Hypogastric artery bypass to preserve pelvic circulation: Improved outcome after endovascular abdominal aortic aneurysm repair

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Objective: **This study was carried out to compare the functional outcomes after hypogastric artery bypass and coil embolization for management of common iliac artery aneurysms in the endovascular repair of aortoiliac aneurysms (EVAR).**

Methods: **Between 1996 and 2002, 265 patients underwent elective or emergent EVAR. Data were retrospectively reviewed for 21 (8%) patients with iliac artery aneurysms 25 mm or larger that involved the iliac bifurcation. Patients underwent hypogastric artery bypass (n = 9) or coil embolization (n = 12). Interviews about past and current levels of activity were conducted. A disability score (DS) was quantitatively graded on a discrete scale ranging from 0 to 10, corresponding to "virtually bed-bound" to exercise tolerance "greater than a mile." Worsening or improvement of symptoms was expressed as a difference in DS between two time points (-, worsening; +, improvement).**

Results: **There was no difference in age (72.6 ± 7.3 years vs 73.1 ± 6.4 years), sex (male-female ratio, 8:1 vs 11:1), abdominal aortic aneurysm size (60.1 ± 5.9 mm vs 59.3 ± 7.0 mm), or number of preoperative comorbid conditions (1.9 ± 0.8 vs 2.1 ± 0.8) between hypogastric bypass and coil embolization groups, respectively. Mean follow-up was shorter after hypogastric bypass (14.8 vs 20.5 months; $P < .05$). There was no difference in the mean overall baseline DS between the bypass and the embolization groups (8.0 vs 7.8). Six (50%) of the 12 patients with coil embolization reported symptoms of buttock claudication ipsilateral to the occluded hypogastric artery. No symptoms of buttock claudication were reported after hypogastric bypass ($P < .05$). There was a decrease in the DS after both procedures; however, coil embolization was associated with a significantly worse DS compared with hypogastric artery bypass (4.5 vs 7.3; $P < .001$). In 4 (67%) of 6 patients with claudication after coil embolization symptoms improved, with a DS of 5.4 at last follow-up. This was significantly worse than in patients undergoing hypogastric artery bypass, with a DS of 7.8 at last follow-up ($P < .001$). There was no difference between the groups in duration of procedure, blood loss, length of hospital stay, morbidity, or mortality (0%).**

Conclusions: **Hypogastric artery bypass to preserve pelvic circulation is safe, and significantly decreases the risk for buttock claudication. Preservation of pelvic circulation results in significant improvement in the ambulatory status of patients with common iliac artery aneurysms, compared with coil embolization. (J Vasc Surg 2004;39:404-8.)**

Endovascular abdominal aortic aneurysm (AAA) repair (EVAR) is a less invasive alternative to open surgical repair. However, currently available devices require normal iliac arteries for distal fixation and seal to prevent distal type I endoleak. Combined aorta and iliac artery aneurysms can be treated with EVAR, but this often requires exclusion of the hypogastric artery, depending on the presence of an adequate distal landing zone. Exclusion of the hypogastric artery is often performed with coil embolization.

Coil embolization of the hypogastric artery often is associated with significant hip and buttock claudication. The incidence of hip and buttock claudication after coil embolization of the hypogastric artery in the endovascular management of aortoiliac aneurysms ranges between 26% and 41%.[1-6] With the high incidence of buttock claudication after coil embolization, common iliac ectasia is often treated with a "bell bottom" technique, in which the larger aortic cuffs are used to appose the stent graft to the iliac artery. However, this technique is limited in patients with larger aneurysms. In these patients, ligation of the internal iliac artery or external to internal iliac artery bypass, followed by placement of the stent graft into the normal external iliac artery, can be performed rather than coil embolization.

The purpose of this study was to compare the functional outcome in patients after hypogastric artery bypass and coil embolization in the management of common iliac artery aneurysms with EVAR.

