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Endovascular Therapeutic Options for Isolated Iliac Aneurysms with a Working Classification

Markus Fahrni,[1] Mario M Lachat,[2] Simon Wildermuth,[1] Thomas Pfammatter[1]

[1]Department of Radiology, University Hospital of Zurich, Zurich, Switzerland
[2]Clinic of Cardiovascular Surgery, University Hospital of Zurich, Zurich, Switzerland

Abstract

The purpose of this paper is to demonstrate a variety of stent-grafting and embolization techniques and describe a new classification for endovascular treatment of isolated iliac artery aneurysms. A total of 19 patients were treated for isolated iliac aneurysms. Depending on the proximal iliac neck and the uni-/bilaterality of common iliac artery aneurysms (CIAA's) the patient may be treated by a tube (*Type Ia*) or a bifurcated stent-graft (*Type Ib*) in addition to internal iliac artery embolization. Neck anatomy is also critical in determining therapeutical options for internal iliac artery aneurysms (IIAA's). These are tube stent-grafting plus internal iliac branch embolization (*Type IIa*), coiling of afferent and efferent internal iliac vessels (*Type IIb*) and IIAA packing (*Type IIc*). The average length of stay for these procedures was 3.8 days. During the mean follow-up of 20.9 months, aneurysm size remained unchanged in all but 4 patients. Reinterventions were necessary in option *Type Ib* (3/8 pat.) and *Type Ia* (1/7 pat.) due to extender stent-graft migration (n = 2) or reperfusion leaks (n = 2). We conclude that iliac artery aneurysms may be successfully and safely treated by a tailored approach using embolization or a combination of embolization and stent-grafting. Long-term CT imaging follow-up is necessary, particularly in patients treated with bifurcated stent-grafts (*Type Ib*).

Key words: Iliac—Aneurysm—Therapy—Endovascular stent-graft—Coils—Classification

Isolated aneurysms of the iliac artery are infrequent, however the rupture risk is high. Treatment is recommended at diameters over 3.0–3.5 cm [1–3]. Because of unspecific symptoms related to their topographic anatomy in the pelvis, clinical diagnosis is often difficult. Surgery in patients with asymptomatic isolated iliac artery aneurysm can be performed with a reasonable mortality, but morbidity and mortality in patients with symptomatic or ruptured isolated iliac aneurysm remains high [1, 2].

Stent-grafting of aortoiliac aneurysms has rapidly gained acceptance as a low-operative risk procedure and therefore, is a good alternative for patients at high risk for open surgery. Accordingly, the number of patients with isolated iliac aneurysms treated by endoluminal means has expanded in recent years because of the increasing availability of a variety of commercial stent-grafts.

The aim of endovascular repair of aneurysmal arteries is the exclusion of the aneurysmal sac by a new conduit, thereby inducing perigraft thrombosis and preventing rupture. A prerequisiste for successful endograft sealing is a suitable proximal and distal stent anchoring zone (aneurysm neck). CIAA's may have a proximal neck but almost always extend to the iliac bifurcation. Therefore, the endografts are distally anchored in the external iliac artery after ipsilateral IIA embolization to prevent retrograde flow into the aneurysm [7, 8]. When there is aneurysmal disease of the IIA, a tailored approach using embolization techniques or a combination of embolization techniques and stent-grafting is necessary.

Here we demonstrate a variety of endovascular therapeutic options for IIAs using stent-grafting, embolization techniques, or both. Furthermore, attempts were made to correlate certain anatomic features with the chosen method of endovascular treatment to elaborate a working classification for endovascular treatment of isolated iliac artery aneurysms.

Materials and Methods

From November 1996 to June 2002, 19 patients underwent endovascular treatment of isolated iliac aneurysms at our institution. Obviously, the coexistence of an abdominal aortic aneurysm was an exclusion criterion. Standard open surgery was considered at high risk in all patients because of comorbid medical conditions, therefore interventional radiological approaches were favored. The cohort of patients consisted of 17 men and 2 women, mean age 71 years and 6 months, range 57–85 years.

