

Challenging Hybrid Cases: How We Do Them

How the GORE Hybrid Vascular Graft can be used to treat complex dialysis cases.

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The primary intent of the GORE Hybrid Vascular Graft is to create a sutureless end-to-end vascular anastomosis, possibly reduce intimal cell proliferation, and improve flow hemodynamics in the outflow track of arteriovenous access or arterial bypass circuits. The expanded polytetrafluoroethylene (ePTFE) transition to stent-graft (nitinol-reinforced section) design creates an end-to-end anastomosis and maintains laminar flow from the graft conduit into the recipient vessel.¹ Extensive fluid and flow dynamics testing suggests that this design significantly reduces the vessel wall shear stresses conveyed on the outflow track when compared to a conventional end-to-side, sutured anastomosis (Figure 1).^{2,3} Presently, there are no peer-reviewed clinical data that prove altering the outflow dynamics with this device has truly had an impact on the genesis of neointimal hyperplasia or overall graft patency. However, as in the case of most novel technology, ideas for new and innovative applications are often discovered, and as such, there has been success with expanded application of the GORE Hybrid Graft in various cases and complex situations.

The GORE Hybrid Graft has been used for complex vascular access, peripheral bypass, carotid reconstruction,

and renal and mesenteric artery reimplantation during aortic debranching surgery.⁴⁻⁶ In this article, we describe two cases in which we used the GORE Hybrid Graft to address challenging situations in complex dialysis access.

CASE 1

A 53-year-old African American man on hemodialysis for more than 15 years presented with frequent thrombosis of his right upper arm graft. Previously, he had an ePTFE graft placed to salvage a basilic vein transposition fistula on the anteromedial aspect of the upper arm. Subsequent to failure, that access was then salvaged by placing a GORE Hybrid Vascular Graft with a 7 mm × 5 cm Nitinol Reinforced Section (NRS) from the brachial artery to the axillary vein that had become dysfunctional secondary to intimal hyperplasia and severe venous outflow stenosis just beyond the anastomosis. Additionally, a GORE VIABAHN Endoprosthesis (8 mm × 5 cm) was used to extend the outflow by overlapping it with the NRS of the GORE Hybrid Device.

The patient's GORE Hybrid Graft had been working extremely well for nearly 3 years until he developed frequent clotting episodes, which required multiple thrombectomy procedures. When the most recent angiograms were reviewed, they revealed a very mild narrowing of the outflow vein just beyond the GORE VIABAHN Endoprosthesis and no significant technical issues within the graft. The mild narrowing did not seem to be flow limiting, but it was noted that the patient had discontinued his antiplatelet therapy several months previously in addition to having newly developed hypotension after dialysis. His antiplatelet therapy was reinitiated, as was midodrine to support his blood pressure in an attempt to prevent future thrombotic events.

Unfortunately, the patient presented to clinic 1 month later having thrombosed his graft despite the previously prescribed therapy. The decision was made to thrombectomize the graft in an open fashion so as to expand the potential options for revision. The GORE Hybrid

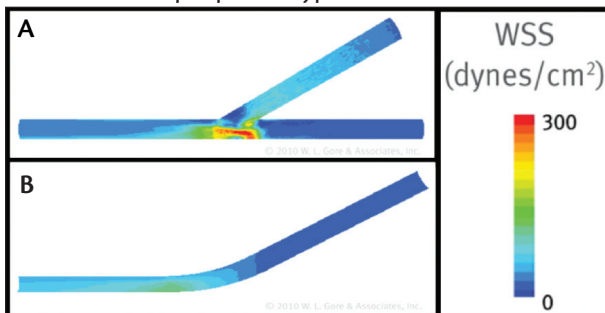


Figure 1. Computational fluid dynamics testing comparing conventional end-to-side anastomosis (A) to GORE Hybrid Graft (B), which demonstrates significant reduction in wall shear stresses with the GORE Hybrid Graft endoluminal anastomosis. The model depicts 600 mL/min flow, 4.8 mm anastomosis at a 30° angle.

