

Conduit Use During Endovascular Repair of AAAs

A case report and review of the techniques.

BY RICHARD C. HERSHBERGER, MD, AND ROSS MILNER, MD

Since its inception in 1991, stent graft technology for treating abdominal aortic aneurysms (AAAs) has continued to evolve, thus allowing a wider patient population to be treated. Additionally, larger aortic endoprosthesis diameters have allowed for the treatment of necks of increasing size. Unfortunately, this has come at the expense of having device delivery systems with larger outer diameters. The smallest bifurcated devices can be delivered through an 18-F sheath (20.4-F outer diameter), with larger devices requiring access that will accommodate delivery systems up to 24.5-F (Table 1). Furthermore, some devices possess a hydrophilic coating that, theoretically, results in improved trackability. Although these advances in technology have diminished the need for adjunctive techniques to facilitate device delivery, challenges to achieving access still exist. In this article, we present a case in which an open iliac conduit was necessary in the endovascular repair of an AAA.

CASE REPORT

The patient is a 69-year-old man with a 7.2-cm AAA that was found incidentally. His workup was being performed out of state when he presented to our emergency department with back pain. The aneurysm was considered the source of this pain, and he was admitted for urgent repair of his AAA. He has a past medical history significant for hypertension. He had previously undergone open cholecystectomy and gastric resection with reconstruction for complications of peptic ulcer disease. In light of this, a decision was made to proceed in an endovascular fashion. Due to his exceptionally small (< 5 mm) and calcified external iliac arteries on both sides (Figure 1), it was believed that the patient would benefit from a right common iliac artery conduit to safely place an endograft.

In the operating room, a retroperitoneal approach to the right common iliac artery was made through a lateral incision. Upon gaining control of the common, internal, and

external iliac arteries, a 10-mm Dacron tube graft was sewn end-to-side to the distal common iliac artery. The distal aspect of the conduit was clamped. We gained access to the midportion of the conduit and placed an 8-F sheath. The contralateral common femoral artery was also accessed using an 8-F sheath. After obtaining an aortogram to confirm our device size selection, the 8-F conduit sheath was replaced with a 20-F sheath. A 31-mm X 14-mm X 14.5-cm Excluder endoprosthesis device (W. L. Gore & Associates, Flagstaff, AZ) was selected. To accommodate the larger sheath, a small graftotomy was made with an 11-blade scalpel to ensure that the 20-F sheath would be hemostatic. The contralateral sheath requirement was only 12 F.

After deploying the graft and obtaining a completion angiogram, the conduit was divided nearly flush with the common iliac artery with a vascular load from an Endo GIA stapler (Covidien/Vnus, Mansfield, MA). All incisions were subsequently closed in the standard fashion. Estimated blood loss from the procedure was 50 mL.

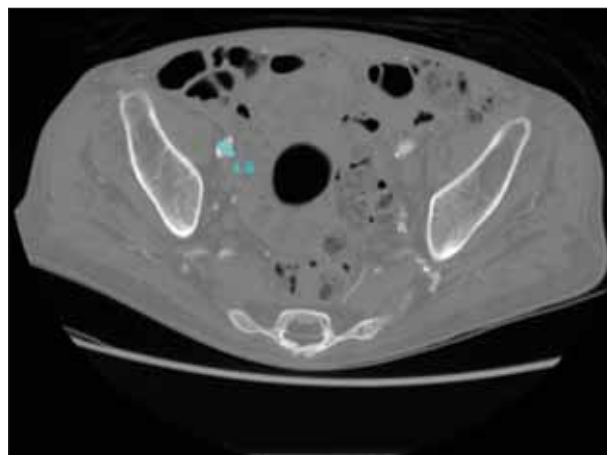


Figure 1. Computed tomography of small, calcified external iliac arteries.