Correspondence to: T. Pfammatter; *email:* pfammatter@dmr.usz.ch

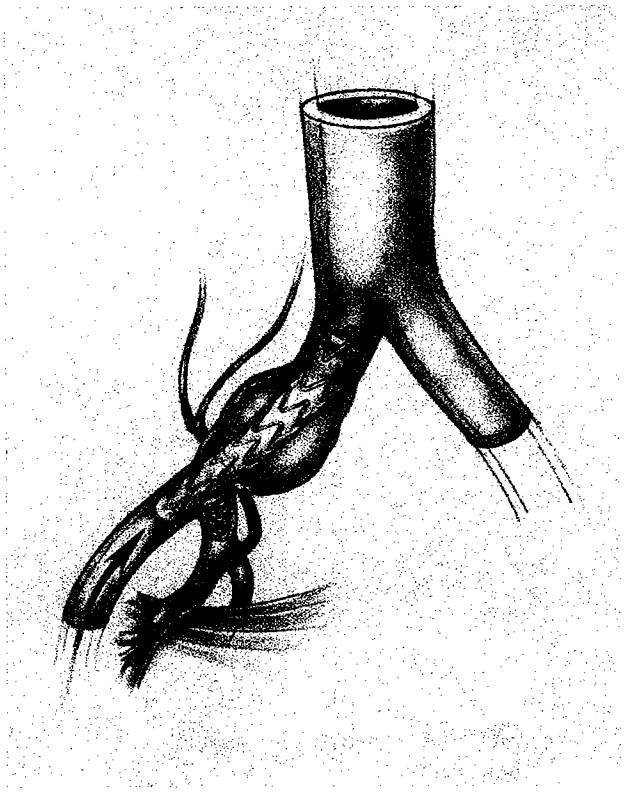

Figure 1. Common iliac artery aneurysm with proximal neck assuring proximal stent-graft fixation and sealing *(Type Ia)*. The ipsilateral internal iliac artery is proximally embolized to avoid cross-filling by pelvic collaterals.

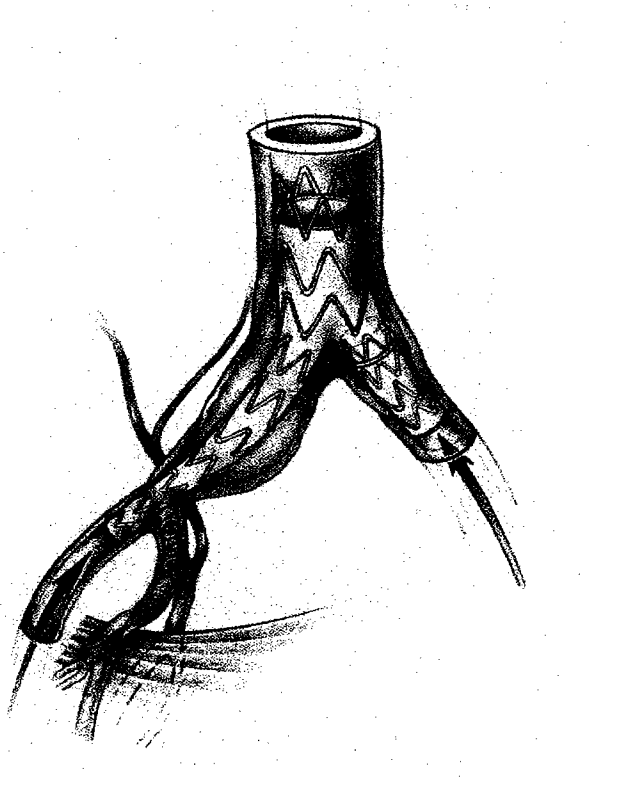

Figure 2. Common iliac artery aneurysm without a suitable proximal neck treated by a bifurcated aorto-iliac stent graft after ipsilateral internal iliac artery embolization *(Type Ib)*.

In all but 4 of our 19 patients the diagnosis of IAA was made incidentally by CT or ultrasonography. The four exceptions were the patients, who had a symptomatic aneurysm. Two of these four aneurysms had acutely ruptured, but were hemodinamically stable at the time of the procedure. The third aneurysm ruptured months before and developed an iliaco-caval arteriovenous fistula leading to a high-output failure. The fourth of these symptomatic aneurysms presented with an obstruction of the left ureter.

