Endovascular treatment of iliac aneurysm: Concurrent comparison of side branch endograft versus hypogastric exclusion

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Objective: To analyze early and mid-term outcome of endovascular treatment in patients with iliac aneurysms, comparing the results of hypogastric revascularization by branch endografting with those of hypogastric occlusion.

Methods: Consecutive patients with iliac aneurysms receiving side branch endograft (Group I) were compared with those receiving endograft with hypogastric exclusion (Group II) during the interval from January 2000 to May 2008. Procedural details and outcomes were prospectively collected and were analyzed at one year to avoid mismatch in follow-up length.

Results: A total of 74 patients (mean age, 75.8 years, 95% males) were treated: 32 in Group I and 42 in Group II. No differences in baseline risk factors and aneurysm diameter (40.2 ± 7.9 mm in Group I vs. 38.4 ± 10.8 mm in Group II) were found. Concurrent treatment of aortic aneurysm was performed in 25/32 (78%) of Group I and 36/42 (86%) of Group II. Fluoro time was 48 minutes (interquartile range [IQR] 31-57) in Group I vs. 31 minutes (IQR 23-38) in Group II (P = .04). The amount of contrast was similar in both Groups: 184 ml (IQR 155-210) in Group I vs. 183 ml (IQR 155-200) in Group II. No intestinal ischemia or deaths occurred. There were no significant differences in failures of hypogastric side branch deployment (2/32) compared with hypogastric coiling (3/42). Limb occlusions all occurring in the external iliac artery side were 2/32 in Group I vs. 3/42 in Group II. Reintervention rates were similar (5/32 vs. 4/42) at one year. Shrinkage of 5 mm or more was detected in 7/23 (30%) of Group I and in 13/37 (34%) of Group II. Iliac endoleak was present in eight patients (19%) in Group II and in one patient in Group I (4%) (P = .1). Similarly, buttock claudication or impotence were more frequent after hypogastric exclusion, recorded in eight patients in Group II and in one patient in Group I (P = .1).

Conclusions: Endovascular treatment of iliac aneurysm with hypogastric revascularization through side branched endografts is feasible and safe in the mid-term. When compared with hypogastric embolization, this option leads to similar technical success and reintervention rates. Endoleak and buttock claudication occur frequently in patients with iliac aneurysm treated with hypogastric exclusion, while are uncommon in those with hypogastric revascularization. Side branch endografting for iliac aneurysm may be considered a primary choice in younger, active patients with suitable anatomy, but larger studies and longer postoperative observation periods are needed. (J Vasc Surg 2009;49:1154-61.)

Unfavorable iliac anatomy is a major challenge in endovascular abdominal aneurysm repair (EVAR). Dilatation of one or both common iliac arteries (CIA), making them unsuitable for adequate distal sealing and therefore compromising the success of endovascular repair and the feasibility of the procedure, may be present in up to 30% of EVAR patients.1-4 To prevent type 2 endoleak, coil embolization of hypogastric artery, followed by endograft extension into the external iliac artery (EIA), is usually performed. The sacrifice of hypogastric artery may rarely result in severe morbidity and mortality, caused by bowel or even spinal ischemia,4 particularly in the presence of bilateral hypogastric occlusion and/or concomitant atherosclerotic occlusive disease, while it does not definitely reduce the risk of type 2 endoleak.4 Repair with a bifurcated iliac endograft, the iliac side branch device (IBD) has recently emerged as an alternative, flow-preserving, endovascular technique to address this problem. While a few recent series have demonstrated the feasibility of this approach in preserving pelvic flow, ensuring distal sealing during EVAR, they failed to contrast this new technique to other contemporary endovascular procedures for management of iliac aneurysms.5-9

The purpose of this study was to compare early and 1-year outcome of the IBD approach with that of hypogastric embolization followed by endograft extension across the iliac bifurcation, in a consecutive series of patients treated for significant (<24 mm) unilateral or bilateral iliac aneurysms associated or not with aortic aneurysm. In particular, rates of pelvic ischemia, failure of aneurysm exclusion, and need for reintervention were analyzed.

