

# Need for hypogastric artery preservation in endovascular repair for aorto - Iliac Aneurysms

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## Abstract

**Objective:** Effective distal sealing in endovascular aorto-iliac aneurysm repair often requires landing in the external iliac artery, thus questioning the fate of the hypogastric artery circulation. Besides simple embolization to prevent a type 2 endoleak, several solutions exist for hypogastric flow preservation, each laden with increasing complexity and/or financial burden. The present study evaluated the rationale of hypogastric artery preservation in this clinical setting.

**Methods:** From January 1999 to June 2016, 749 patients underwent endovascular repair of abdominal aortic aneurysm. Among these, 112 with aneurysm involving the iliac vessels required consideration for closing one (95) or both (17) hypogastric arteries. One-hundred and three patients were male and 9 were female. The mean age was 75 (52-88). When only one hypogastric artery (with patency of the contralateral) needed sacrifice, the usual practice has been simple embolization with plugs or coils before the endografting. Nevertheless, 4 patients with unilateral iliac involvement, who had an active lifestyle, received a branched endograft for hypogastric preservation. When landing in the external iliac artery was needed bilaterally, in 16 cases one hypogastric artery was embolized and the other one was preserved with branched endografts (N=11), “double barrel” technique (N=3) or hybrid repair using an open bypass from external to internal iliac artery (N=2); in only one patient a bilateral branched endograft was used to preserve both hypogastrics.

**Results:** Preservation of the hypogastric artery was achieved in 21 out of the 22 target vessels: one patient, who received a branched endograft, experienced immediate occlusion of the hypogastric stent, without any clinical sequelae. In the early postoperative period none of the 112 patients had symptoms of critical gluteal and/or pelvic visceral ischemia. At a mean follow-up of 48 months (1-152), no further procedures were necessary for proximal and/or distal type I endoleak. All the hypogastric arteries but one, in the 20 patients in whom they were preserved, remained patent. Even though 33% of the patients (37 out of 112) reported mild to moderate gluteal claudication during the first 6 months after the procedure, the symptoms improved progressively, and residual complaints were presented at the 1 year visit or later only in 8% of cases. Moreover, no substantial changes in sexual activity were reported in any case.

**Conclusion:** From a cost-effectiveness perspective, adjunctive procedures for monolateral hypogastric artery preservation with contralateral patency are not warranted. These techniques should be reserved for the selected few cases when both hypogastric arteries need to be sacrificed, or when there is a peculiar need for their preservation.

**Keywords:** Aortoiliac aneurysm, Hypogastric artery, Iliac branched device, Endovascular aneurysm repair

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## Introduction

Effective distal sealing in endovascular aorto-iliac aneurysm repair (EVAR) often requires landing in the external iliac artery, thus questioning the fate of the hypogastric artery (HA) circulation.<sup>[1]</sup> Simple hypogastric embolization is generally used to prevent a type 2 endoleak.<sup>[2, 3]</sup> Nevertheless, preservation of the internal iliac flow is important to avoid ischemic complications after EVAR, particularly in patients with previous procedures or potential additional future interventions.<sup>[4, 5]</sup> Indeed, the sacrifice of the HA carries a non-negligible rate of complications, which may include buttock claudication, sexual dysfunction, ischemic colitis, spinal cord ischemia, as well as buttock and scrotal necrosis.<sup>[2, 3, 6, 7]</sup> Buttock claudication may improve over time, but up to 15% of the patients remain symptomatic.

In order to reduce the incidence of complications and the disability level, it is advisable to preserve the flow in at least one of the internal iliac arteries, taking advantage of the extensive collateral network in the pelvis.<sup>[2, 3, 6, 7]</sup> Several solutions exist for hypogastric flow preservation, such as the bell-bottom technique, hypogastric transposition/bypass, the “double barrel” technique, and the use of dedicated branched endografts, each laden with increasing complexity and/or financial burden.<sup>[3, 6, 8-16]</sup> The present study evaluated the rationale of HA preservation in this clinical setting.