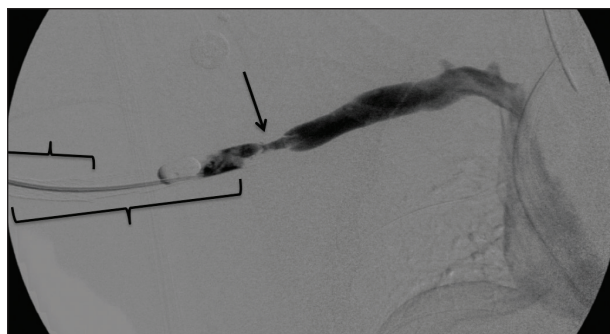


Figure 2. Intraoperative angiogram, before second GORE Hybrid Graft placement. Previous Hybrid NRS (top bracket) and previous Gore VIABAHN Device (bottom bracket). Severe stenosis central to the GORE Hybrid Graft NRS (arrow).

Graft was accessed via surgical exposure distally, near the arterial anastomosis, and the inflow was successfully thrombectomized using a compliant thrombectomy balloon. We attempted thrombectomy of the venous limb but had significant difficulty crossing the cannulation segment. We were able to eventually traverse the cannulation segment with a wire and directional catheter, but attempts at thrombectomy were unsuccessful. Angiography of the venous outflow identified aggressive stenosis of the outflow vein just central to the NRS of the previous GORE Hybrid Graft and VIABAHN Device (Figure 2).

Due to our inability to satisfactorily thrombectomize the entire graft, we decided to once again salvage this right upper arm access site by placing a new GORE Hybrid Graft. At this point in the patient's dialysis access history, he had had three previous concentric grafts in the right upper arm, with each new graft being placed just lateral to the last. Geometrically speaking, placing a new graft just lateral to the previous, in this case, would have been more technically challenging and would have likely exposed the graft to a mechanical complication such as kinking or torsion. As such, we decided to place the new GORE Hybrid Graft medial to the previous three grafts.

An incision was made in the axilla proximal to the venous anastomosis from the previous graft (through which the currently thrombosed GORE Hybrid Graft had been inserted). We identified the thrombosed GORE VIABAHN Device within the axillary vein. The vein and stent-graft were transected, and the new 7 mm × 10 cm GORE Hybrid Graft was inserted under direct visualization into the previously stented axillary vein. Completion angiography noted successful treatment with the 10 cm NRS, but there was a residual stenotic segment just central to the GORE Hybrid Graft. Extension of the NRS with an 8 mm × 5 cm GORE VIABAHN Device provided an excel-

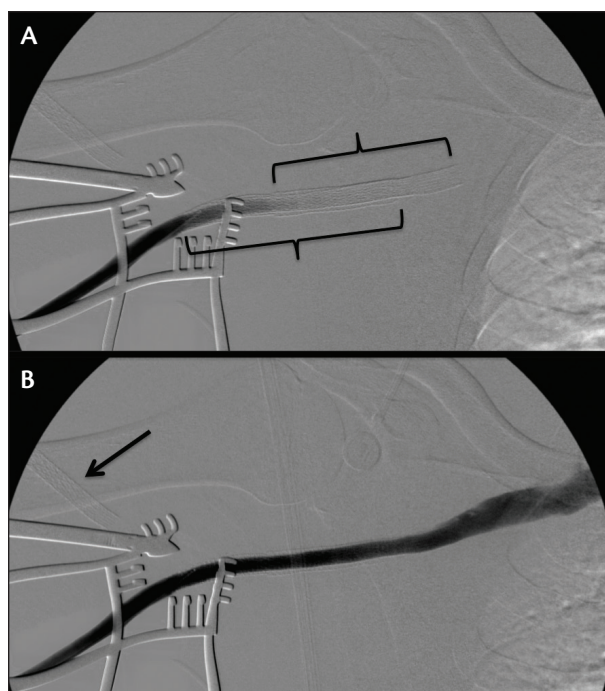


Figure 3. After second GORE Hybrid implant (A): 10 cm NRS (bottom bracket) overlapping with extension of 5 cm GORE VIABAHN Device (top bracket). Successfully treated venous stenosis after GORE Hybrid Graft deployment with patent central veins noted (B). Previously placed Hybrid NRS and VIABAHN Device (transected) (arrow).

lent final result (Figure 3). Finally, the GORE Hybrid Graft was tunneled distally (and medial to the previous grafts), utilizing the cuff of the previous graft for arterial inflow. A graft-to-graft anastomosis was completed using a 5–0 GORE suture (1:1 ratio, needle-to-suture diameter). The patient returned to the vascular clinic 2 weeks after the procedure with a well-functioning arteriovenous graft (Figure 4).