MATERIALS AND METHODS

All consecutive patients undergoing endovascular treatment between January 2000 and May 2008 for iliac aneurysm involving iliac bifurcation, associated or not with abdominal aortic aneurysm (AAA) repair, were reviewed. Pseudoaneurysms, symptomatic, and ruptured iliac aneurysms, as well as iliac aneurysms managed with open repair.
or with a simple common iliac endograft, or using bell-bottom technique were excluded.

Iliac aneurysms were selected as either single or multiple dilation with diameter larger than 24 mm, located within the common, external, or hypogastric arteries, without a suitable proximal and distal neck for sealing with commercially available endovascular iliac endografts.

Patient characteristics, comorbidities, operative data, intra-, and postoperative complications, were prospectively gathered in a computed database.

After January 2006, patients considered candidates for endograft repair and requiring coverage of one or both hypogastric artery origins to obtain a distal seal, were offered to IBD procedures using bifurcated iliac Zenith endograft devices (William Cook, Bloomington, Ind), when anatomical characteristics were suitable.

Patients receiving IBD (Group I) were compared with those receiving the most traditional hypogastroc coverage and embolization, followed by extension of the endograft into the EIA (Group II). Primary outcomes were: aneurysm-related death (defined as any death occurring within 30 days or within the same hospitalization from the original endovascular or from any secondary procedure, any death caused by the aneurysm or coming from graft complications), aneurysm rupture, pelvic ischemia (bowel, spinal cord or nerve ischemia, sexual impotence, buttack or thigh claudication, buttack necrosis), failure to exclude iliac aneurysm (growth > 5 mm in maximum diameter, endoleak), and need for reintervention. Secondary outcomes were: technical failure, defined as impossibility to deploy the IBD, stent-grafts or coils in the intended sites, newly occurring bilateral hypogastric occlusion at the end of the procedure, and/or iliac graft or external iliac occlusion, iliac patency, operative times, medium contrast usage, and fluoroscopy times.

Patients were routinely interviewed for the new onset of symptoms and signs indicative of bowel ischemia, leg ischemia, or impotence after treatment. Bowel ischemia was clinically suspected based on symptoms, physical examination, and chemical laboratory findings, and eventually endoscopically documented and checked with laparotomy. Buttock claudication was defined according to Interconsensus standards and based on physical examination and patients’ complaint.10 Echo-doppler with ankle-brachial index (ABI) measurements were used to assess patency of hypogastric, iliac, and femoral vessels. Impotence was assessed by patient referred symptoms.

All patients underwent preoperative evaluation with computed tomographic (CT) scanning with intravenous contrast. Maximum intensity projections (MIP), thin axial cuts, and 3D reconstruction using high magnification software have been used to assess iliac dilation extension, morphology, tortuosity, sizing, and to plan the repair.

Operative techniques. Intraoperative aortic angiography with a marked catheter for appropriate length measurements was commonly used. When an AAA was also present, EVAR was performed using modular commercially available endografts, selected according to anatomical characteristics and operators preferences in case of hypogastric exclusion, or with a Zenith device (Cook Inc, Bloomington, Ind) in case of IBD. A proximal and distal fixation zone of 15 mm was usually required for endovascular repair to obtain safe seal.

Those individuals presenting with bilateral iliac aneurysm were treated with revascularization of at least one of the two iliac sides when technically feasible, either with IBD (Group I) or by means of external to internal iliac surgical bypass (Group II).

IBD technique (Group I). IBD approach was used with a suitable healthy segment of EIA to provide a distal fixation zone of at least 15 mm length, in the absence of excessive tortuosity associated with calcification that could prevent delivery and deployment of the graft. A patent lumen of the CIA of at least 20 mm in diameter and 40 mm in length was required for correct graft expansion. A distal landing zone of at least 10 mm length on the main hypogastric trunk was required. In case of bilateral IIA aneurysmal involvement, the side with the most proximal healthy segment, with richer distal arterial bed, without extensive calcification or tortuosity (as evaluated on the preoperative CT) was chosen for IBD placement. The other side was excluded with coil embolization.