## Materials and Methods

From January 1999 to June 2016, 749 patients underwent EVAR at our Institution. Among these, we retrospectively reviewed the data of 112 patients (103 males, 9 female), with a median age of 75 years (range 52-88 yrs), who received an endovascular treatment for an aneurysm involving the iliac vessels. Demographics, clinical and radiological information were extracted from prospectively maintained computed databases and from hospital records when needed. Comorbid conditions are outlined in **Table 1**.

The endovascular approach was chosen based on anatomical characteristics and the presence of significant comorbidities. Indication for treatment was the pres-

ence of an abdominal aortic aneurysm (AAA) >50mm associated with dilated common iliac arteries (>25mm) precluding an effective distal sealing, or the presence of an isolated common iliac artery aneurysm greater than 35mm on one or both sides. In this scenario, to achieve a good distal sealing, endograft landing into the external iliac artery was required in 95 patients on one side and in 17 patients on both sides. The preoperative imaging protocol included contrast-enhanced computed tomography (CT) in all patients. A vascular dedicated digital workstation has been used for CT-scan images analysis since 2007 (Aycan Osirix PRO Workstation, Aycan Inc, Wuerzburg, Germany).

All the procedures were carried out in the operative room with the aid of a C-arm equipment, under local or general anesthesia, as appropriate. When only one hypogastric artery (with patency of the contralateral) needed sacrifice, the usual practice was simple embolization at its origin with plugs or coils before deploying the endograft (91 patients). Nevertheless, in this group of unilateral iliac involvement, in 4 cases the HA was preserved using an iliac branched device (IBD), based on patient young age and active lifestyle (**Table 2**). When landing in the external iliac artery was needed

**Table 1. Demographics and comorbid conditions in 112 patients**

	N	%
<b>Total</b>	<b>112</b>	<b>100</b>
<b>Males</b>	<b>103</b>	<b>92</b>
<b>Females</b>	<b>9</b>	<b>8</b>
<b>CAD*</b>	<b>60</b>	<b>54</b>
<b>Hypertension</b>	<b>91</b>	<b>81</b>
<b>COPD**</b>	<b>21</b>	<b>19</b>
<b>Smoking</b>	<b>93</b>	<b>83</b>
<b>Diabetes</b>	<b>24</b>	<b>21</b>
*Coronary Artery Disease, **Chronic Obstructive Pulmonary Disease		

bilaterally, in 16 cases one HA was embolized and the other one was preserved with different techniques, according to the period considered. In the first phase of the experience, a hybrid repair with open prosthetic bypass from the external to the internal iliac artery was adopted to preserve hypogastric flow in 2 cases. Later, deployment of parallel grafts, one for the internal and one for the external iliac artery (the so-called “double barrel” technique) was used in 3 patients (Figure 1). In the last years, with the availability of dedicated branched endografts for hypogastric preservation, our policy has been to implant an IBD on one side plus contralateral hypogastric embolization (11 patients) (Figure 2). In only one patient we decided to preserve both hypogastriacs implanting a bilateral IBD: he was a 52 years-old man with an aorto-iliac aneurysm involving both iliac arteries, who specifically asked for endovascular repair to avoid any possible complication affecting his sexual activity (Tabel 2) (Figure 3).

As far as the embolization technique is concerned, our strategy is to deploy the occluder (Amplatzer, AGA Medical Corp, Plymouth, MN, USA) or the coils as proximal as possible in the main trunk of the HA, to

better allow for an effective collateral circulation. For aneurysms involving the HA, its primary branches are embolized by means of coils. After hypogastric occlusion, the endograft is deployed down to the external iliac artery during the same operation or few days later in case of staged procedures.