Figure 4. Two weeks postprocedure. Four concentric grafts in the right upper arm with an "X" to denote each. The outlined, and most medial graft, is the new, functional GORE Hybrid Graft.

CASE 2

A 56-year-old African American woman was seen 18 months after placement of a right upper extremity hemodialysis reliable outflow (HeRO) graft (Hemosphere/CryoLife, Inc.) for central venous occlusion. She presented to the vascular clinic with new development of a right upper extremity firm fluid collection in the right axilla in the region of the arterial anastomosis (Figure 5). She did not report fever, chills, or tenderness, and the graft was otherwise working extremely well for hemodialysis. The graft had recently thrombosed and was successfully thrombectomized at an outpatient vascular access center just weeks before. Based on exam, the working diagnosis was weeping syndrome (graft ultrafiltration), but the timing did not make sense for a classic presentation. Typically, weeping syndrome occurs near the arterial anastomosis immediately after graft implantation due to failure of the plasma proteins to seal the air interstices of an ePTFE graft.

At the time of the initial HeRO Graft implantation, there was a strong concern for the development of steal syndrome due to the small arterial anatomy of the patient, so the graft segment of the HeRO Graft was replaced with a 4 to 7 mm tapered graft. We presumed that it had not been appreciated that the graft was tapered and that the operators, thinking that an acquired arterial stenosis had developed, treated this region with balloon angioplasty at the time of graft thrombectomy, thus overstretching and damaging the ePTFE, which allowed plasma to leak from the graft to develop a large collection.

The patient was taken to the operating room for evacuation of fluid and gelatinous material and stent-graft placement in the most proximal 5 cm of the graft adjacent to the arterial anastomosis, our treatment of choice for weeping syndrome (Figure 6). The patient presented



Figure 5. Right upper extremity graft ultrafiltration fluid collection over arterial anastomosis weeping syndrome.

to the clinic 2 weeks later with complete reaccumulation of fluid at the site. To date, we had never observed this degree of fluid reaccumulation after treating weeping syndrome. This made us concerned that fluid was still leaking around the stent-graft due to lack of apposition of the stent to the graft wall secondary to the tapered configuration of the graft or incomplete deployment of a slightly oversized stent (Figure 7).

Access abandonment was considered; however, the patient had no further options due to her central vein occlusion and limited inflow. We had already decided to proximalize her inflow from the brachial to the axillary position and to use a tapered graft at her initial operation to avoid steal syndrome. We were determined to maintain her current inflow, as this was virtually the patient's last option for access salvage. In order to preserve her inflow, we decided to use the GORE Hybrid Graft to create a sealed, sutureless, arterial anastomosis between the previously placed stent-graft and the GORE Hybrid Graft.

So as to avoid damaging the stented portion of the graft, a compliant balloon was inserted through the graftotomy and inflated for arterial control. The existing tapered graft was transected from around the balloon catheter and removed. The 6 × 50 mm GORE Hybrid Graft was then inserted into the previous graft and

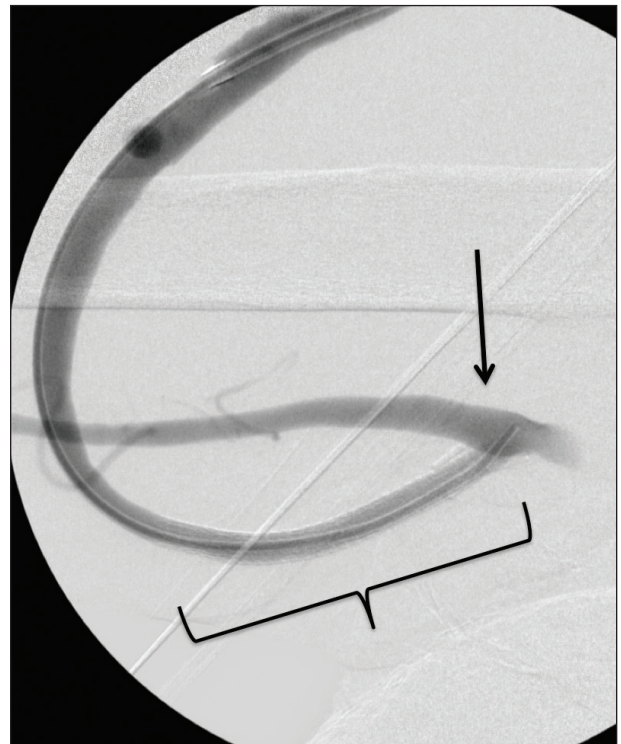


Figure 6. Completion angiogram from the first operation to repair weeping syndrome (stent-graft, bracket; arterial anastomosis, arrow).