The device used is the version of the Zenith IBD (Cook Inc) with a side, straight, short IIA branch, different from the “spiral” IBD used in other published experiences.6 The IBD was introduced through femoral access, either percutaneously or by small surgical cut down, over a stiff guidewire (Lunderquist; Cook Inc) and oriented under fluoroscopic guidance. After IBD deployment, a covered stent (Advanta; Atrium Medical, Hudson, NH, or Fluency; C.R. Bard Inc, Murray Hill, NJ) was deployed to fill the gap between side branch of the IBD and the hypogastric artery, to ensure adequate sealing and patency.

In the presence of AAA, the procedure was completed by placing the main bifurcated Zenith body and subsequently bridging the gap to the proximal portion of the IBD with a Zenith limb extension (Fig 1).

Embolization technique (Group II). Coil embolization (MR Eye Coils, Cook Inc) or occluder placement (Amplatzer, AGA Medical Corp, Plymouth, Minn) of the origin of the hypogastric artery was performed at the same time as EVAR, to achieve an appropriate sealing in CIA aneurysm without adequate distal neck (>15 mm in length). For aneurysms involving the hypogastric artery, its primary branches were coil embolized. The origin of hypogastric artery was then, during the same procedure, covered with an endograft limb extending into the EIA.

In case of bilateral IIA aneurysmal involvement for the group of patients without IBD placement, one side was chosen for surgical revascularization based on anatomical grounds (the one with the most proximal healthy segment, with richer distal arterial bed, without extensive calcification as evaluated on the preoperative CT). An oblique incision over the inguinal ligament was performed and a retroperitoneal approach was used. A bypass from the EIA, distally to the previously deployed aorto-iliac endograft, to the transected hypogastric artery with proximal over-
sowing was then carried out with a Dacron graft, 8 mm in diameter, sutured distally in an end-to-end fashion to the IIA.

Follow-up. Follow-up protocol after repair included physical examination, abdominal color Duplex ultrasound, and plain abdominal radiography at one month and every six months thereafter, while CT scan was repeated at one month and yearly thereafter, to control aneurysm diameters and the presence of any endoleak, graft occlusion, or complications.

Statistical analysis. Categorical variables in Group I and Group II were compared with the \( \chi^2 \) or the Fischer exact test, and means were compared using the Student \( t \) test. \( P \) values < .05 were considered significant. To avoid mismatch in the length of follow-up (since IBD was most recently employed) only results at 12 months have been evaluated in the analysis, therefore outcomes were compared at 30 days (perioperative) and at one year. All the analyses were performed using SPSS package, 13.0 version (SPSS Inc, Chicago, Ill).

RESULTS

During the study period, a total of 74 patients (69 men) with a mean age of 75.6 years underwent iliac aneurysm repair using IBD or hypogastric coverage and embolization. These included 32 IBD repairs (Group I) occurring between 2006 and 2008, and 42 hypogastric embolizations with EIA endograft extension (Group II).

Table I shows preoperative patient characteristics and risk factors in Group I and Group II. There was a tendency toward younger age and reduced cardiac risk in the IBD group compared with the IIA exclusion group, without significant differences. No patient presented buttock or thigh claudication.

In most of the cases, iliac aneurysm was associated with AAA (25 in Group I, 36 in Group II) and required concomitant EVAR repair.

In Group I, six aneurysms extended to IIA (19\%). Group II showed a higher rate of IIA involvement (14 patients, 34\%), with nine isolated IIA requiring treatment. Incidence of IIA aneurysm between groups was not statistically different (\( P = .2 \)). There were no EIA aneurysms, while a total of eight patients had bilateral iliac involvement (Table II). The mean preoperative maximum iliac diameter was 40.2 ± 7.9 mm in Group I and 38.4 ± 10.8 mm in Group II (\( P = .4 \)).

Operative details in Group I showed that 13 patients have been operated by local, eight by epidural, and 11 by general anesthesia; 13 patients had a percutaneous femoral access pre-closed with a Prostar XL device (Abbott Vascular, Abbott Park, Ill). A bifurcated aorto-iliac endograft was used in 26 patients, while six had only the IBD placed in one iliac artery, without aortic graft. To bridge the gap between the IBD and the distal IIA, a balloon expandable graft, Advanta V12, was used in 19 patients (59\%), five required a second self expandable stent apposition distally for sealing. In 13 patients (41\%), a self expandable stent (Fluency, C.R. Bard) was used, with a double stent-graft needed in one case.

