Does Difficult Iliac Access Still Exist?

EVAR device profiles are getting smaller, and access techniques are becoming more refined, but are we there yet?

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Despite advances in stent graft technology and improvements in delivery systems, iliofemoral access-related difficulties continue to be a problem in endovascular therapy. It was documented that almost one-fourth of patients who had an abdominal aortic aneurysm (AAA) also had some degree of iliofemoral occlusive disease.[1] Successful implantation of an endovascular device from an artery remote to the target lesion requires a fine balance between the patient's anatomy and available technology.[2] Hostile iliofemoral anatomy is often regarded as one of the major factors that can prevent thoracic and abdominal endovascular aneurysm repair (EVAR) (Figures 1 and 2). This is particularly so if the patient is of small stature, especially in Asian patients who have small external or common iliac artery diameters.[3]

In a study based in Hawaii, which included patients of different ethnic origins, access-related complications occurred in 11 out of 92 patients (12%) and were significantly associated with Asian ethnicity, age > 80 years, and external iliac diameters smaller than 7.5 mm.[4] Asian patients had statistically smaller external iliac artery diameters (a mean of 8.2 mm compared to 9.1 mm in non-Asian patients) and more tortuous iliac arteries.[4] In a series of 191 Korean patients with AAAs, nine patients (8.8%) had external iliac diameters of < 8 mm, and three patients (2.9%) had totally inadequate access.[5]

Irrespective of ethnicity, iliac access problems were more often encountered in women, with twice as many female patients deemed unsuitable for conventional EVAR than male patients (62.3% vs 33.6%). The narrowest external iliac artery diameter in women was significantly smaller (mean, 7.29 mm) than in men (mean, 8.62 mm).[6] With the ever-increasing patient age and widespread atherosclerosis, these problems associated with poor iliac access appear certain to persist.

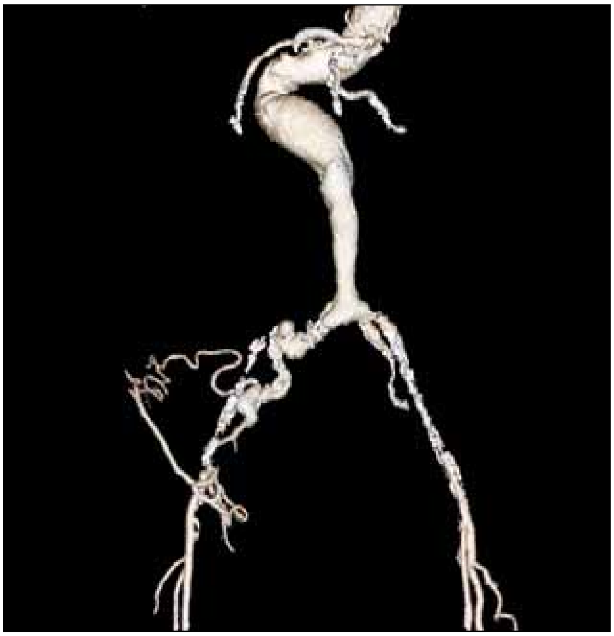

Figure 1. An infrarenal aneurysm with an occluded right external iliac artery and severely calcified left iliac system.

A LOOK AT ILIAC ACCESS

Forcing a large stent graft delivery system into a suboptimal iliac access artery may cause devastating complications

Figure 2. A paravisceral aortic aneurysm and infrarenal aortic aneurysm. The right iliac system was heavily calcified with a minimal luminal diameter of 8.05 cm. The left external iliac artery had a long calcified occlusion.

such as rupture, dissection, thrombosis, or distal ischemia. The trauma to iliac artery access after EVAR may be subclinical, or the clinical manifestations may be delayed. In a series of 42 EVAR patients, Tillich et al found that 16 (38%) had acute iliac arterial dissections, with the length of the dissected iliac segment ranging from 10 to 215 mm.[7] The dissections may extend from the common femoral artery to the distal iliac limb landing zone.[7] Using volumetric analysis of computed tomographic angiography, these dissection points corresponded to the most stenosed tortuous portion, with a tortuosity index of 35.5 ± 20.8 (mean ± SD) and a mean dissected arterial segment of 6 mm. Tortuosity index is the inverse radius of curvature (cm-1) at 1-mm intervals along the median luminal centerline on three-dimensional reconstructions of computed tomographic angiography.[8]