In the 3 cases treated with the “double barrel” technique, the Gore Excluder platform (W.L. Gore and Associates, Flagstaff, AZ, USA) was used. Once the bifurcated endograft was in position, two parallel covered stents were deployed, one into the external iliac artery (through the ipsilateral femoral access) and one into the HA through a brachial approach. For the external iliac artery a standard Gore Excluder limb was used, whereas for the HA the covered stent of choice was the Gore Viabahn.

Regarding the 17 IBDs used in our experience, in 5 patients we implanted the Zenith branch device (Cook, Bloomington, IN, USA) with the adjunct of a bridging covered stent (Advanta, Atrium Medical, Hudson, NH, USA or Fluency, C.R., Bard Peripheral Vascular Inc., Murray Hill, NJ, USA) to land and seal into the HA. In the remaining 12 cases, the Gore Excluder branch device (W.L. Gore and Associates, Flagstaff, AZ, USA) was used, which includes a dedicated additional covered stent to bridge to the HA.

**Table 2. Technical Details.**

Distal Sealing in EIA*	N
One side	95
Simple HA** embolization	91
HA preservation with IBD***	4
Both sides	17
HA embolization on one side + preservation of the contralateral one	16
EIA to HA bypass	2
“Double barrel” technique	3
IBD implant	11
Bilateral HA preservation with 2 IBD	1
*EIA: External Iliac Artery - **HA: Hypogastric Artery - ***IBD: Iliac Branched Device	

**Figure 1. Volume Rendering CT-scan reconstruction, showing the “double barrel” technique for the preservation of the right hypogastric artery plus embolization of the left hypogastric artery.**



Postoperatively, all patients underwent clinical examination in order to detect symptoms of buttock claudication, skin or muscle necrosis, ischemic colitis, and neurological deficits. Follow-up included clinical evaluation plus imaging with Duplex scan and/or CT scan at 1 month, 6 months and 12 months after the intervention, and yearly thereafter. The persistence of buttock claudication was particularly investigated. Also sexual function was evaluated by questioning all male patients preoperatively as well as after the intervention in the follow-up.

## Results

Technical success, defined as the absence of a graft-related endoleak at the end of the procedure, was obtained in all the 112 patients who received an endovascular treatment for an aorto-iliac aneurysm. For patients who underwent hypogastric preservation procedures, the overall procedural success rate in maintaining the patency of the HA with an effective sealing was 95,4% (21 patent HA out of the 22 target vessels). Indeed, one patient, treated with plug embolization on one side and a Cook Zenith IBD on the contralateral one, experienced immediate occlusion of the hypogastric stent that was detected on the completion angiogram at the end

**Figure 2.** Volume Rendering CT-scan reconstruction after preservation of the right hypogastric artery with an iliac branched device, associated with embolization of the left hypogastric by means of two occluder plugs.

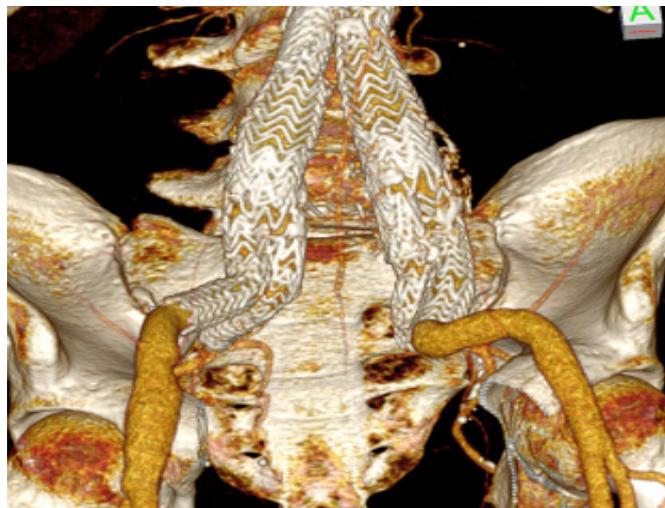


of the procedure, with failed attempt of recanalization. Nevertheless, the patient did not experience severe clinical sequelae but only a mild buttock claudication persistent in the follow-up.