In Group II, 18 patients had general anesthesia, 14 patients had been operated under epidural, and eight under local anesthesia. Regarding graft configurations, three patients had an aorto-uni-iliac (AUI) graft (one Talent, one Zenith, converted to AUI after impossibility to cannulate the contralateral limb of a bifurcated device, one Endomed), five had an iliac tube graft (one Hemobahn, one Excluder, one Talent, two Zenith), and 34 had an aortic bifurcated device (one AneuRx, three Fortron, four Excluder, six Talent, and 20 Zenith). There were no perioperative deaths, myocardial infarctions, strokes, conversion to open repair, mesenteric or spinal cord infarcts, or buttock necrosis in either group. Major morbidity requiring medical treatment in Group I occurred in three patients: one had an episode of atrial fibrillation requiring medical treatment, one patient had asymptomatic pulmonary embolism detected at the postoperative CT control, and the third patient, with preoperative renal failure, had a worsening of renal dysfunction requiring chronic dialysis. In Group II, major morbidity occurred in four patients: two required prolonged hospitalization for inguinal lymphorrhea, one had clostridium difficile pseudomembranous colitis, and the fourth had embolic renal infarct medically treated.

Technical success was 94\% in the IBD Group and 93\% in the IIA embolization group (\( P = 1 \)). There were two failures in Group I, both for intraoperative IIA occlusion. One was due to thrombus shift into the IIA during catheters and guidewire manipulations inside the iliac aneurysm, and the other due to impossibility to correctly deploy the covered stent into the distal IIA landing zone for excessive.
tortuosity. In Group II, the three failures included two patients with bilateral IIA occlusion: in one the EIA to IIA by-pass occluded early and in the other EIA to IIA bypass was not performed for extensive calcification. The third failure was due to iliac aneurysm tortuosity and unfeasibility to place the planned coils into the IIA. Therefore, for the subgroup of four EIA to IIA surgical bypass performed to obtain one side revascularization in bilateral iliac aneurysm in Group II, technical success was 50%: one was not feasible for vessel calcification, another occluded intraoperatively, and the other two remained well patent and asymptomatic during follow-up.

In the first 30 days postoperatively, two external iliac limb occlusions occurred in each group for a limb primary patency of 95% and 94%, respectively. Patency was restored in two of the four patients by thrombectomy and stent. Distal revascularization was achieved with femoro-femoral cross over bypass in a third patient, while in the fourth (Group II) non-limiting symptoms required no surgical treatment.

Early reintervention was required in five patients in the IBD group (16%): two patients underwent thrombectomy, one, with known bleeding disorder, underwent a femoral revision for bleeding after percutaneous access. Another patient, who underwent femoral artery repair for pseudoaneurysm at the access site, had a type I distal endoleak at the distal IIA sealing zone requiring a secondary IIA stent-grafting. The fifth patient with a type 3 endoleak between IIA branch and IIA stent required another interposition endograft placement. Early reintervention was performed in two patients (5%) of Group II, one for limb ischemia and the other for femoral wound dehiscence.

The 30-day follow-up CT examination revealed a type 2 iliac endoleak in nine patients, eight in Group II, refilled from IIA branch (Table III). None of these type 2 early endoleaks was treated.

Mean follow-up was 9.8 months in Group I (range, 1-24 months) and 31.1 months (range, 1-74 months) in Group II ($P = .001$), reflecting the younger adoption of IBD technique in our center. To obtain comparable results in the two groups, we report here the 12-month results regarding 23 patients in Group I and 37 patients in Group II (Table IV). Overall mortality at one year was 4% in Group I and 7% in Group II, all due to unrelated causes: one patient with IBD died of myocardial infarction two months after the operation; in Group II, the three deaths were caused by oesophageal cancer, bleeding gastric ulcer, and respiratory failure.