In a series of 528 patients treated with the Zenith endograft (Cook Medical, Bloomington, IN) published in 2001, 13.9% of patients experienced iliac access complications, with three conversions to open repair.[9] In the EUROSTAR registry (European Collaborators on Stent Graft Techniques for Abdominal Aortic Aneurysm Repair) involving 1,871 patients who underwent infrarenal EVAR, 13% of patients had access problems due to excessive iliac tortuosity, stenoses, or small diameter. Forty-nine patients (2.6%) required conversion, 38 of whom were converted during the first postoperative month, mainly due to access problems such as excessive iliac tortuosity, occlusive disease, small-caliber vessels, or device migration.[10] The EUROSTAR experience also revealed that approximately 10% of white patients have complex access and were not able to accommodate the typical device diameter of 8 mm.[11]

Use of the Amplatz Super Stiff (Boston Scientific Corporation, Natick, MA) or the Lunderquist (Cook Medical) wires with an introducer catheter is usually adequate for dealing with tortuous vessels, bringing the common femoral access site more in line with the common iliac artery and allowing greater tracking of the device into position.[12,13] If the iliac artery is unduly tortuous, it can be straightened with primary excision of the redundant portion with anastomoses of the ends.[14] The utility and durability of an aortouni-iliac endograft with femoral-femoral bypass has been well described in cases when one iliac system is considered unfavorable for endovascular access in view of tortuosity or stenosis. Studies have shown that this is a reliable method of repair for aortoiliac aneurysmal disease in patients with complex iliac anatomy. In 51 consecutive patients with aortouni-iliac endografts with a mean follow-up of 15.8 months, only one femoral-femoral bypass graft occluded immediately postoperatively, thereby yielding a 98% primary patency rate and 100% secondary patency rate.[15]

In a series of single-institution experiences of 231 patients who underwent EVAR with aortouni-iliac stent grafts and had a median follow-up period of 22 months, Hinchliffe et al found that the 3- and 5-year patency rates for the femoral-femoral bypass graft were 91% and 83%, respectively.[16] This article further commented that graft occlusion is usually due to inadequate inflow from the endovascular stent graft itself or due to endoluminal damage of the external iliac artery.[16]

Retroperitoneal dissection and anastomosis of a prosthetic Dacron iliac conduit or aortoiliac femoral bypass graft are the most commonly used options to combat iliac disease. In most cases, a lower-quadrant, muscle-splitting extraperitoneal dissection provides adequate access to the common iliac artery or distal aorta.[17] In a 2007 publication, Criado described the technical considerations, stating that "a 10-mm-diameter Dacron graft is the best conduit because it provides enough luminal space for introduction of all delivery systems . . . the anastomosis is sewn end-to-side between the graft and the common iliac artery. After completion of the anastomosis, the conduit is exited through the abdominal wall via a small stab incision made just above the inguinal ligament, providing a smooth angle of entry that will facilitate introduction of the large devices to be passed through the conduit."[18] This newly created anastomosis can be held manually to provide support as large delivery sheaths are advanced into the native vessel.

The placement of a radiopaque marker at the anastomosis may also be helpful to avoid repetitive exchanges and disruption of the suture lines.[17] As an alternative, retroperitoneal exposure and direct puncture of the iliac artery, or even direct puncture of the infrarenal aortic access, can also be considered.[19] Although the direct iliac puncture avoids the need for a handsewn anastomosis, the passage of the stent grafts does not form a smoother angle than that of a conduit, especially in an obese patient. Lee et al found that in a cohort of 164 patients who underwent EVAR, 32 patients (20%) required 38 separate adjunctive retroperitoneal procedures (22 iliac conduits only, 14 iliac conduits with iliofemoral bypass grafts).[20] Although the construction of an iliac conduit or bypass graft enabled more patients to undergo EVAR, the open retroperitoneal procedures were associated with greater blood loss, longer procedure times, and a higher rate of perioperative complications.[20]