METHODS

Between October 1996 and July 2002, 265 patients underwent elective or emergent endovascular repair of aortic or aortoiliac aneurysms with the AneuRx (Medtronic/AVE, Santa Rosa, Calif) or Talent stent graft (Medtronic/AVE), and patient data were captured in a

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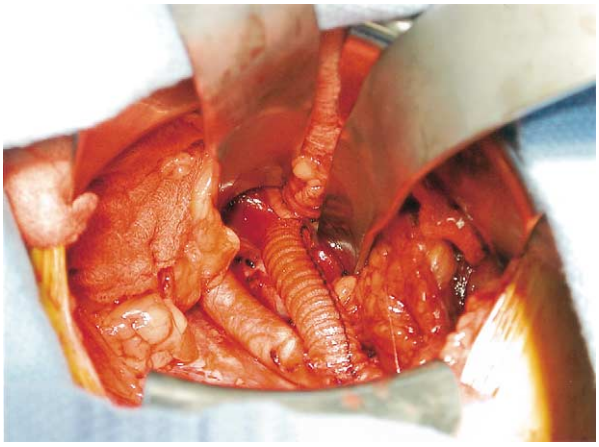

Fig 1. Hypogastric artery bypass from the external iliac artery to the internal iliac artery. The proximal anastomosis comes off the external iliac artery, and the graft then courses downward and medially to the hypogastric artery.

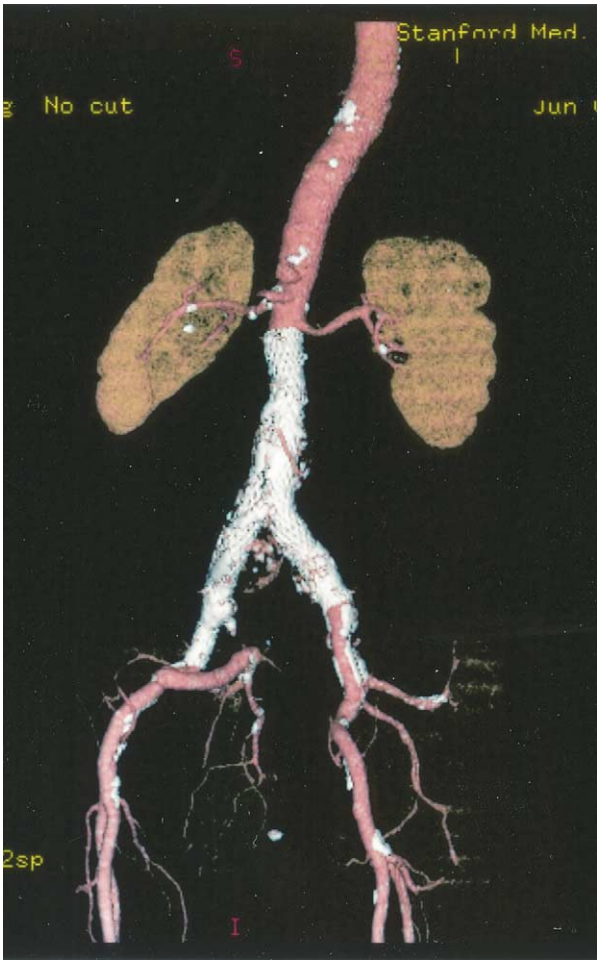

Fig 2. Three-dimensional reconstruction 6 months post-procedure shows a widely patent external to internal iliac artery bypass.

vascular registry. Both stent grafts are modular, self-expanding, and bifurcated. The iliac limbs are secured to the common iliac arteries with a minimum length of 2 cm for secure distal fixation and seal. Common iliac aneurysms (≥25 mm) extending to the iliac bifurcation were treated with either preoperative or perioperative coil embolization, with extension and fixation of the stent graft to the external iliac artery (n = 12) or external to internal iliac artery bypass (n = 9) perioperatively. All patients received general anesthesia except those undergoing preoperative coil embolization, who received local anesthesia. Early in our experience patients routinely underwent coil embolization; however, as patients began experiencing symptoms of buttock claudication, we offered external to internal iliac artery bypass. Patients who were candidates for both treatment options were allowed to choose between the two, on the basis of knowledge of their own ambulatory status.

Coil embolization of primary branch vessels was performed in patients with hypogastric artery aneurysms (n = 3); otherwise the main hypogastric artery was embolized. Patency of the contralateral hypogastric artery was assessed before elective hypogastric artery occlusion, and all patients were informed of the potential for hip and buttock claudication. Nine patients underwent external to internal iliac artery bypass to avoid the risk for hip and buttock claudication, and the contralateral artery was left undisturbed.