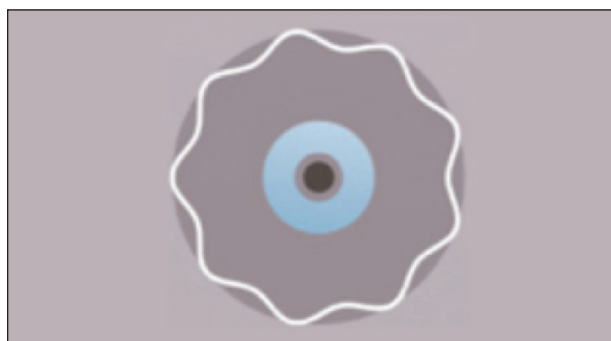


Figure 7. Incomplete deployment and nonapposition of oversized stent-graft within vessel.

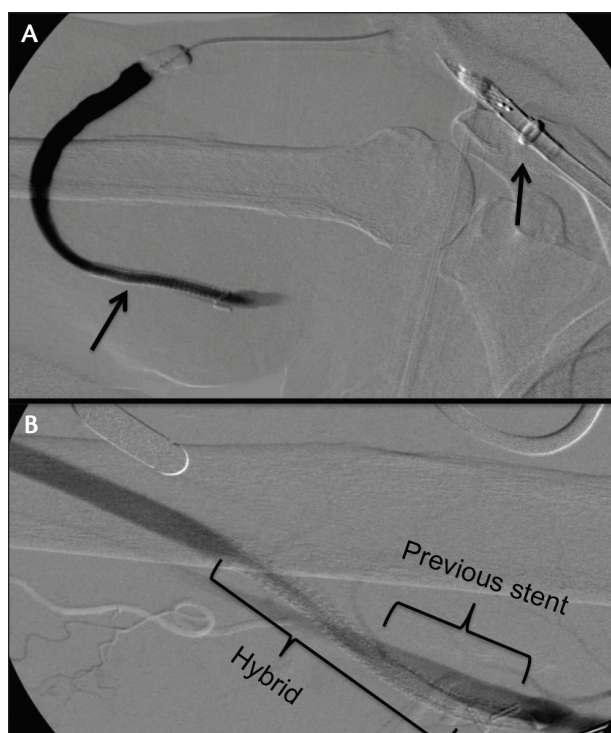


Figure 8. Previously deployed stent-graft within 4- to 7 mm tapered graft before stent transection (left arrow); HeRO Graft titanium connector (right arrow) (A). Completion angiogram of deployed GORE Hybrid Graft within transected stent-graft (B).

stented segment and deployed (Figure 8). The GORE Hybrid Graft was tunneled, the HeRO Graft cannulation segment was interposed and replaced with the GORE Hybrid Graft, and a graft-to-graft anastomosis was created near the titanium connector of the HeRO Graft venous outflow component. Once again, the plasma-

rich gelatinous material was evacuated from around the original arterial anastomosis, irrigated, and closed. The patient presented at the clinic 2 weeks after the operation with a well-functioning HeRO Graft/GORE Hybrid Graft, without evidence for graft ultrafiltration.

CONCLUSION

These cases demonstrate the expanded utility of the GORE Hybrid Graft to rapidly accomplish a sutureless end-to-end anastomosis in challenging cases in which limited alternative options exist. The utility of this goes far beyond improvement of the flow dynamics at the anastomosis and recipient vessel. The graft has become an effective adjunct in complex and often convoluted vascular cases in which we now have an improved ability to treat patients in the most effective way: open surgery, endovascular therapy, or a hybrid combination of the two. As such, the GORE Hybrid Graft takes advantage of both conventional open vascular graft and endovascular stent technologies and maintains the current trajectory and natural evolution toward minimally invasive and cutting-edge vascular surgery. ■

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