



# Therapeutic Management of Iliac Aneurysms are Open Operation Still Indicated?

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## Abstract

**Objective:** Isolated aneurysms of the iliac artery are relatively rare (7% of all intra-abdominal aneurysms), but also pose a great therapeutic challenge in combination with aortic aneurysms. As a rule, iliac aneurysms with a size of > 3 cm are treated independently of the abdominal aortic aneurysm, in the interventional setting. In case of contraindications due to anatomical findings and patient-specific contraindications, such patients have to undergo a complex revascularization operation.

**Patients and Methodology:** For this study, between 2007 and 2017, 28 patients with complicated BAA with irrigation of the iliac arteries or with isolated iliac aneurysms in contraindications to interventional therapy underwent surgery. All patients underwent multi-detector row CT with three-dimensional (3D) reformation in 3 mm slices. In addition, peripheral blood flow was determined in all patients by measuring ABI. Primary and secondary outcome of patients was determined after 30 days, after 3 months, and then every 6 months.

**Results:** The extension of the aneurysm of the a. iliaca required in all cases the implantation of a Y-prosthesis, in 22 cases bifemoral, in 4 cases biiliac, in 2 cases with unilateral aneurysm of the a. iliaca, unilateral anastomosis iliac and 2nd anastomosis femoral. In 26 cases an internal iliac artery revascularization was performed, in 3 cases even both arteries. Iliacae internae. The interponate to the revascularizing internal iliac artery was always implanted in the opposite leg of the Y-prosthesis. In 2 cases the internal iliac artery was unilaterally ligated and the reciprocal internal iliac artery revascularized. In 4 cases, the inferior mesenteric artery was reimplanted in the left prosthesis leg, in 3 cases, with revascularization of both arteries. Iliacae internae ligated. In 21 patients this was closed. To illustrate the surgical techniques

**Conclusion:** One of the patients with a perforated aneurysm of the internal iliac artery died of urosepsis shortly after his discharge, all other patients survived the operation very well. Postoperative gluteal ischemia did not occur in any of the patients. The duplex sonographic anastomoses to internal iliac artery were inconspicuous to date. Postoperative mesenteric ischemia did not occur in patients with ligation of the internal mesenteric artery. The surgical procedure presented here, which is adapted to the anatomic conditions of each patient, represents a demanding form of therapy which, in case of contraindications to conventional therapy, represents the only possibility for the treatment of such patients.

**Keywords:** Open surgery, iliac aneurysms

## Introduction

With about 7% of intraabdominal aneurysms, isolated aneurysms of the iliac artery are a rarity [1-4]. In most cases (80%), iliac aneurysm involves the infrarenal aorta [5]. Incredibly, iliac aneurysms occur twice as often on the left side as on the right side [6]. The indication for treatment of isolated iliac aneurysms

is considered to be larger than 3 cm, although there are reports of perforation of small aneurysms [7-9]. Previously established surgical therapy of isolated iliac aneurysms is increasingly being replaced by endovascular therapy [10-12]. Especially in the first post-interventional years, interventional procedures have

advantages over open procedures, which show a mortality rate of 7-11% for elective operations and more than 50% for emergencies [13,14]. In addition, anatomical variants as well as pathological findings such as ectasia or aneurysm of the iliac artery lead to the formation of an endoleak type Ib in 15% of EVAR-treated patients with an iliac aneurysm [15,16]. To avoid this, unilateral or bilateral embolization of the internal iliac artery is recommended [17-19]. This procedure often leads to pelvic claudication, sexual disorders, circulatory disorders of the spinal cord and ischemic colitis. Newly developed stent prostheses with one side arm for the internal iliac artery and new techniques such as the sandwich technique are limited in the proximal landing zone in ectasia of the comm. iliac artery [20-24]. Intentional therapy of all types of iliac aneurysms (I-V) involves embolization of the iliac artery, in types IV and V the affected pelvic axis may even be closed, and blood flow to the extremities of the affected side is restored using a cross-over bypass [14]. The site branch methods available to reduce complications caused by occlusion of the internal iliac artery require a considerably longer period of operation, which despite the primary success can lead to occlusion of the internal iliac artery with all its consequences [21,25-32]. Often complicated isolated iliac aneurysms or large BAA with involvement of iliac arteries must be adequately treated by complicated surgical procedures. The present study describes the surgical deficiency of such patients using several examples.