Preoperative, intraoperative and postoperative radiological data were reviewed retrospectively to study the population with CIAA's and/or IIAA's who underwent endovascular treatment. In addition to preinterventional computed tomographic angiography (CTA) all patients had pre- or periinterventional, as well as complete documented calibrated catheter digital subtraction angiographies. Imaging followup was in most cases done with 4 channel multidetector-row computed tomographic angiography (MD-CTA) exams. In our follow-up control protocol the patients are routinely scheduled after 1, 3, 6 months and then annually after the vascular intervention. For measurement of the postoperative aneurysm diameter the latest examination was used. The mean follow-up period was 20.9 months with a range from 1 month to 5 years and 7 months. Clinical follow-up data were drawn from medical records including discharge summaries and outpatient reports.

The mean preoperative diameter of the common iliac artery aneurysms (CIAA's) (n = 15) was 5.1 cm (range 3.3–8.0). The mean preoperative diameter of the IIAA's (n = 4) was 4.5 cm (range 3.1–6.1).

Five different interventional techniques were applied to achieve exclusion of the isolated iliac aneurysms. There were two options for the treatment of the CIAA's, categorized as Types Ia and Ib. The presence of proximal iliac neck and whether the aneurysm was uni- or bilateral determined the treatment by a tube (*Type Ia*) (Fig. 1) or a bifurcated stent-graft (*Type Ib*) (Fig. 2). In addition, in both these types the ipsilateral internal iliac artery was embolized to prevent a possible reperfusion of the aneurysms by an internal iliac back-flow via the pelvic collaterals. Occlusion of the IIA was accomplished with Gianturco coils by a transfemoral ipsi- or contralateral access. The coils were preferentially placed proximal to the level IIA bifurcation to preserve communication between the anterior and posterior division branches. After the observation of a late aneurysm reperfusion via the lumbar-iliolumbar artery pathway, attention was paid to deploy the coils in the IIA proximally to the iliolumbar artery origin or to embolize the iliolumbar artery itself.

To determine the therapeutical options for IIA aneurysms, again the anatomy of the aneurysm neck was critical. There were three options, categorized as *Type IIa* (Fig. 3) - no proximal neck, *Type IIb* (Fig. 4)—long proximal neck and *Type IIc* (Fig. 5)—cone-shaped proximal neck. In *Type IIb*, the IIAA was excluded by insertion of a tube stent-graft, extending from the CIA to the external iliac artery, after internal iliac artery branch embolization. In *Type IIb*, morphology coil embolization of afferent and efferent internal iliac aneurysm vessels was performed. In *Type IIc*, IIAA of

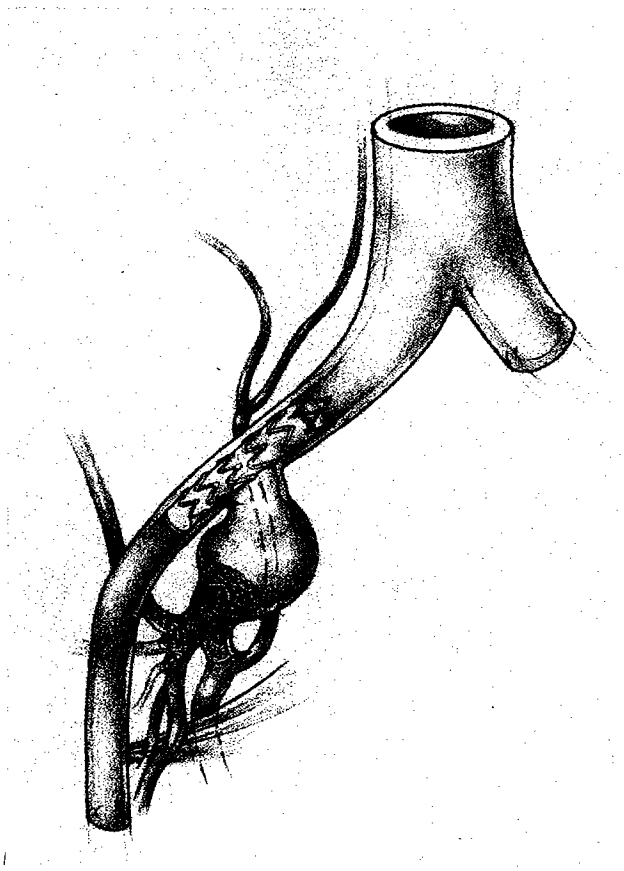

Figure 3. Internal iliac artery aneurysm with a wide mouth *(Type IIa)*. The aneurysm is treated by distal internal iliac embolization, followed by iliac stent-graft placement.