TABLE 1. OUTER DIAMETER OF IPSILATERAL AND CONTRALATERAL SHEATH SIZES FOR COMMERCIAL DEVICES AVAILABLE IN THE UNITED STATES FOR REPAIR OF AAAs

	Ipsilateral Sheath Size (OD)	Contralateral Sheath size (OD)
Zenith (Cook Medical, Bloomington, IN)	21–24.5 F	14–16 F
IntuiTrak (Endologix, Inc., Irvine, CA)	21 F	9 F
Excluder (W. L. Gore & Associates)	20.4–23 F	15–20 F
Talent (Medtronic-Invatec, Frauenfeld, Switzerland)	22–24 F	18–20 F

The patient did well after the procedure. He was transitioned to a clear diet on postoperative day 1 and to a regular diet the next day. He was discharged on postoperative day 7 to a rehabilitation facility. When the patient returned for 1-month follow-up, the size of his aneurysm had decreased to 6.9 cm, and there was no evidence of endoleak.

DISCUSSION

The need for adjunctive techniques for stent graft delivery occurs more commonly with devices that are designed to treat the thoracic aortic pathology. Deploying thoracic devices may require access sheaths as large as 25 F, whereas abdominal devices can require sheaths as small as 18 F. The implications of these differences are readily apparent in that patients undergoing thoracic stent grafting require conduits twice as often as patients undergoing abdominal aortic stent grafting.¹

Despite the decreasing diameter of the systems used to deliver abdominal aortic stent grafts, access complications remain a prevalent issue. Gabrielli et al investigated the incidence of periprocedural complications during endovascular aneurysm repair. While reviewing 1,696 procedures, they discovered a 7.7% incidence of problems related to delivery system insertion.² Furthermore, the complication rate may be higher in women who have narrower iliac arteries with a higher degree of calcification, leading to an increased rate of adjunctive access maneuvers.³ These issues make access-related complications the leading cause of immediate conversion to open repair.⁴

Therefore, a continued need exists to overcome anatomic issues of iliac tortuosity, stenosis, and occlusion in order to deliver abdominal aortic devices. Multiple options for alternate iliac access exist and are described in the literature. With the prudent use of these techniques, complications ranging from iliac artery dissection to complete disruption of the iliac artery can be avoided.

ADJUNCTIVE PERCUTANEOUS TECHNIQUES

The simplest solution to achieving difficult iliac artery access is serial dilation. Should the delivery system encounter resistance, the larger-diameter sheath can be replaced by a 16-F sheath (Cook Medical) with a long tapered nose cone. If this passes with ease, a serial dilation can be performed with the Endovascular Dilator Set (Cook Medical).⁵ This set contains dilators that range in size from 14 to 26 F, each with a length of 45 cm. If serial dilation fails, then balloon angioplasty can be used as an alternative.

Yano et al describe balloon angioplasty in eight patients with short-segment stenotic iliac lesions.⁶ After deployment of the endograft, they placed a 10- to 12-mm Wallstent (Boston Scientific Corporation, Natick, MA) to prevent arterial recoil. If bare-metal stents are used, it is recommended that they be placed after endograft deployment. This will prevent bare-metal stent migration during placement of the endograft delivery system through the stent. The technique of simple balloon angioplasty has been described by multiple investigators.^{7,8}

Alternatively, Hinchliffe et al describe a technique that they refer to as “paving and cracking.”⁵ They describe the deployment of both self-expanding and balloon-expandable polytetrafluoroethylene (ePTFE)-covered stents (Advanta V12 [Atrium Medical Corporation, Hudson, NH] or Fluency [Bard Peripheral Vascular, Tempe, AZ]). These stents are then dilated to 9 to 10 mm in the external iliac artery and to 10 to 12 mm in the common iliac artery. The use of covered stent grafts in this situation is required to prevent hemorrhage from the rupture of the iliac arteries, which is likely to be caused by excessive dilation. Furthermore, they recommend covering the internal iliac artery bifurcation because this is the typical site of rupture.

Peterson and Matsumura use the term *endoconduits* to describe this technique. Their paper tabulates the balloon size required to gain sheath access for the delivery device. In short, 10-mm balloons can be used for 20- to 22-F sheaths, and 12-mm balloons can be used for 24-F sheaths.⁹

Although it is not discussed in this paper, endoconduits have also been employed after inadvertent iliac artery rupture or avulsion (“iliac on a stick”) caused by passage of large delivery systems through stenotic iliac arteries. Hemodynamic stability can be maintained with an aortic occlusion balloon. The maintenance of wire access allows for deployment of a covered stent over the ruptured/avulsed segment.