## Material and Methods

### Patients

Between 2007 and 2017, 28 patients with complicated BAA with irrigation of the iliac arteries or with isolated iliac aneurysms in contraindications to interventional therapy underwent surgery. Patient data are shown in Table 1.

**Table 1:** Characterization of the study cohort.

Iliac Aneurysm (n=28)		
	male	female
	(73.15 years)	(82 years)
Age	27	1
Comorbidities		
Nicotin, active	12 (44.4 %)	0
Ex-nicotin	1 (0.03 %)	0
Hypertension	25 (92.5%)	1 (100%)
Diabetes	9 (33.3%)	0
Hyperlipoproteinaemia	7 (25.9%)	0
Hyperuricaemia	3 (11.1%)	0
CHD	14 (51.8%)	1 (100%)
Carcinoma	1 (0.03%)	0
Renal insufficiency	5 (18.5%)	
	0	
COPD, emphysema	7 (25.9%)	0

### Preprocedural Imaging

All patients underwent multi-detector row CT with CT and three-dimensional (3D) reformation in 3 mm slices to accurately measure the proximal and distal length and extent of the aneurysm. In addition, peripheral blood flow was determined in all patients by measuring ABI. In patients with intermittent claudication, the walking distance without symptoms was measured on a treadmill at a speed of 3.5 km/h with a 3.5% increase.

### Followup Protocol

The primary outcomes were determined by mortality within 30 days of the operation, then after 3 months and from then on, every 6 months. All procedure-dependent and aneurysm dependent as well as minor and major pelvic ischemia were considered. Secondary outcomes were determined by checking blood flow, duplex sonographic imaging of the anastomoses, treadmill examination and in rare cases with unclear findings by CT angiography.

### Surgical Indications

The indication for surgery was given for combined BAA with an iliac aneurysm for fusiform aneurysms with a size > 5 cm, or a growth tendency of 1 cm/year, for a saccular aneurysm independent of the size or for combined BAA and iliac aneurysm for smaller BAA < 5 cm, for an aneurysm size of the A. iliaca > 3cm. The isolated iliac aneurysms were only operated on if the size of the aneurysm was > 3 cm or in case of complications. The indication for conventional elimination of the aneurysms was only given after exclusion of the interventional therapy in an interdisciplinary conference. The exclusion criteria for the interventional elimination of the aneurysms were: lack of possibility for proximal placement of the stent type III and IV according to Sakamoto et al. [14], unilateral closure of the A iliaca interna, bilateral aneurysms of the internal iliac artery with involvement of the internal iliac artery or bilateral aneurysms of the internal iliac artery, severe renal insufficiency with a GFR of less than 30 ml/, and KM allergy.

### Results

There were 9 patients with isolated iliac aneurysms, 2 patients with a perforated Re-BAA combined with an iliac aneurysm after application of a Y-prosthesis, one patient with a perforated Re-BAA combined with an iliac aneurysm after EVAR, and 16 patients with a combined BAA and iliac aneurysms. In 3 of these 16 patients there was a surgical indication even without an iliac aneurysm with a BAA size >5 cm (Table 2).