Iliac aneurysm significantly (at least 5 mm) decreased in diameter, in seven patients in Group I (30%) and in 13 (34%) in Group II ($P = .005$). Only one patient, in Group II, experienced iliac aneurysm growth, of 5 mm, due to hypogastric incomplete exclusion and type 2 endoleak (Fig 2), requiring successful secondary coil embolization through contralateral hypogastric super-selective catheterization. At one year, type 2 endoleak was present in eight iliac aneurysms (13.3%), all but one in Group II. The difference was not statistically significant ($P = .13$). Besides the one
associated with aneurysm growth stated above, no other endoleak received secondary treatment. Endoleak origin was clearly identified in six patients in Group II: in four with IIA aneurysm, coils were deployed in only one of the terminal branches of the IIA, leaving other branches patent and responsible for back filling into the aneurysm. In another one, the type 2 endoleak originated through a communication with patent inferior mesenteric artery, while in the last, refilling was due to the lack of successful IIA coil embolization. In other two cases, one in each group, a tiny endoleak resulted from unclear origin. None of the IBD limbs occluded during follow-up. Limb occlusion occurred in one patient in Group II, eight months after the original procedure and required a femoro-femoral crossover by-pass, leading to a one-year reintervention rate of 5.4% in Group II, while no secondary procedures had been performed in patients in Group I (P = .1).

Prevalence of pelvic ischemic signs was higher in patients in Group II compared with Group I, 22% (eight patients) versus 4% (one patient), respectively, the difference not being statistically significant (P = .1). In patients with IIA embolization, buttock claudication was present in five patients with a single IIA occlusion, in one with IIA occlusion and contralateral patent EIA to IIA bypass, and in one with bilateral IIA occlusion after a failed IIA revascularization. One patient with single IIA occlusion complained of a new onset of sexual impotence, persisting at 12 months. In Group I, only one patient with a patent IBD and contralateral IIA occlusion complained of persisting buttock claudication at 12 months.

**DISCUSSION**

Proper management of iliac aneurysms has not been completely standardized. Since several reports documented the utility of endovascular approach, a number of endovascular techniques have been applied either preserving (bell bottom, transposition/bypass, external to internal endografting) or sacrificing (simple coverage, coil embolization of hypogastric artery) hypogastric flow.\(^1\) \(^4\) Despite good midterm results, with low morbidity/mortality rates, a number of drawbacks, such as endoleak, disconnection, iliac occlusion, and risk of pelvic ischemia are still unsolved issues, limiting the generalization of the procedures. Currently, the first choice for endovascular treatment of iso-

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**Table III.** Perioperative results (30 days)

<table>
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<tr>
<th></th>
<th>Group I = 32</th>
<th></th>
<th>Group II = 42</th>
<th></th>
<th>P</th>
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<tbody>
<tr>
<td>Mortality/rupture</td>
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<td>%</td>
<td>0</td>
<td>%</td>
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<tr>
<td>Procedure time (min)</td>
<td>153</td>
<td></td>
<td>160</td>
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<tr>
<td>Fluoro time (min)</td>
<td>45 ± 23</td>
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<td>31 ± 14</td>
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<td>Contrast (cc)</td>
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<td>180 ± 42</td>
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<td>.8</td>
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<tr>
<td>External iliac limb occlusion</td>
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<td>6</td>
<td>2</td>
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<tr>
<td>Iliac endoleak</td>
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<td>3</td>
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<td>16</td>
<td>2</td>
<td>5</td>
<td>.2</td>
</tr>
<tr>
<td>Local complications</td>
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<td>3</td>
<td>7</td>
<td>1</td>
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<tr>
<td>Pseudoaneurysm</td>
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<td>2</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Wound dehiscence</td>
<td>–</td>
<td>–</td>
<td>1</td>
<td>2</td>
<td>–</td>
</tr>
<tr>
<td>Wound hemorrhage</td>
<td>1</td>
<td>3</td>
<td>–</td>
<td>–</td>
<td>–</td>
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<tr>
<td>Lymphorrhea</td>
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<td>2</td>
<td>5</td>
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**Table IV.** One-year results

