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Use of Internal Endoconduits as an Adjunct to Endovascular Aneurysm Repair in the Setting of Challenging Aortoiliac Anatomy

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Abstract

The combination of Trans-Atlantic Intersociety Consensus (TASC) D aortoiliac occlusive disease as well as a symptomatic abdominal aortic aneurysm (AAA) is not a common occurrence. Extensive calcified atherosclerotic disease, occlusions, and small iliofemoral segmental arteries make transfemoral access difficult, if not impossible, for endovascular aneurysm repair (EVAR) in these patients. We present a case in which “controlled rupture” of the external iliac artery with a covered stent allowed transfemoral delivery of an aortouni-iliac stent graft with a completion femoral-to-femoral bypass. The patient is a 60-year-old male with a 5.3 cm symptomatic infrarenal AAA and a history of one block right leg claudication. Preoperative computed tomography angiography revealed the patient to have occlusion of the right common iliac artery, extensive calcified stenoses of his aortoiliac segments, and a prohibitively small left external iliac artery, which measured 4.5 mm at its narrowest diameter. The patient, despite discussions concerning the suitability of his iliac arteries as conduits for the delivery of the stent graft, insisted on an endovascular approach to lessen his chances of postoperative sexual dysfunction as well as minimize his length of stay. Access was obtained through bilateral femoral artery cutdowns, and attempts at dilating the left external iliac artery using 16-French dilators were performed without success. An 8 mm × 5 cm covered self-expanding stent was deployed in the diseased 4.5 mm left external iliac artery, followed by angioplasty performed with an 8 mm noncompliant balloon to disrupt the vessel. This endoconduit now allowed accommodation of our 18-French introducer for the aortouni-iliac stent graft. The operation was completed with a femoral–femoral bypass. Flow to both hypogastric arteries was preserved. We believe use of such techniques will ultimately expand the number of patients eligible for EVAR and avoid devastating access-related complications.

CASE REPORT

The patient is a 60 year old male who was referred for severe bilateral thigh, buttock, and calf claudication of several years' duration in the setting of known aortoiliac occlusive disease (AIOD). He was also referred with a report of an asymptomatic 4.7 cm infrarenal abdominal aortic aneurysm (AAA). An extensive discussion with the patient was held at that time regarding the natural history of AAA as well as AIOD and treatment of this disease. At follow up in January 2008 a computed tomography (CT) angiogram was performed at the treating institution, which demonstrated a 5 cm infrarenal AAA as well as Trans Atlantic Intersociety Consensus (TASC) D AIOD. His symptoms of claudication were worse on the right and had improved from one block to two blocks after successfully completing a smoking cessation

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program and a supervised walking program. He continued to deny any symptoms related to the aneurysm and was advised to return in 6 months for follow up imaging. The patient missed his 6 month follow up CT and appointment. In September 2008 he presented to the emergency department complaining of several days of left flank and abdominal pain with tenderness over his aneurysm on examination. He was hemodynamically stable on presentation and in no acute distress. A CT angiogram was performed, which revealed the aneurysm to have grown to 5.3 cm without evidence of rupture (Fig. 1). The right common iliac artery was occluded, as was the celiac artery and inferior mesenteric artery. Additionally, the left common iliac artery was noted to contain extensive calcified vascular disease (Fig. 2).

The need for urgent intervention for his symptomatic AAA was discussed with the patient. Given the extent of his AIOD, classified as TASC D because of right common iliac artery occlusion with his aneurysm, an open aneurysmorrhaphy and aortobifemoral bypass was recommended. The patient refused an open repair, citing his unwillingness to accept a risk of erectile dysfunction as high as 85% following open repair.¹ We ultimately agreed to attempt endovascular aneurysm repair (EVAR) with an understanding from the patient that if, despite our best efforts, we would be unable to deliver the stent graft, then open repair remained an intraoperative option.