ALTERNATIVE ACCESS TECHNIQUES

Conventional endovascular solutions to difficult iliac access include aggressive angioplasty techniques and stent placement. Transfemoral balloon angioplasty of the stenotic iliac vessels during aortic endografting is the simplest solution. Henretta et al suggested that when targeting the external iliac artery, treatment is recommended several weeks before EVAR to allow for the iliac stent, if required, to incorporate.[13] However, if the treatment site is the common iliac artery, treatment may be performed simultaneously with EVAR so that the stent graft itself can buttress the common iliacs open.[13] A dilator can then be used to test whether a delivery device will negotiate through the vessel. Severely dissected iliac segments may be stented or covered with limb extension from the stent graft.

Paving and Cracking

In 2007, Hinchliffe et al described the technique of "paving and cracking" in five patients who had unsatisfactory iliac access.[21] This technique relined and dilated the iliac arteries using both self-expanding and balloon-expandable polytetrafluoroethylene covered stents (Advanta V12 [Atrium Medical Corporation, Hudson, NH] or Fluency stent grafts [Bard Peripheral Vascular, Inc., Tempe, AZ). These devices were deployed along the length of the diseased iliac arteries; they were dilated to 9 to 10 mm in the external iliac artery and 10 to 12 mm in the common iliac artery. These covered stent grafts help to prevent hemorrhage. The iliac limbs of the aortic stent graft could then be extended into the covered stents in the iliac arteries to achieve adequate distal seal.

Internal Endoconduit Technique

A similar technique was described in 2008 by Peterson and Matsumura, called the "internal endoconduit technique," in which a 14-cm-long stent graft with a 16-mm proximal diameter X 12-mm distal diameter (Gore & Associates, Flagstaff, AZ), designed as a contralateral limb for EVAR, was deployed from the common iliac extending into the proximal common femoral artery. The prosthesis was initially dilated with a 10-mm balloon, and subsequently, a 12-mm balloon was used to create controlled rupture of the external iliac artery with proximal seal in the common iliac artery and distal seal in the common femoral artery. This allowed passage of a 40-mm X 10-cm TAG thoracic endoprosthesis (Gore & Associates) for a ruptured thoracic aneurysm.[22] These stent grafts inevitably sacrificed the internal iliac artery and avoided exsanguination by careful placement of proximal and distal seal.

The same principle applies when there are iatrogenic iliac ruptures during EVAR or TEVAR. Most of the time, these can be successfully managed with endovascular stent grafting, depending on expertise and inventory. Fernandez et al reviewed 369 EVAR and 67 TEVAR patients from 1997 to 2008 and documented 11 iliac conduits used, all during TEVAR (16%). There were 18 ruptured iliac arteries in 17 patients. Only one of these EVAR patients was converted to open repair, but the other 17 iliac ruptures in 16 patients were successfully treated with endovascular stent graft placement.[23] To use endovascular repair for iatrogenic iliac injuries, intraoperative arterial blood pressure monitoring is essential. A stiff wire capable of tracking a stent graft through tortuous injured iliac arteries must be maintained in situ, with aortic or iliac occlusion balloons and a wide selection of appropriate iliac extension grafts readily available.

Carotid Access

In selected cases when iliac access is impossible, the carotid arteries can be used as access ports. In 2001, May et al reported the use of common carotid access for endoluminal aortic aneurysm repair.[24] Right common carotid access was favored, as it was thought to provide a more expedient angle of entry to the distal aorta.[24] The investigators noted that care must be taken to ensure that the device delivery system will be long enough to reach the distal abdominal aorta from the neck. Estes et al similarly presented a case of a high-risk male patient with a thoracic aortic aneurysm and severe occlusive disease of the iliac arteries, with device delivery through the left common carotid artery. The procedure was successful, with no neurological complications. In this case, the left carotid approach was chosen because the investigators believed that this would be technically easier for the right-handed surgeon.[25]