<table>
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<tr>
<th></th>
<th>Group I = 23</th>
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<th>Group II = 37</th>
<th></th>
<th>P</th>
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<tbody>
<tr>
<td>Unrelated mortality</td>
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<td>3</td>
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<tr>
<td>Reinterventions</td>
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<td>2</td>
<td>5</td>
<td>.1</td>
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<tr>
<td>Iliac endoleak</td>
<td>1</td>
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<td>7</td>
<td>19</td>
<td>.1</td>
</tr>
<tr>
<td>Pelvic ischema*</td>
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<td>4</td>
<td>8</td>
<td>22</td>
<td>.1</td>
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<tr>
<td>Iliac diameter decrease</td>
<td>7</td>
<td>30</td>
<td>13</td>
<td>35</td>
<td>.8</td>
</tr>
<tr>
<td>Iliac limb occlusion</td>
<td>0</td>
<td>–</td>
<td>1</td>
<td>3</td>
<td>1</td>
</tr>
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</table>

*Including the combination of bowel, spinal cord, nerve ischemia, sexual impotence, buttock or thigh claudication, and buttock necrosis.

Fig 2. Abdominal 3-D computerized tomography reconstruction after aorto-bi-iliac endografting and right hypogastric coil embolization. With * a type 2 iliac endoleak is indicated, while # indicates the coils deployed at the distal end of the hypogastric aneurysm.
lated iliac or aortoiliac aneurysm involves the embolization of the hypogastric artery and extension of the endograft into the EIA. However, literature data show that approximately one-third of patients with hypogastric occlusion have symptoms of pelvic ischemia: buttock claudication is fortunately the most common, occurring in about 80% of symptomatic patients, with impotence in about 10% and colonic ischemia in 6% to 9% of all the pelvic ischemic complications. Although most of these complications may be benign and may improve with time, severe colonic ischemia resulting in death has been described.

The IBD is a new device that offers the possibility of preserving antegrade hypogastric artery flow in patients with aortoiliac aneurysms during endovascular repair. Here we present the first report comparing coil embolization with IBD approach in a contemporary series of patients.

Our results suggest that a vast majority of patients can be successfully treated with this device without complications both in the perioperative period and in the mid-term. At 12-month follow-up, only two patients (6%) had IIA occlusion after IBD and only one patient (4%) complained of buttock claudication, because of the planned IIA occlusion contralateral to a patent IBD. Conversely, after IIA embolization, a higher incidence of buttock claudication is to be expected (22% in our experience), with invalidating symptoms even after one year.

These figures are similar to those recently reported by Farahmand et al who investigated the outcomes of 101 patients with either IBD procedure and coil embolization (n = 76) or simple IIA ostium coverage (n = 25). They found an incidence of buttock claudication of 50% after EVAR that did not improve with time in 33%; sexual dysfunction occurred in 19.6% of patients without any improvement during follow-up. The authors also underlined the higher risk of symptoms in deep deployment of coils into the IIA ramifications and in patients with left ventricular dysfunction.

These findings bring to discussion the possible extensive indication to IBD in patients with unilateral IIA aneurysm involvement and eventual use of dual IBDs in patients with bilateral IIA aneurysms. Results of these approaches and cost effective analyses have not been fully evaluated yet, but the rationale to preserve both IIA to avoid invalidating symptoms appears to justify an aggressive posture toward IBD use at least in cases of younger patients with active lifestyles.

In our experience, both the IBD procedure and coil hypogastric embolization with EIA extension were effective in the medium term, because no patients had persistent type 1 endoleak, junction endoleak, or bowel ischemia. However, some advantages were observed in the IBD Group procedure, including only one case of occurrence of buttock claudication, no impotence (vs one in Group II after coil embolization), and only one type 2 endoleak (vs 20% from hypogastric reperfusion in Group II). These data could suggest that IBD is more effective in both ensuring distal sealing with aneurysm exclusion and preserving adequate pelvic flow. However, more robust data are needed to confirm this hypothesis.

Despite the apparent increased complexity of IBD with respect to coil embolization, there were no higher perioperative failure rates. There were two unsuccessful deployments of IBD in Group I, with immediate intraoperative occlusion of the hypogastric side branch, and three failures to coil or complete the procedures in Group II. In both groups, main reasons of failure were severe iliac artery tortuosity and calcification; these anatomic features still representing exclusion criteria for endovascular approach. Of relevance, the two intraoperative occlusions of hypogastric side branch in Group I were entirely asymptomatic and did not require adjunctive treatment. At the same time, the occluded device was still able to ensure adequate distal sealing and prevent reperfusion (no type 2 endoleak, no disconnection). Therefore, when comparing the IBD technique with embolization and covering of the hypogastric origin, an additional advantage is that there is nothing to be lost if the side branch occludes when using IBD.