### Operating techniques

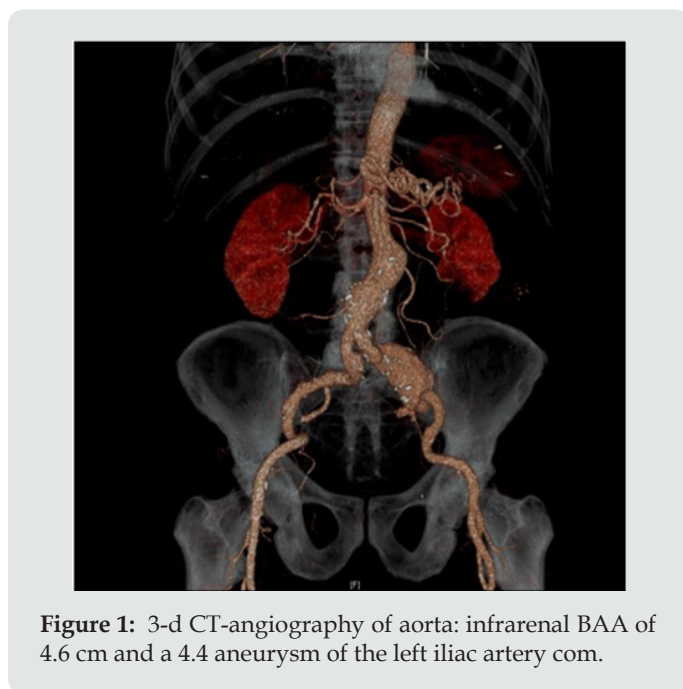
As shown in Table 2, the extension of the aneurysm of the a. iliaca required in all cases the implantation of a Y-prosthesis, in 22 cases bifemoral, in 4 cases biiliac, in 2 cases with unilateral aneurysm of the a. iliaca, unilateral anastomosis iliac and 2nd anastomosis femoral. In 26 cases an internal iliac artery revascularization was

performed, in 3 cases even both arteries. Iliacae internae. The interponent to the revascularizing internal iliac artery was always implant2ed in the opposite leg of the Y-prosthesis. In 2 cases the internal iliac artery was unilaterally ligated and the reciprocal internal iliac artery revascularized. In 4 cases, the inferior mestic artery was reimplemented in the left prosthesis leg, in 3 cases, with revascularization of both arteries. Iliacae internae ligated. In 21 patients this was closed. To illustrate the surgical techniques, 3 cases are presented as examples.

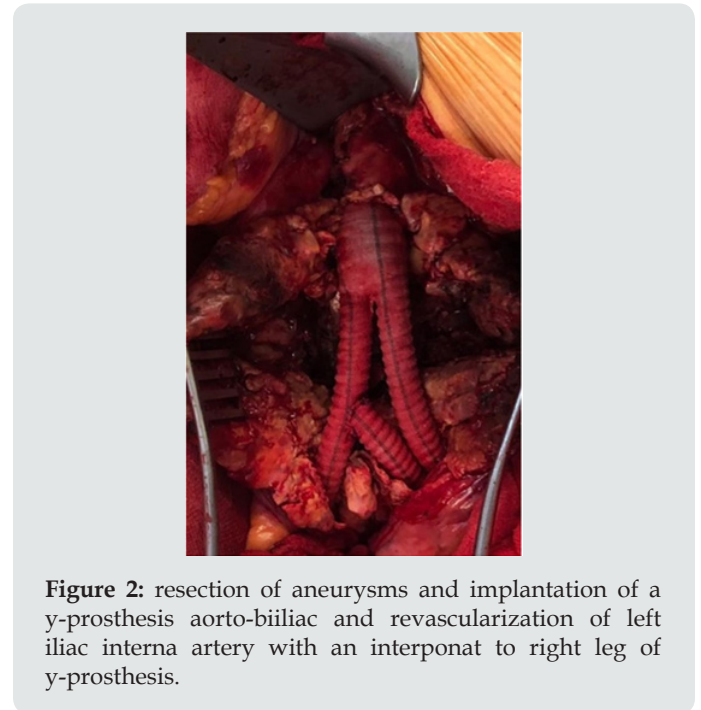
**Table 2:** Aneurysm formation.