The operation was performed with bilateral femoral artery cutdowns, exposing the left common femoral artery for eventual delivery of our stent graft. A 7 French introducer sheath (Cook Medical, Bloomington, IN) was placed into the left common femoral artery with insertion of a Benson wire (Cook Medical). Under fluoroscopic guidance, the Benson wire was directed across the calcified stenoses of the iliac segmental arteries and into the abdominal aorta. An aortoiliac angiogram was performed with a calibrated catheter. The left external iliac artery was severely stenosed, measuring 4.5 mm at its narrowest point (Fig. 3). An Amplatz (Cook Medical) stiff wire was exchanged through the calibrated catheter and placed into the aorta. We attempted first to utilize serial dilation catheters over the wire under fluoroscopy but were unsuccessful in crossing the lesions. We selected an 8 mm × 5 cm Viabahn Endoprosthesis (W. L. Gore & Associates, Newark, DE) for use as an internal endoconduit to line the left external iliac artery with our proximal landing zone just distal to the hypogastric artery. With the Viabahn Endoprosthesis deployed, an 8 mm × 2 cm noncompliant balloon angioplasty catheter was positioned within it, and under controlled, metered insufflation to its full profile, the Viabahn stent was dilated to its maximum diameter along its entire length. An angiogram was then performed to ensure proper dilation of the left external iliac artery and that free rupture of the vessel had not occurred. The angiogram was satisfactory, and the patient remained hemodynamically stable. With the left external iliac artery now dilated to 8 mm, we were able to insert a Zenith (Cook Medical) 22 × 133 mm aortouni iliac stent graft mounted on an 18 French delivery system with an extension into the common iliac artery with a 10 × 71 mm limb extender (Fig. 4). We landed the distalmost portion of the limb extender just proximal to the left hypogastric origin, ensuring continued patency. A completion angiogram revealed no evidence of endoleak (Fig. 5). A left to right femoral—femoral crossover bypass was performed with a 10 mm ringed polytetrafluoroethylene (PTFE) prosthetic graft (W.L. Gore & Associates) to revascularize the right lower extremity.

Postoperatively, the patient had an uneventful recovery and no complications. He was eventually discharged to home on day 6 of his postoperative course. On 1 and 6 month follow up, a CT angiogram was performed, which demonstrated no evidence of endoleak, continued patency of the endoconduit in the left external iliac artery, continued patency of the left hypogastric artery, and retrograde perfusion of the right hypogastric artery (Fig. 6A, B).

DISCUSSION

Given the current state of technology for EVAR, challenging aortoiliac anatomy continues to be one of several limiting factors in its applicability to all patients with AAA. Small caliber, severe calcified stenoses, and severe angulation of the iliac anatomy, which are hallmarks of AIOD, represent some of the most frequently cited reasons for non-navigability of stent-graft delivery systems. Unmodified, challenging iliac anatomy carries a 15% risk of complication including hemorrhage, rupture, and dissection necessitating conversion to an open operation.² A variety of innovative techniques have been described in the literature to modify the iliac anatomy to render it suitable for the delivery of stent grafts in EVAR. These include simple dilation of the iliofemoral segmental vasculature using over-the-wire dilators, balloon angioplasty, endoluminal balloon endarterectomy, direct retroperitoneal iliac conduits, and the internal endoconduit.² All but direct iliac conduits and the endoconduit have the disadvantage of being uncontrolled and carry the devastating complications of iliac dissection or free iliac artery rupture.

The direct prosthetic iliac conduit is the most common approach to bypassing difficult iliofemoral access for stent-graft delivery. This requires a retroperitoneal incision and dissection, followed by a prosthetic conduit anastomosis to the iliac artery or direct insertion into the iliac artery for delivery of the stent-graft device. A retroperitoneal approach to access the iliac anatomy for stent-graft repairs of aortic aneurysms has been reported to have a significantly higher morbidity when compared to standard femoral access.^{3,4} While there was no significant difference in perioperative mortality, Lee et al.³ found that both blood loss (2.6-fold greater) and operative time (82% longer) were higher, median hospital length of stay was 1.5 days longer, and the incidences of postoperative complications such as respiratory failure, ileus, and thrombotic complications were significantly higher in the retroperitoneal group compared to the femoral access group.

The endoconduit was first described by Yano et al.² in 2001 as an alternative approach to difficult iliofemoral anatomy in stent-graft repairs of aortic aneurysms. As originally described, the endoconduit is composed of a PTFE graft sewn onto a self-expanding metallic stent, which was then backloaded onto a delivery system. This covered stent was then deployed into the common iliac artery and, when necessary, extended into the external iliac artery. A noncompliant balloon was then utilized to perform a “controlled rupture” of the iliac artery, allowing passage of the stent-graft delivery system. Endoconduits avoid the complications of retroperitoneal dissection associated with the direct iliac conduit and offer a greater degree of control than over-the-wire dilator catheters or balloon angioplasty of diseased iliofemoral anatomy. Case reports^{5–7} since then have described the use of endoconduits primarily in both the common iliac artery and the external iliac artery. There have been few reported instances of adverse complications related to the use of endoconduits, the most significant of which was hematoma at the femoral access site not requiring operative intervention, and no instances of free iliac artery rupture.² A summary of the current literature on the use of internal endoconduits in stent-graft delivery and noted complications is provided in Table I. Further, Yano et al.² report the patency of the endoconduits to be 100% following stent-graft delivery at a median follow-up time of 24 months postoperatively.