Endoluminal conduits have also been described.⁶ This technique is primarily performed when the concern of arterial rupture with balloon angioplasty exists. Yano et al describe the technique of suturing a 6-mm ePTFE graft to a Palmaz stent (Cordis Corporation, Bridgewater, NJ). The Palmaz stent is then deployed over the internal iliac with the ePTFE graft extending through the diseased external iliac. The graft is subsequently balloon dilated and either implanted into the distal external iliac artery or common femoral artery with a hand-sewn anastomosis.

Placement of a second wire into the tortuous iliac artery via a brachial approach is a final percutaneous option.^{7,8,10} This technique facilitates the trackability of the larger deployment devices, allowing such devices to be guided into the aorta. Generally, this requires the placement of a stiff wire such as the Amplatz Super Stiff wire (Boston Scientific Corporation). When using this technique, it is suggested that a protective catheter be placed at the level of the proximal subclavian artery to prevent shear injury.

ADJUNCTIVE OPEN TECHNIQUES

The first option for overcoming difficult iliac anatomy is aortouni-iliac endograft placement performed with concomitant femoral artery-to-femoral artery bypass.⁶ Obviously, this technique requires that one iliac artery system be relatively disease free. Concerns regarding the patency of this repair were alleviated by Rehring et al, who reported 98% primary patency and 100% secondary patency rates with a mean follow-up of 15.8 months.¹¹

Creation of an iliac conduit with subsequent conduit ligation versus conversion to an iliofemoral bypass graft has been described by multiple investigators.^{6,8,12} The technique is primarily indicated in the presence of an external iliac artery that is diffusely small in caliber (< 5 mm). The distal common iliac artery is accessed via a retroperitoneal dissection where an end-to-side anastomosis is performed using a 10-mm graft. Depending on the patient's preoperative symptoms, after endograft deployment, the conduit can either be ligated or anastomosed to the common femoral artery.

Important key aspects to the procedure are well described.¹² These include a careful review of preoperative computed tomography to ensure the appropriate side

(right vs left) for conduit placement and direct puncture of the graft for device placement using the introducer sheath to enlarge the opening to allow for a hemostatic field. An 11 blade can be used to enlarge the initial access only slightly. Finally, passage of the device through the anastomosis must be performed with care. Suture line disruption can occur, particularly if the anastomosis is small or the common iliac artery is thin walled.

Abu-Ghaida et al compared outcomes after elective and emergent conduit placement to elective endovascular AAA repair without conduits.¹³ Although the use of an elective conduit significantly increased operating time and estimated blood loss when compared to AAA repair without a conduit, perioperative mortality rates were the same for both groups. They concluded that the use of a conduit is safe and effective and has “outcomes similar to those expected for standard transfemoral endovascular repair.” Lee et al found similar results; however, they encountered a 1.8-fold higher rate of perioperative complications.¹⁴ They concluded that the lack of increase in early mortality justifies the technique in that a larger number of patients can be treated by endovascular means.

The applications for conduit use continue to broaden. Conduits have also been described to aid in the deployment of fenestrated grafts. Batt et al used a conduit to not only aid in deployment of the main body device but also used the same conduit to cannulate the renal and mesenteric fenestrations to allow stent graft deployment in visceral vessels.¹⁵

Two other open options have been described to aid in device navigation through difficult iliac arteries. External iliac artery straightening can be performed via a retroperitoneal dissection. Depending on the degree of tortuosity, resection of the redundant segment has been described.⁶ In order to provide adequate landing zones, the internal iliac artery can either be transposed or bypassed to a more distal point on the external iliac artery.¹⁶ This prevents the need for bilateral internal iliac artery coil embolization, with its described incidence of pelvic ischemia that can be as high as 54%.¹⁷

Finally, a hybrid option has been described for limited retroperitoneal access. Carpenter describes direct puncture of the common iliac artery or aorta after a limited retroperitoneal exposure.¹⁸ This technique employs the placement of a double purse-string suture for hemostasis before arterial puncture. Direct puncture of the iliac artery prevents the need for extensive dissection and provides an excellent hemostatic alternative.