Iliac Aneurysm (n=28)	
Isolated aneurysms of iliac artery(n=9)	n=9
Typ I	3
Typ II	2
Typ III	3
Typ IV	1
Combined AAA and IAA	n=19
Typ VAAA and IAA after Aortenreconstruction (Open and EVAR)	3
Combined AAA and IAA	16

**Case 1:**74-year-old patient with a randomly determined infrarenal BAA of 4.6 cm and a 4.4 aneurysm of the iliac artery comm. An interventional elimination of the aneurysm was not possible due to the extension of the aneurysm of the iliac artery comm. The aneurysms were resected, and a Y-prosthesis was implanted, on the right side to the A. iliaca comm. shortly before the iliac bifurcation and on the left side to the A iliacaexterna. The left internal iliac artery was revascularized by an interponate to the right leg of the Y- prosthesis (Figures 1 & 2):

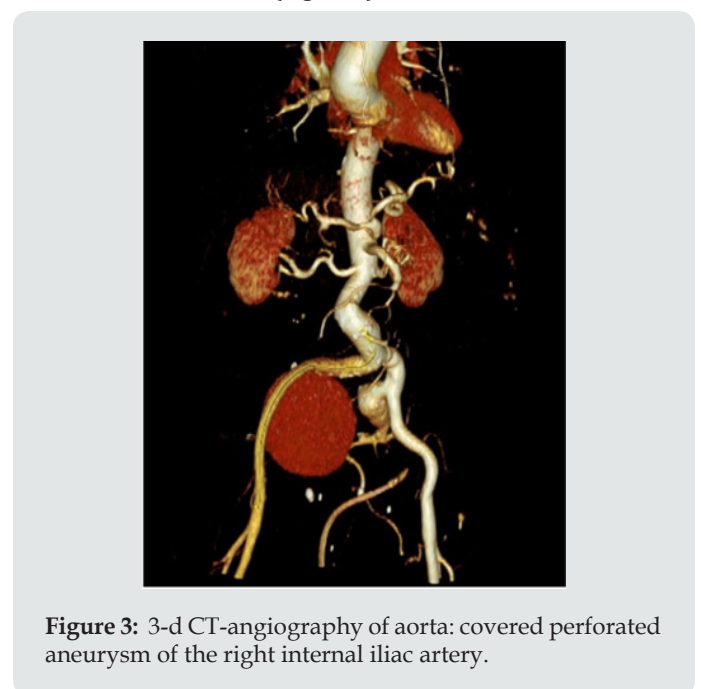


**Figure 1:** 3-d CT-angiography of aorta: infrarenal BAA of 4.6 cm and a 4.4 aneurysm of the left iliac artery com.



**Figure 2:** resection of aneurysms and implantation of a y-prosthesis aorto-biiliac and revascularization of left iliac interna artery with an interponat to right leg of y-prosthesis.

**Case 2:** The 83-year-old patient was admitted emergency under the clinical picture of hypovolemic shock with severe abdominal pain. The immediately performed CT angiography of the aorta with KM in 3 mm slices showed a covered perforated aneurysm of the right internal iliac artery. He underwent emergency surgery. The perforated aneurysm of the internal iliac artery was uncovered, and all vessels were ligated after the aorta and the left iliac artery were disconnected. The segment of the common iliac artery with the exit of the internal iliac artery was resected and the common iliac artery anastomosed end-to-end (Figure 3).



**Figure 3:** 3-d CT-angiography of aorta: covered perforated aneurysm of the right internal iliac artery.

**Case 3:** In the 82-year-old patient, in addition to a considerable elongation of the aorta, an aneurysm of the right common iliac artery and the left internal iliac artery had been known for some time. During a urological follow-up examination, the aneurysm of the right common iliac artery had shown a considerable size progression to 7 cm and the internal iliac artery to 4 cm. An interventional elimination of these findings was not possible due to the necessary revascularization of the right internal iliac artery. Therefore, the aneurysms were resected, and a Y-prosthesis was implanted between the aorta and the external arteries on both sides. The internal iliac artery on the left side. In addition, was revascularized by an interponat to the right prosthetic leg, and the right internal iliac artery by another interponat to the first interponent(Figures 4-7).All of these patients underwent a follow-up examination. In addition to the peripheral blood flow, the blood flow of the internal iliac artery was measured by duplex sonography. One of the patients with a perforated aneurysm of the internal iliac artery died of urosepsis shortly after his discharge, all other patients survived the operation very well. Postoperative gluteal ischemia did not occur in any of the patients. The duplex sonographic anastomoses to internal iliac artery were inconspicuous to date. Postoperative mesenteric ischemia did not occur in patients with ligation of the internalmesenteric artery.