In our series, no occlusion of the hypogastric branches were detected during follow-up after successfully completed procedure. This was not the case in other experiences, where longer follow-up reported the results of older generation IBD together with the current version. Ziegler et al, reviewing a five-year experience with IBD in 46 patients, reported technical success of only 58% in older version IBD, while for the second generation device, the same used in our experience, it reached 85%. During follow-up, 11% of IBD (4/35) showed hypogastric branch occlusion, all within the first 12 months, but without significant differences between the two device generations.

Long-term results of dilated iliac arteries treated by endovascular route are not yet fully understood. According to our data, one year after endovascular repair, iliac aneurysm shrinks in about 30% and secondary intervention may be necessary in 5%-16% regardless of the technique used. However, unlike for AAA, the natural history of iliac aneurysm is not well defined and the true incidence of rupture and its correlation with size is still unclear, with earlier series reporting rates of 14% to 70%. Given the unclear natural history of these aneurysms and the higher rate of morbidity in the setting of emergent repair (even with endovascular techniques), patients with favorable anatomy should be repaired by endovascular route.

The Achilles heel of all endograft landings into the EIA is always the risk of late occlusions due to graft kinkings at the level of iliac tortuosities. In our experience, external iliac occlusion occurred in two cases of IBD, where the hypogastric branch was patent in one case and occluded in the second. Both were successfully managed by thrombectomy and additional stenting to give more support to the endograft limb, but this underlines the need for careful evaluation of any residual angulation at the end of the procedure and the liberal use of additional stents to prevent graft kink. Houlen et al reported three cases of external iliac occlusion in 52 patients with helical IBD, occurring in the non-branched side in two cases and in the IBD side in one case after occlusion of the hypogastric branch. They postulated that the increased flow in the side of a patent IBD...
could prevent thrombosis of the external iliac limb, but this hypothesis failed at least once in one of our patients. We believe that any graft angulation, especially at the origin of the EIA, can be sufficient to provoke a later occlusion, and in any case of suspicion of graft kink after removing the guidewire at the end of the procedure, we now confirm the absence of flow limitation by measuring the pressure gradient immediately above and below the graft curvature, and liberally place additional bare stents.

In this study, no late external iliac artery occlusions occurred after the first month, confirming the importance of careful evaluation of the intraoperative technical result. However, other experiences with IBD reported occlusion of the external limb of the IBD that were detected at later times. Dias et al reported two late external iliac occlusions in 22 patients with IBD, occurring at four and six months, both determined by kinking of the graft. Malina et al, from the same group, underlined that one (10%) late occlusion of the EIA (at six months) on the side of a patent hypogastric branch, remained asymptomatic without adjunctive treatment.9,25

Our results were not provided by a randomized comparison. Small sample size, limited follow-up, lack of cost-benefit analyses, as well as lack of standardized questionnaire and objective criteria to assess impotence (eg, penile-brachial index) are other limitations of this preliminary experience with IBD.

In conclusion, the use of IBD in maintaining antegrade flow to at least one hypogastric artery for aortoiliac aneurysm repair is feasible and safe. Careful patient selection and exclusion of those presenting excessive iliac tortuosity and deep aneurysmal involvement of the hypogastric artery are the keys to technical success. When compared with hypogastric embolization, the IBD approach presents fewer symptoms of pelvic ischemia and endoleaks. Moreover, there is nothing to be lost if the side branch occludes, producing the same effect of hypogastric branch, remained asymptomatic without adjunctive treatment.9,25

Longer term follow-up and larger studies are needed to confirm these suggestions.

AUTHOR CONTRIBUTIONS

Conception and design: FV, GP, LR, PDR, PC
Analysis and interpretation: FV, GP, PDR, PC
Data collection: GP, LR, GP
Writing the article: FV, GP, PDR
Critical revision of the article: PDR, PC
Final approval of the article: PC
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REFERENCES