There were no perioperative deaths. In the early postoperative period, none of the 112 patients had symptoms of critical gluteal and/or pelvic visceral ischemia, buttock necrosis, ischemic colitis, or neurologic deficits (Table 3).

At a mean follow-up of 48 months (range 1-152), no further procedures were necessary for type I or type III endoleak. Fourteen type II endoleaks were detected at the 1 month post-operative CT-scan: among these, two patients required inferior mesenteric artery embolization for a persistent type II endoleak with aneurysm growth, respectively 18 and 31 months after the EVAR procedure. No aneurysm rupture occurred in the follow-up. All the successfully preserved hypogastric arteries but one remained patent during the follow-up (20 out of 21, 95,2%). One patient treated with the “double barrel” technique on one side and embolization on the contralateral one, showed occlusion of the hypogastric stent at the CT scan 1 year after the operation, without any symptoms.

**Figure 3.** Volume Rendering CT-scan reconstruction, showing bilateral implant of an iliac branched device for preservation of both hypogastric arteries.



Even though 33% of the patients (37 out of 112) reported mild to moderate gluteal claudication during the first 6 months after the procedure, the symptoms improved progressively, and residual complaints were presented at the 1 year visit or later only in 9 cases (8%). In all these patients, symptoms occurred on the side of HA embolization. No patient with two patent HA referred symptoms of buttock claudication.

Moreover, no substantial changes in sexual activity were reported in any case.

## Discussion

Effective distal sealing in endovascular repair of abdominal aortic aneurysm may be impaired by the presence of concomitant iliac aneurysmal disease.<sup>[1]</sup> This is the case of up to 30% of patients or more, and, particularly in the first phase of the endovascular era, it represented a consistent limiting factor for this technology.<sup>[3]</sup> In case of aortoiliac aneurysms extending down to the iliac bifurcation or involving the hypogastric arteries,

distal landing into the external iliac artery is required, thus impacting on pelvic circulation.<sup>[1-3, 5, 6]</sup> Indeed, the usual policy is to embolize the HA to prevent a retrograde reperfusion of the aneurysmal sac. Although unilateral hypogastric occlusion is considered a relatively safe procedure, significant post-operative complications may occur, such as buttock claudication, skin/muscle necrosis, ischemic colitis, paraplegia and impotence.<sup>[2, 4, 5]</sup> The rate of these adverse events and their severity is higher in case of bilateral occlusion, although not all the authors agree with this statement.<sup>[3]</sup> Indeed, the severity of symptoms following the sacrifice of one or both internal iliac arteries is strictly depending on the collateral arterial supply and it is likely that younger and more active patients would experience higher risk of buttock claudication after hypogastric occlusion.<sup>[5, 6, 9, 14, 17]</sup> That's why it is generally agreed that effort should be made to preserve at least one hypogastric artery in almost all patients, in order to prevent the risk of life-threatening postoperative ischemic complications.<sup>[3, 18]</sup> Attempts at maintaining the flow in both hypogastric arteries are justified only in selected cases, based on patient's young age and in the presence of a real active lifestyle, to limit the possibility of functional disabilities after the operation (such as buttock claudication or sexual function impairment) that clearly assume more clinical relevance in this subset of population.<sup>[16]</sup> This is the case of the 4 patients in our experience with unilateral iliac involvement, in whom hypogastric preservation was adopted instead of simple embolization, or the case of the 52 years-old patient described above with bilateral iliac disease, where the implant of 2 IBD was carried out aimed at revascularizing both HA, so preventing possible sexual dysfunction.