**Figure 4:** 3-d CT-angiography of aorta: a 7 cm aneurysm of the right common iliac artery.



**Figure 5:** 3-d CT-angiography of aorta: a 4 cm aneurysm of the left interna iliac artery.



**Figure 6:** 3-d CT-angiography of aorta considerable elongation of the aorta, a 7 cm aneurysm of the right common iliac artery and 4 cm aneurysm of left internal iliac artery.



**Figure 7:** Intraoperative situs: implantation of a y-prosthesis was implanted between the aorta and the external arteries on both sides, revascularization of the left interna iliac artery by an interponat to the right prosthetic leg, and revascularization of the right internal iliac artery by an another interponat to the first interponent.

## Discussion

The more than 80% of cases of iliac aneurysms associated with BAA or occurring in isolation are still a major therapeutic challenge,

not only because of the considerable risk of perforation and the associated mortality and morbidity [33-35]. Even for electively treated patients with aneurysms larger than 5 cm, mortality, and morbidity rates of 11-13% are reported [36,37]. The current treatment concepts for isolated and combined iliac aneurysms are covered in current guidelines for the treatment of BAA, so that the consensus on the explicit indication size for iliac aneurysms was derived from observation cases of perforated iliac aneurysms. Accordingly, an aneurysm size of >3 cm is considered to be the intervention size [38,39]. The indication for surgical therapy in case of contraindications to interventional therapy is given in case of a size of 3 cm, a growth tendency > 5 mm/year and the occurrence of symptoms and complications [39-42]. Different factors such as the aneurysm morphology (size, shape, uni- or bilateral), wall pathologies of the aneurysm sac (thrombi, calcification), the existence of a landing zone (length, diameter), the perfusion conditions of the aneurysm, iliac interna and the anatomy of the pelvic arteries (vessel diameter, angulation, elongation, kinking, tortuosity) and their wall pathologies (calcification and thrombus load) are taken into account in the considerations of technical realization, the choice of materials and the planning of the procedure[43].

Due to high morbidity and mortality rates, endovascular procedures are preferred, although open and interventional therapy procedures do not differ from each other over the long term in terms of mortality, openness, and complication rates. Only in terms of 30-day mortality, inpatient length of stay and transfusion frequency is there an advantage in favour of endovascular procedures[44-47]. The maintenance of perfusion of the internal iliac artery is ensured by the sandwich and iliac sidebranch technique, particularly in the frequent type I and III aneurysms according to Pfabe et al. [48-55]. Together with the procedures described above, the bell-bottom technique is also expected to reduce the risk of serious complications of a perfusion failure of the internal iliac artery such as gluteal necrosis, impotence, ischemic colitis, ileus and sepsis[56-59]. The lack of a proximal anchorage of the prosthesis, distal torsion of the internal iliac artery and accompanying stenoses lead to significantly longer operating times, radiation exposure, leading to early closure of the branch, thus the induction of pelvic ischemia[27]. Thus, the very demanding surgical procedure represents an alternative method of treating these patients. As we were able to show with 3 examples, a reconstruction procedure was developed for each patient individually according to the anatomic conditions and pathological findings, which, in addition to the anatomic reconstruction of the pelvic tract, ensures the revascularization of the internal iliac artery. In cases with clear contraindications to interventional therapy, the procedure presented here is the only therapeutic procedure. Follow-up examinations showed an acceptable postoperative result even after 10 years. None of the patients showed signs of ischemia

based on the internal iliac artery. Only the surgical technique makes high demands on the surgeon, which despite enormous progress in interventional therapy procedures is part of the repertoire of vascular surgeons.

### Conflict of Interest

I hereby declare that there were no financial or other interests in the execution and evaluation of this work.

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