Covered Stent Compression in Dialysis Access

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Given a recent study which shows that stent grafts provide superior short-term patency compared with angioplasty alone in treatment of venous outflow stenosis in dialysis grafts, these devices are increasingly used for this application.¹ Long-term patency data are not yet available and few complications related to these devices have been reported to date.

CASE REPORT

A 32-year-old woman with end-stage renal disease and a thrombosed right forearm arteriovenous dialysis graft was referred to our Vascular and Interventional Radiology Section for evaluation and treatment. A pharmacomechanical thrombolytic procedure was performed in standard fashion using crossed catheter technique and 4 mg of tissue plasminogen activator (Alteplase[®], Genentech, South San Francisco, CA) After reestablishing flow within the graft, a high-grade elastic outflow stenosis was noted which was dilated with an 8-mm high-pressure angioplasty balloon catheter (Blue Max[®], Boston Scientific, Natick, MA) with suboptimal results (Fig. 1). A residual stenosis was noted that had a pressure gradient of 20 mm Hg, and the graft remained pulsatile on physical examination. A 7 mm × 50 mm stent graft (FLAIR[®] Endovascular Stent Graft, Bard Peripheral Vascular, Tempe, AZ) was deployed across the stenosis with good angiographic and hemodynamic results. On physical exam, the graft had a good thrill without significant pulsatility.

The patient was discharged but experienced recurrent graft thrombosis while sleeping 2 days later. Repeat declotting was performed but the etiology of the repeat thrombosis remained unclear (Fig. 2). A pullback pressure measurement was performed from the right atrium through the graft; no angiographically occult stenoses were discovered. Given the location of the stent graft in close proximity to the elbow joint, dynamic compression was considered. Therefore, the patient's arm was flexed at the elbow under fluoroscopy and it was noted that the previously deployed stent graft crimped at the site of flexion precluding antegrade flow in the graft.

To buttress the stent graft, a 10 mm × 40 mm uncovered stent (Wallstent[®], Boston Scientific) was deployed within the stent graft. Repeat imaging during forearm flexion revealed no further crimping. The graft has remained patent at 2-month follow-up.

DISCUSSION

The FLAIR[®] Endovascular Stent Graft is indicated for use in the treatment of stenosis at the venous anastomosis of synthetic arteriovenous access grafts. The stent graft is composed of expanded polytetrafluoroethylene (ePTFE) over a nitinol stent that has a flared distal segment, which is larger in diameter than the main body of the stent graft. The device is designed to be placed partially within the access with the flared end extending into the outflow vein. A recent

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Thoracic Interventions; Guest Editor, Charles T. Burke, M.D.

Semin Intervent Radiol 2011;28:128–130. Copyright © 2011 by Thieme Medical Publishers, Inc., 333 Seventh Avenue, New York, NY 10001, USA. Tel: +1(212) 584-4662.

DOI: <http://dx.doi.org/10.1055/s-0031-1273947>.

ISSN 0739-9529.

Figure 1 Angioplasty and stent graft treatment of venous outflow stenosis. (A) Digital subtraction study showing outflow stenosis. (B) Fluoroscopic image showing balloon angioplasty stenosis. (C) Digital subtraction study showing residual outflow stenosis. (D) Fluoroscopic image showing stent graft deployment. (E) Digital subtraction study showing no residual outflow stenosis.

well-designed prospective, controlled randomized multicenter clinical trial of 190 patients has shown that compared with angioplasty, the FLAIR[®] stent graft demonstrated increased patency at 6 months in the treatment of venous outflow stenosis.¹ In this study, published in the *New England Journal of Medicine*, treatment area patency was 51% for the stent graft versus 23% for angioplasty alone at 6 months. Access circuit patency at 6 months also favored stent grafts by a 38% to 20% margin. Although long-term results are lacking, this experience has argued for increased use of stent grafts. In our own practice, due to cost considerations, we use stent grafts in dialysis access for two indications: pseudoaneurysm exclusion in patients who are poor surgical candidates and in some outflow stenosis cases that have suboptimal results after simple angioplasty. Some investigators also use covered stents for vein rupture refractive to balloon tamponade. We do not use covered stents routinely for this latter indication; in both our published and unpublished experience, uncovered stents work adequately in virtually all cases and are less costly than covered stents.

There are a large number of commercially available stents and stent grafts that are marketed in a wide variety of shapes, materials, and sizes. Classifications that are used to categorize these devices become less and

less useful over time due to the smaller and smaller incremental differences between prostheses. For example, open versus closed cell stents has been a subject of debate in the treatment of carotid stenoses with reported differences between devices. Some have argued differences were attributed to cell size rather than open or closed geometry. They predict that current open cell stents with small cell size will have identical similar results to closed cells stents.

The three most commonly used stent grafts for dialysis access are the FLAIR[®] (Bard), FLUENCY[®] (Bard), and VIABAHN[®] (GORE, Flagstaff, AZ). All are self-expanding, open cell stents constructed from laser-cut nitinol tubes and premounted inside a delivery catheter. The FLAIR[®] has a nitinol stent framework encapsulated within two layers of ePTFE and comes in a straight or flared configuration. The FLUENCY[®] has an internal and external layer of ePTFE. The VIABAHN[®] is constructed with ePTFE externally supported with nitinol wire. Ideal properties of a stent graft would include resistance to compression, flexibility, and fatigue resistance. The self-expanding nature of stent grafts allows them to regain diameter after being compressed. The open cell design of these stents provides greater flexibility, opposed to the closed cell design, which has a greater scaffolding and provides resistance to kinking during

Figure 2 Repeat intervention 2 days after initial stent graft placement. (A) Digital subtraction venogram after declotting showing widely patent venous outflow. (B) Fluoroscopic image of stent graft with arm in neutral position. (C) Fluoroscopic image of stent graft with elbow flexion showing significant crimping and narrowing of stent at flexion point. (D) Fluoroscopic image of self-expanding bare metal stent insertion. (E) Digital subtraction venogram after bare metal stent insertion showing widely patent venous outflow. (F) Fluoroscopic image of stent graft and bare metal stent with elbow flexion showing no significant crimping or narrowing of stent at flexion point.

joint flexion, at the cost of flexibility. In the patient described in this report, in retrospect, a more flexible graft such as the VIABAHN[®] may have been a better choice. This device tends to be more flexible and has demonstrated good short-term results for treatment of popliteal aneurysms when placed across the knee joint. On the other hand, similar studies with the VIABAHN[®] in the arm are not available and patency

data of this graft in dialysis access are currently lacking.

SUGGESTED READING

Haskal ZJ, Trerotola S, Dolmatch B, et al. Stent graft versus balloon angioplasty for failing dialysis-access grafts. *N Engl J Med* 2010;362(6):494–503