When HA sacrifice is planned, its embolization prior to endograft deployment (instead of simple graft coverage) is usually suggested to avoid a type II endoleak from retrograde flow into the aneurysmal sac.<sup>[2, 6, 19]</sup> There is general consensus on the opportunity to place the occluder or the coils as proximal as possible, to not interfere with the collateral circulation.<sup>[18, 19]</sup> Farahmand et al. 2 reported a higher risk of symptoms in patients in whom coils are deployed into distal ramifications of the HA: this is the case of a not well conducted emboliza-

**Table 3. Peri-operative results (30 days).**

	N	%
Mortality	0	0
Aneurysm rupture	0	0
Endoleak Type I and III	0	0
Endoleak Type I	14	12
HA* preservation success	21 out of 22 attempted	95
Buttock necrosis	0	0
Buttock claudication	37	33
Ischemic colitis	0	0
Paraparesis / paraplegia	0	0
New onset impotence	0	0
*HA: Hypogastric Artery		

tion procedure, or the case of an aneurysm involving the HA, when embolization of the distal branches is the only option to prevent a retrograde endoleak.

When HA preservation is considered, several techniques have been described. Hybrid procedures with surgical bypass or transposition have been substantially abandoned in the last decade, in favour of a total endovascular approach.<sup>[3, 5, 6, 8-11, 14-16]</sup> Different off-label endoluminal techniques using commercially available devices have been proposed, among which the most relevant is the “double-barrel” intervention first described by Lobato.<sup>[13]</sup> In our series, we treated 3 patients with this procedure, with an immediate technical success in hypogastric preservation of 100% and a HA patency in the follow-up of 67% (2 out of 3). Nevertheless, considering the present availability of dedicated endografts for HA preservation, we now reserve this procedure only for patients who don't meet the anatomical requirements for an IBD.

Indeed, the introduction on the market of branched endografts, with the possibility of maintaining an antegrade flow in the HA, significantly changed the scenario in endovascular treatment of aortoiliac aneurysms. Despite the apparent higher complexity of this procedure compared to simple HA embolization, a total endovascular solution with respect of pre-existing pelvic circulation is appealing. Several reports demonstrated the feasibility of this technique, with a high success rate in terms of aneurysm exclusion and HA preservation.<sup>[2, 3, 6, 8-14]</sup> In our series, we experienced only one intraoperative failure with early hypogastric stent occlusion, accounting for a technical success of 94,1% (16 out of 17 IBD implanted). All the hypogastric stents remained patent in the follow-up, with no evidence of graft-related endoleaks.

From a technical point of view, we didn't experience any significant difference between the two IBD models we used, although our preference in the last period goes to the Gore Excluder platform, which offers a dedicated bridging covered stent to land into the HA. From

an economical perspective, the cost-effectiveness of branched devices is open to question: it has been shown that the IBD technique carries an increased operative cost compared to simple HA embolization of approximately 6.000,00 euros, and this confirms the need for careful patient selection.<sup>[20]</sup>

It is worth of notice that, with our policy of preserving at least one HA, we didn't report any severe post-operative ischemic complication (mesenteric or spinal cord infarcts, buttock necrosis). Moreover, considering the relative high median age of our patients, there were no complaints of significant sexual dysfunction compared to the preoperative status. Despite the high incidence of buttock claudication (33%) after ipsilateral HA occlusion, most of the patients spontaneously recovered in the first postoperative year, accounting for residual symptoms in less than 10% of cases. This is the main reason for which we reserve procedures aimed at maintaining HA circulation on both sides only in selected cases of relatively young patients with an active lifestyle.

## Conclusion

Considering the relative low risk of complication after unilateral HA interruption when the contralateral one is patent, simple HA embolization with stent graft extension down to the external iliac artery represents in our experience the treatment of choice in EVAR for aortoiliac aneurysms. Techniques for preserving HA flow should be reserved for cases when both hypogastric arteries need to be sacrificed (preserving on one side and embolizing on the contralateral one) or in the presence of a relatively young patient, whose lifestyle could be severely impaired by buttock claudication or sexual dysfunction: in such a patient, in case of bilateral iliac aneurysmal disease, the implant of an IBD on both sides may be worth of consideration.

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