External to internal iliac artery bypass was performed in all cases with an 8-mm HemaShield graft (Boston Scientific, Natick, Mass), with minimal mismatch. The iliac bifurcation was mobilized through a small retroperitoneal incision. The hypogastric artery was clamped proximally and distally. Eight of nine arteries had minimal calcific disease and were of large caliber. Proximally the artery was oversewn with 4-0 polypropylene suture for hemostasis. The distal artery was mobilized, and the 8-mm graft was sutured end-to-end to the artery. A conduit was sutured end-to-side to the external iliac artery after appropriate systemic anticoagulation and proximal and distal control of the artery were obtained. The bifurcated device was then placed. After deployment of the device and completion angiography, the two ends of the graft were sutured end-to-end to restore flow to the hypogastric artery (Fig 1).

Preoperative evaluation and device sizing were performed with timed-bolus, contrast-enhanced spiral computed tomography angiography (CTA) with three-dimensional reconstruction. Postoperative imaging studies included CTA, magnetic resonance angiography (MRA), or duplex ultrasound scanning. Patients were followed up with clinical evaluation and imaging at 1, 6, and 12 months, and yearly thereafter (Fig 2).

Interviews regarding past and current levels of activity were conducted after the procedure with each individual patient, with a standardized questionnaire as described by Lee et al,[6] to determine symptoms of hip and buttock claudication at the follow-up visit and at 1 and 6 months. Disability was graded with a semiquantitative scale, with a

Disability score

Score	*Description*
0	Bed-bound
1	Wheelchair, minimal participation in activities of daily living
2	Ambulatory with significant assistance
3	Ambulatory with moderate assistance
4	Ambulatory with minimal assistance
5	Ambulatory without assistance but less than 1 block, or buttock pain at rest
6	Claudication at 1 to 2 blocks
7	Claudication at 3 to 4 blocks
8	Claudication at more than 4 blocks to ½ mile
9	Nonlimiting ambulation more than 1/2 to 1 mile
10	Nonlimiting ambulation more than 1 mile

disability score (DS) ranging from 0 to 10, with 0 corresponding to "virtually bed-bound" and 10 corresponding to "walking greater than a mile" (Table). Patients were questioned about their level of physical activity before and immediately after the repair, when the symptoms of claudication appeared, time to improvement, and current level of physical activity and symptoms. Worsening or improvement of symptoms was expressed as a difference in DS between two time points (−, worsening; +, improvement).

Results are expressed as mean ± SD. Statistical analysis was performed with the two-tailed Student *t* test. $P < .05$ was considered significant.

RESULTS

Between 1996 and 2002, 265 patients underwent EVAR. Twenty-one (8%) patients had iliac artery aneurysms 25 mm or larger involving the iliac bifurcation. Of these 21 patients, 12 patients underwent coil embolization of the hypogastric artery and 9 patients underwent hypogastric artery bypass. There was no difference in age (72.6 ± 7.3 years vs 73.1 ± 6.4 years), gender (male-female ratio, 8:1 vs 11:1), AAA diameter (60.1 ± 5.9 mm vs 59.3 ± 7.0 mm), or number of preoperative comorbid conditions (1.9 ± 0.8 vs 2.1 ± 0.8) between hypogastric artery bypass and coil embolization groups, respectively.

Both groups included only patients in whom a bifurcated endovascular device was placed. Mean follow-up was shorter after hypogastric artery bypass (14.8 months) compared with coil embolization (20.5 months; $P < .05$). All patients completed the survey at 1 and 6 months. There was no difference between the two groups in the mean overall baseline DS (bypass vs embolization, 8.0 vs 7.8). Three patients undergoing coil embolization had hypogastric artery aneurysms not amenable to bypass. These were treated with coil embolization of primary branches of the hypogastric artery, whereas in the other 9 patients coils were placed in the main hypogastric artery trunk.

Six (50%) of 12 patients who underwent coil embolization reported symptoms of buttock claudication postprocedure. All 3 patients who underwent branch embolization of hypogastric artery aneurysms had post-procedure claudication. The incidence of buttock claudication in patients with coil embolization of the main hypogastric artery was 33% (3 of 9). No symptoms of buttock claudication were reported in patients who underwent hypogastric artery bypass. Mean postoperative DS was significantly higher after hypogastric artery bypass compared with coil embolization at 1-month follow-up (7.3 vs 4.5; $P < .001$). When comparing only those patients who underwent coil embolization of the main hypogastric artery (n = 9), the mean postoperative DS was still significantly higher after hypogastric artery bypass at 1-month follow-up (7.3 vs 5.4; $P < .001$).