CONCLUSION

Although deployment devices for abdominal aortic endografts continue to decrease in diameter, patients with

concomitant iliac occlusive disease and aortic aneurysmal disease still exist. These patients can pose a challenge to accessing the abdominal aorta through endovascular means. The techniques described in this article can aid in the successful, safe deployment of aortic endografts in these difficult anatomies. ■

Richard C. Hershberger, MD, is Assistant Professor with Loyola University Medical Center in Maywood, Illinois. He has disclosed that he holds no financial interest in any product or manufacturer mentioned herein. Dr. Hershberger may be reached at (708) 327-3431; rihershberger@lumc.edu.

Ross Milner, MD, is Associate Professor and Division Chief, Vascular Surgery and Endovascular Therapy, with Loyola University Medical Center in Maywood, Illinois. He has disclosed that he is a consultant for W. L. Gore & Associates. Dr. Milner may be reached at (708) 327-3431; rmilner@lumc.edu.

- Freezor RJ, Huber TS, Martin TD, et al. Perioperative differences between endovascular repair of thoracic and abdominal aortic diseases. *J Vasc Surg.* 2007;45:86-89.
- Gabrielli L, Baudo A, Molinari A, Domanin M. Early complications in endovascular treatment of abdominal aortic aneurysm. *Acta Chir Belg.* 2004;104:519-526.
- Sampaio SM, Panneton JM, Mozes GI, et al. Endovascular abdominal aortic aneurysm repair: does gender matter? *Ann Vasc Surg.* 2004;18:653-660.
- Cuyper PWM, Laheij RJF, Buth J, on behalf of the EUROSTAR collaborators. Which factors increase the risk of conversion to open surgery following endovascular abdominal aortic aneurysm

- repair? *Eur J Endovasc Surg.* 2000;20:183-189.
- Hinchliffe RJ, Ivancev K, Sonesson B, Malina M. "Paving and cracking": an endovascular technique to facilitate the introduction of aortic stent-grafts through stenosed iliac arteries. *J Endovasc Ther.* 2007;14:630-633.
- Yano OJ, Faries PL, Morrissey N, et al. Ancillary techniques to facilitate endovascular repair of aortic aneurysms. *J Vasc Surg.* 2001;34:69-75.
- Henretta JP, Karch LA, Hodgson KJ, et al. Special iliac artery considerations during aneurysm endografting. *Am J Surg.* 1999;178:212-218.
- Fairman RM, Velazquez O, Baum R, et al. Endovascular repair of aortic aneurysms: critical events and adjunctive procedures. *J Vasc Surg.* 2001;33:1226-1232.
- Peterson BG, Matsumura JS. Internal endoconduit: an innovative technique to address unfavorable iliac artery anatomy encountered during thoracic endovascular aortic repair. *J Vasc Surg.* 2008;47:441-445.
- Criado FJ, Wilson EP, Abul-Khoudoud O, et al. Brachial artery catheterization to facilitate endovascular grafting of abdominal aortic aneurysm: safety and rationale. *J Vasc Surg.* 2000;32:1137-1141.
- Rehring TF, Brewster DC, Cambria RP, et al. Utility and reliability of endovascular aortoiliac with femorofemoral crossover graft for aortoiliac aneurysmal disease. *J Vasc Surg.* 2000;31:1135-1141.
- Criado FJ. Iliac arterial conduits for endovascular access: technical considerations. *J Endovasc Ther.* 2007;14:347-351.
- Abu-Ghaida AM, Clair DG, Greenberg RK, et al. Broadening the applicability of endovascular aneurysm repair: the use of iliac conduits. *J Vasc Surg.* 2002;36:111-117.
- Lee WA, Berceci SA, Huber TS, et al. Morbidity with retroperitoneal procedures during endovascular abdominal aortic aneurysm repair. *J Vasc Surg.* 2003;38:459-465.
- Batt M, Haulon S, Bouillanne P, et al. Iliac conduit for renal and visceral artery access during endovascular repair of a pararenal aneurysm with a fenestrated stent-graft. *J Endovasc Ther.* 2007;14:416-420.
- Parodi JC, Ferreira M. Relocation of the iliac artery bifurcation to facilitate endoluminal treatment of abdominal aortic aneurysms. *J Endovasc Surg.* 1999;6:342-347.
- Yano OJ, Morrissey N, Eisen L, et al. Intentional internal iliac artery occlusion to facilitate endovascular repair of aortoiliac aneurysms. *J Vasc Surg.* 2001;34:204-211.
- Carpenter JP. Delivery of endovascular grafts by direct sheath placement into the aorta or iliac arteries. *Ann Vasc Surg.* 2002;16:787-790.