Hinchliffe et al.⁵ recommend deploying the endoconduit into both the common and external iliac arteries, covering the origin of the hypogastric artery, as the internal iliac bifurcation would be the commonest site for rupture. We avoided coverage of the hypogastric artery origin to preserve flow to the pelvis and avert any risk of pelvic ischemia. To eliminate the risk of hypogastric rupture as a result of our controlled rupture of the external iliac artery, we were careful to avoid balloon angioplasty of the native segment of iliac artery proximal to our deployed endoconduit. An extensive review of the literature yielded no reported cases of

hypogastric artery rupture as a result of balloon angioplasty of the external iliac artery in isolation.

CONCLUSION

AAA in the setting of TASC D AIOD is not a common occurrence and presents many issues in challenging iliofemoral access for EVAR. Access to the challenging iliac anatomy continues to be a limiting factor in EVAR becoming a universally applicable technology in the treatment of AAA. With continued use and development of innovative techniques to render the iliofemoral segmental arteries navigable by stent-graft delivery systems, this will ultimately expand the eligible population of AIOD patients for EVAR.

We believe preservation of hypogastric artery flow is of paramount importance in avoiding pelvic ischemia syndromes in the setting of TASC D AIOD. Endoconduits are most often cited in cases of severe, diffuse disease of the common iliac and external iliac arteries. Isolated non-navigable disease of the external iliac artery with acceptable anatomy of the native common iliac artery has not been described in the literature in the use of endoconduits in EVAR. With extension of the endoconduit from the common iliac artery into the external iliac artery, the intervening, patent hypogastric artery is invariably acutely covered. While the significance of acutely covering the hypogastric arteries for pelvic ischemia has not been clearly elucidated in the literature, complications of this have been reported to be as high as 40% or 50% in some series.^{8,9} Sexual complications as a result of aneurysm repair, characterized by erectile dysfunction or ejaculatory failure, have been described in both open repair and EVAR, with a significantly greater incidence among patients who have open repair.^{10,11} With regard to EVAR, sexual dysfunction has been attributed to poor pelvic perfusion as a result of hypogastric artery occlusion, primarily in cases where an associated iliac aneurysm necessitates coverage of a patent hypogastric artery.^{10,11} Given this, however, some studies have concluded that acute coverage of one or both hypogastric arteries in the course of EVAR results in a negligible number of complications related to pelvic ischemia.¹² Until this has been resolved, it is advisable, where possible, to maintain patency of the hypogastric artery. Limiting the use of endoconduits to only those segments of the iliofemoral anatomy that are non-navigable by the stent-graft delivery system is also advisable in an effort to maintain hypogastric patency.

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Fig. 1.
CT angiogram demonstrating 5.3 cm AAA without evidence of rupture or leak.

Fig. 2. Coronal reconstructions from CT angiogram demonstrating right common iliac artery occlusion and severe left common iliac artery calcified stenoses.

Fig. 3. Calibrated angiogram showing severe stenosis of the left external iliac artery, measuring 4.5 mm at its narrowest point.

Fig. 4. After controlled rupture of the left external iliac artery, an 18 French delivery system of the Zenith stent graft was easily accommodated.

Fig. 5. Completion angiogram showing no evidence of endoleak. An aortouni iliac device is in place as well as the Viabahn Endoprosthesis in the left external iliac artery.

Fig. 6.
A, B Follow up CT angiogram at 6 months showing no evidence of endoleak, continued patency of the femoral-femoral crossover bypass graft, and patency of the Viabahn Endoprosthesis in the left external iliac artery.

Table I

Summary of the current literature on the use of internal endoconduits in the common iliac artery (CIA), external iliac artery (EIA), or both in challenging iliac access for EVAR

Study	Patients for whom both CIA and EIA were covered (<i>n</i>)	Complications
Peterson and Matsumura, 2008 ⁷	1	None
Hinchliffe et al., 2006 ⁵	5	None
Yano et al., 2001 ²	5	Hematoma ^a

^a Access site hematomas were noted in 5/35 (14%) patients who underwent procedures to facilitate delivery of the endovascular stent graft, which included the internal endoconduit in addition to iliac artery angioplasty, balloon endarterectomy, and a retro peritoneal iliofemoral bypass conduit.