In 4 (67%) of 6 patients with claudication after coil embolization symptoms improved, but not to the baseline level, at 6-month follow-up, with an overall mean improvement of 1.1 on the DS in those patients. Two of the 3 patients who underwent coil embolization of the primary branches of the hypogastric artery did not have any improvement in symptoms of claudication. At 6-month follow-up the mean DS was significantly higher after hypogastric artery bypass compared with coil embolization (7.8 vs 5.4; $P < .001$). Again, when including only those patients with coil embolization of the main hypogastric artery (n = 9), the mean DS was still significantly higher after hypogastric artery bypass (7.8 vs 6.0; $P < .001$).

There was no difference between the groups in duration of the procedure (194 ± 21 minutes vs 201 ± 41 minutes), blood loss (195 ± 50 mL vs 173 ± 46 mL), or length of hospital stay (2.3 ± 1.6 days vs 2.1 ± 1.8 days) for hypogastric artery bypass or coil embolization, respectively. In these 21 patients, no morbidity or mortality was related to the procedures. Eight (89%) of 9 hypogastric artery bypasses were patent on follow-up images at 6 months. The single patient with an occluded bypass had no symptoms of claudication. This patient had significant calcification of the artery, which made the bypass difficult to perform.

DISCUSSION

The hypogastric arteries supply a key portion of blood to the pelvic organs and buttock muscles and are an important source of circulation to the colon and rectum. Often, extensive cross-pelvic circulation between the two arteries will permit ligation of one of the arteries without adverse sequelae. However, ligation or embolization of both arteries can result in severe pelvic ischemia, manifested by hip and buttock claudication, bowel and bladder dysfunction, and colon ischemia, and can lead to significant sexual dysfunction as well.[5-7]

During open repair of aortoiliac aneurysms preservation of the hypogastric artery is attempted, to minimize these complications. However, endovascular repair of aortoiliac aneurysmal disease does not allow direct revascularization or reconstruction of the hypogastric artery by purely endovascular methods with currently available devices. Certainly there are those who advocate the safety of coil

embolization of the internal iliac artery in endovascular grafting of AAAs; however, significant buttock claudication in 26% to 41% of patients has been reported after this procedure. Furthermore, these symptoms often persist with late follow-up of 35 months.[1-6]

We found a similar incidence of buttock claudication in 39% of patients who sustained unilateral hypogastric artery occlusion as a result of coil embolization of the artery or inadvertent covering of the artery. While most of these patients did have some improvement of symptoms, none returned to their baseline level of activity.[6] The purpose of this study was to compare the functional outcome in patients after hypogastric artery bypass and coil embolization for management of common iliac artery aneurysms with EVAR.

Both groups of patients were well-matched with regard to demographic data and aneurysm size, and both groups had similar preoperative baseline DS. The iliac artery aneurysms in these two sets of patients could not be treated with the "bell bottom" technique, which is often used in patients with common iliac artery ectasia. Patients in whom coil embolization was performed underwent a significantly longer follow-up. This longer follow-up is a reflection of our practice, in which coil embolization was used early in our experience, and we tended to use hypogastric bypass less frequently. We now tend to favor hypogastric artery bypass to preserve pelvic circulation in active patients with normal sized, minimally diseased vessels.

Coil embolization of a unilateral iliac artery resulted in buttock claudication in a high percentage (50%) of patients. This was completely avoided in those patients who underwent hypogastric artery bypass. The preoperative DS for patients with coil embolization was 7.8, which corresponded to a level of claudication at between four blocks and one-half mile. After the procedure the mean DS was reduced 43%, to 4.5, and patients reported claudication at one block. This was true even when we included only patients who underwent embolization of the main hypogastric, but to a lesser degree. Reports in the surgical literature suggest that the incidence of hip and buttock claudication after unilateral hypogastric artery ligation is lower than that with endovascular occlusion. Possible explanations include improved collateral revascularization of the contralateral hypogastric artery and reimplantation of the inferior mesenteric artery.[7-11] In addition, the magnitude of the operative procedure is greater in conventional open surgery, and incisional pain may mask milder symptoms of buttock claudication. However, even in the presence of a larger retroperitoneal incision to access the hypogastric artery, patients undergoing the bypass procedure were able to walk significantly longer without symptoms at 1 month.