Indications for Use

The Medtronic Vascular Complete SE Vascular Stent System is indicated for improving luminal diameter in patients with iliac stenosis in previously unstented lesions with vessel reference diameters between 4.5 mm and 9.5 mm and lesion lengths up to 90 mm. The stent is intended as a permanent implant.

Contraindications

There are no known contraindications.

Warnings/Precautions

The Complete SE Vascular Stent System is provided sterile for one procedure only. Do not resterilize. Use prior to the "Use By" date noted on the package. • Use of the Complete SE Vascular Stent System requires advanced iliac angioplasty technical skills. The following instructions provide technical guidance but do not obviate the need for adequate training prior to use of the device. • Do not use if the temperature indicator found on the inner pouch is changed from a gray square to a black square as this indicates the unconstrained stent diameter and stent release may be compromised. • Persons with known hypersensitivities to nitinol and/or its components (e.g. nickel, titanium) may suffer an allergic reaction to the Complete SE Vascular Stent. • Maintain the delivery system parallel to the patient and as straight as possible during the procedure to prevent delivery system catheter kinking. • Do not deploy the stent if it is not optimal or appropriate for the vessel. The stent cannot be repositioned once deployed. • Care should be taken when stenting near a bifurcation, aneurysm or bypass graft. • Prior to stent deployment, utilize fluoroscopy to verify the stent has not been damaged or dislodged during positioning. • If unable to initiate stent release, remove the entire system from the patient and advance a new, previously unopened stent delivery system. • Once deployment is initiated, the stent cannot be recovered by the sheath. In the event of partial delivery of the stent, remove the entire delivery system from the patient. This may result in damage to the vessel wall requiring surgical intervention. • Prior to completion of the procedure, utilize fluoroscopy to ensure proper positioning of the deployed stent. If the target lesion is not completely stented, use additional Complete SE Vascular Stents as necessary to adequately treat the lesion. • The Complete SE Vascular Stent System is intended for use by physicians familiar with iliac stenting techniques and the risks associated with stenting. • Thrombogenicity evaluations were conducted using a heparinized model. If your patient cannot be adequately anticoagulated, it is unknown whether thrombus formation may occur with this product. • The use of overlapping stents with the Complete SE Vascular Stent System has not been formally evaluated in a clinical trial. • Caution must be taken when crossing the stented area with ancillary equipment to avoid dislodgment of the stent.

Potential Adverse Events

The following complications may be associated with the use of iliac stenting devices or iliac angioplasty: abrupt stent closure; allergic reaction (contrast medium, drug, stent or filter

material); amputation/limb loss; aneurysm or pseudoaneurysm in vessel or at vascular access site; angina/ coronary ischemia; arrhythmia (including premature beats, bradycardia, atrial and/or ventricular tachycardia, atrial and/or ventricular fibrillation [VF]); asystole or bradycardia requiring placement of a temporary pacemaker; arteriovenous fistula; bleeding complications from anticoagulant or antiplatelet medication requiring transfusion or surgical intervention; death; detachment and/or implantation of a component of the system; emboli, distal (air, tissue, plaque, thrombotic material, stent); fever; hematoma at vascular access site, with or without surgical repair; hemorrhagic event, with or without transfusion; hypotension/hypertension; infection, local or systemic including bacteremia or septicemia; ischemia requiring intervention (bypass or amputation of toe, foot, or leg); myocardial infarction; pain (leg/foot); pain at catheter insertion site; pulmonary embolism; renal failure/ insufficiency secondary to contrast medium; stent malposition/ migration; stent strut fracture; stroke; vascular thrombosis/ occlusion at puncture site, treatment site, or remote site; vessel dissection, perforation or rupture; vessel spasm or recoil; worsened claudication/rest pain

Please reference appropriate product *Instructions for Use* for a more detailed list of indications, warnings, precautions and potential adverse events.

CAUTION: Federal (USA) law restricts this device to sale by or on the order of a physician.

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