy, and the needle was exchanged for a 7-F introducer. Angiography was performed to visualize the central venous system and the axillary vein where the NRS of the Gore Hybrid vascular graft was deployed (Figure 4A). The outflow axillary vein was approximately 8 mm in diameter, and a Gore Hybrid vascular graft with an 8-mm-diameter NRS was chosen. The graft was tunneled in the usual manner (Figure 4B), and the 7-F introducer was exchanged over the wire for a 14-F tearaway introducer (Galt Medical Corporation, Garland, Texas) (Figure 4C). The 14-F peel-away introducer was necessary to accommodate the vascular graft with the 8-mm-diameter NRS. The dilator of the peel-away sheath was removed, and while keeping a thumb over the open end of the sheath to prevent back-bleeding, the guidewire was threaded into the constrained NRS and through the vascular graft section (Figure 4D). As the wire was pulled through the device, the constrained NRS was introduced into the end of the peel-away sheath.

As the peel-away sheath was split, the NRS of the Gore Hybrid vascular graft was advanced into the axil-
The percutaneous implantation technique using the Gore Hybrid vascular graft simplifies difficult arteriovenous access creation and revision procedures. The device enables additional access sites for patients who have exhausted all sites with a conventional AVG. Without the use of this device, many cases would have been time-intensive, invasive surgical procedures, resulting in abandonment of the access site. The unique design and deployment of the Gore Hybrid vascular graft allows us to overcome multiple problems at once and opens up more time for patients to undergo dialysis. Six- and 12-month functional patency rates suggest that this graft decreases the incidence of outflow stenosis, decreases the incidence of infection and seroma, and improves outcomes in the most challenging patient populations.

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