Most patients who had hip and buttock claudication after coil embolization did have some improvement in their symptoms over time. However, they never reached their preoperative baseline level, and their DS remained significantly lower than the scores of those who underwent hypogastric artery bypass. The patients that fared the worst were those who underwent coil embolization of the branches of the hypogastric artery. These included 3 patients with hypogastric artery aneurysms that were not amenable to revascularization. Others have reported similar results with coil embolization of the branches of the hypogastric artery.[12]

As we and others have reported, hypogastric artery occlusion is not a benign procedure. The use of hypogastric artery bypass avoided postoperative hip and buttock claudication in patients with combined aortoiliac aneurysms. Use of a limited retroperitoneal approach did not increase the operative time, blood loss, or morbidity and mortality of the procedure. Furthermore, the hospital length of stay was not different. Thus, the bypass appears to pose little additional risk to the endovascular procedure.

A prospective study with a standardized instrument of functional assessment with objective measures of walking distance, such as treadmill testing, would enhance the validity and objectivity of a study of this nature. Furthermore, other indicators including preoperative and postoperative sexual function should be evaluated as well. However, the combined weight of previously published studies and their relatively similar rates of complications as in the current study would appear to support the conclusion that hypogastric occlusion is not a benign procedure.

In conclusion, coil embolization followed by occlusion of the hypogastric artery should be avoided if possible. Hypogastric artery bypass to preserve pelvic circulation results in significant improvement in ambulatory status in patients with common iliac artery aneurysms, compared with coil embolization.

REFERENCES

1. Sanchez LA, Patel AV, Ohki T, Suggs WD, Wain RA, Valladares J, et al. Midterm experience with the endovascular treatment of isolated iliac aneurysms. J Vasc Surg 1999;30:907-14.
2. Criado FJ, Wilson EP, Velazquez OC, Carpenter JP, Barker C, Wellons E, et al. Safety of coil embolization of the internal iliac artery in endovascular grafting of abdominal aortic aneurysms. J Vasc Surg 2000;32:684-8.
3. Razavi MK, DeGroot M, Olcott C, Sze D, Kee S, Semba CP, et al. Internal iliac artery embolizations in the stent-graft treatment of aortoiliac aneurysms: analysis of outcomes and complications. J Vasc Interv Radiol 2000;11:561-6.
4. Lee C, Kaufman JA, Fan CM, Geller SC, Brewster DC, Cambria RP, et al. Clinical outcome of internal iliac artery occlusions during endovascular treatment of aortoiliac aneurysmal disease. J Vasc Interv Radiol 2000;11:567-71.
5. Cynamon J, Lerer D, Veith FJ, Taragin BH, Wahl SI, Lautin, et al. Hypogastric artery coil embolization prior to endoluminal repair of aneurysms and fistulas: buttock claudication, a recognized but possibly preventable complication. J Vasc Interv Radiol 2000;11:537-7.
6. Lee WA, O'Dorisio J, Wolf YG, Hill BB, Fogarty TJ, Zarins CK. Outcome after unilateral hypogastric artery occlusion during endovascular aneurysm repair. J Vasc Surg 2001;33:921-6.
7. Hassen-Khodja R, Pittaluga P, Le Bas P, Declemy S, Batt M. Role of direct revascularization of the internal iliac artery during aortoiliac surgery. Ann Vasc Surg 1998;12:550-6.

8. Pittaluga P, Batt M, Hassen-Khodja R, Declemy S, Le Bas P. Revascularization of internal iliac arteries during aortoiliac surgery: a multicenter study. Ann Vasc Surg 1998;12:537-43.
9. Urayama H, Ohtake H, Katada S, Harada T, Kawakami K, Watanabe Y. Exclusion of internal iliac arterial aneurysm concomitant with abdominal aortic aneurysm repair. J Cardiovasc Surg (Torino) 1999; 40:243-7.
10. Brewster DC, Franklin DP, Cambria RP, Darling RC, Moncure AC, Lamuraglia GM, et al. Intestinal ischemia complicating abdominal aortic surgery. Surgery 1991;109:447-54.
11. Connolly JE, Ingegno M, Wilson SE. Preservation of the pelvic circulation during infrarenal aortic surgery. Cardiovasc Surg 1996; 4:65-70.
12. Wyeres MC, Schermerhorn ML, Fillinger MF, Powell RJ, Rzucidlo EM, Walsh DB, et al. Internal iliac occlusion without coil embolization during endovascular abdominal aortic aneurysm repair. J Vasc Surg 2002;36:1138-45.

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