Subsequent isolated case reports were published on this technique. In 2005, Murray et al reported the endovascular management of two patients in whom iliofemoral access was not possible; the thoracic endovascular repairs were effected by endograft deployment via the common carotid artery.[26] Ghosh et al treated a 61-year-old man with a 5.8-cm infrarenal aortic aneurysm and extensive iliac disease with a custom-made Zenith aortouni-iliac endograft blunt-tipped nose cone, which was mounted in the reverse direction onto a TX2 delivery device and delivered via the left common carotid artery.[27] Of course, cerebrovascular accidents such as carotid injury, embolism, occlusion, or hypoperfusion during the procedure are specific concerns with the carotid approach. Both carotid arteries should be disease-free to accommodate the delivery system, and a smaller delivery system should be chosen to maintain cerebral perfusion. Aggressive anticoagulation is necessary to prevent embolic cerebral complications. Using several shorter, more trackable devices, as opposed to one single device, may allow the operator to more easily negotiate tortuous anatomy.[26]

Another means of improving the trackability is to place tension on the wire by controlling both ends. The wire is first passed via the left brachial artery, down the thoracic and infrarenal aorta, and out through the common femoral artery using a snare, known as a "through-and-through" wire.[28,29] This brachiofemoral wire is sometimes known colloquially as the "body floss" technique. Traction upon both ends of the body floss allows for improved device tracking.[13,30] It is crucial to protect the aortosubclavian junction with a guiding catheter and not use overzealous tension to decrease the chance of catastrophic arterial injury.[13,30,31]

LOWERING PROFILES

Decreasing the profile by simplifying the delivery systems and improving on the delivery sheath diameter could theoretically increase the number of suitable candidates for endovascular repair. Aortic stent graft delivery sheaths usually have an outer diameter of 18 to 22 F. There are newly developed lower-profile, self-expanding modular endovascular prostheses available. Laborde et al reported the use of a new modular nitinol stented Dacron graft with a 14-F delivery system (Tripelay, Paris, France). This system features a unique design using two D-shaped legs, thus allowing a much-reduced profile.[32] The Tripelay stent graft can be used percutaneously and was reported to be highly trackable with good deliverability through small-diameter iliac arteries.[32]

The Incraft ultra-low-profile AAA stent graft system (Cordis Corporation, Bridgewater, NJ) consists of a three-piece modular device with an ultra-low-profile 13-F delivery system for main body diameters up to 30 mm. The ongoing INNOVATION trial, a multicenter, open-label, prospective, nonrandomized study of the Incraft stent graft system in patients with AAA, has already recruited patients.[33]

The Zenith low-profile AAA endovascular stent graft has also been developed to address the clinical need for a smaller-diameter delivery system to treat patients with inadequate access for conventional devices. It is a three-piece modular device with a proximal suprarenal fixator composed of nitinol stents and polyester graft material and uses a 16-F Flexor sheath (Cook Medical).[34] A prospective, nonrandomized, global study of the safety and effectiveness of this Zenith low-profile AAA endovascular stent graft is being conducted in 120 patients. All devices were successfully deployed, and 30% (36/120) of the procedures were performed entirely percutaneously. Preliminary results showed that there were no type I or III endoleaks, with only one conversion to open repair due to continual sac growth.[34]

CONCLUSION

Various techniques have been adopted to overcome difficult access situations. Murray et al performed a systematic literature review from 1994 through 2005 to identify relevant articles on endovascular access techniques and concluded that excessive iliac tortuosity, circumferential vessel wall calcification, significant occlusive disease, and small-caliber vessels account for the majority of access problems.[2] Access problems may be difficult to foresee, even with careful preoperative assessment. Although ancillary procedures described in this article may be used to facilitate EVAR, vascular specialists should never underestimate the significance of poor iliac access, so as to avoid catastrophic access-related complications. It is anticipated that with the availability of the new low-profile devices and careful choice of access vessels, iliac access may be less of a deterrent for endovascular aortic interventions. ■

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