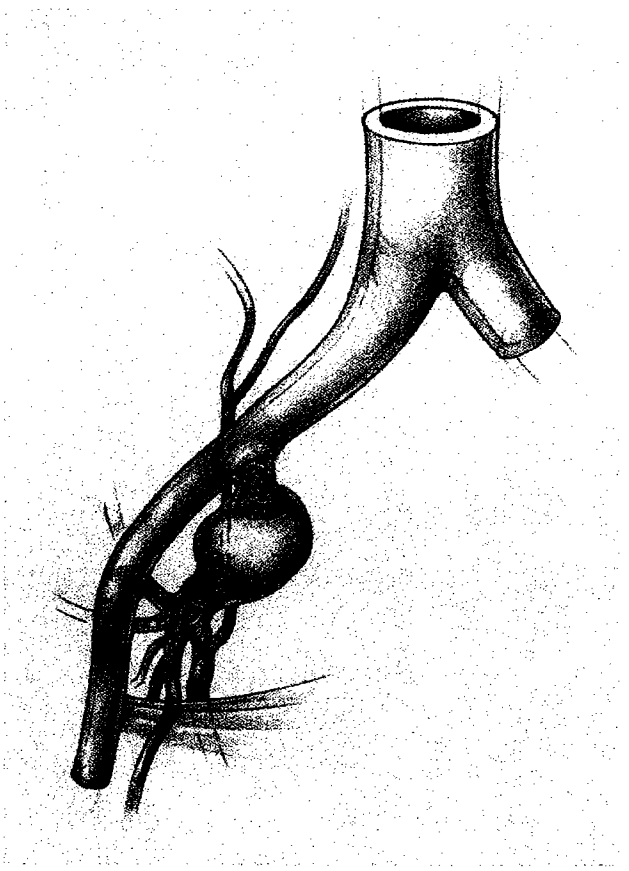

Figure 4. Internal iliac artery aneurysm with a proximal neck *(Type IIb)*. This aneurysm morphology is suited for afferent and efferent coil embolization.

the whole aneurysm was packed with embolization coils. This was the standard transluminal therapeutic approach to IIAA's before the advent of stent-grafts [9–11].

As this study relies on a retrospective data analysis, approval by the ethical committee was not requested at our institution.

Results

In our series isolated *Type Ia* and *Type Ib* CIAA's have been treated most often (*Type Ia*, n = 7; *Type Ib*, n = 8). Isolated IIAA were distributed as follows: *Type IIa*, n = 2; *Type IIb*, n = 1 and *Type IIc*, n = 1.

Overall, 9 patients underwent placement of unilateral tube stent-grafts and 8 had bifurcated aorto-iliac stent-grafts placed. Different stent-graft types have been employed: the bifurcated Vanguard II® (Boston Scientific/Meditech, Oakland, CA, USA), n = 2; the bifurcated Excluder® (W.L. Gore, Flagstaff, AZ, USA), n = 6, the contralateral iliac component of the bifurcated Excluder, n = 8 and, a custom-made tube device (Corvita®, Schneider, Bülach, Switzerland), n = 1. In 2 patients, therapy consisted uniquely of Gianturco coil embolization.

All the treatments could be done under local anesthesia, except for one patient with bilateral CIIA's, who additionally got an external-internal iliac artery bypass under general anesthesia. All prodedures involving bifurcated stent-graft placement required an arteriotomy because of the size of the introduction sheats which ranged from 18 to 22 Fr. If stent-graft insertion was planned, 5000 IU of heparin were given at the beginning of the procedure and then fully reversed with protamine sulfate at completion. Lifelong prophylactic aspirine medication was prescribed in all the patients treated with a stent-graft.

A femoral access pseudoaneurysm, treated with ultrasound-guided thrombin injection, was the only early post-interventional complication; the 30-day mortality rate was 0%. The average length of stay was 3.8 days, depending on whether arteriotomy was necessary (5 days) or not (3 days). No acute ischemic gluteal or bowel complication was observed after internal iliac interruption. There were no complaints regarding chronic buttock claudication or impaired sexual function in this small group of mostly elderly men. In

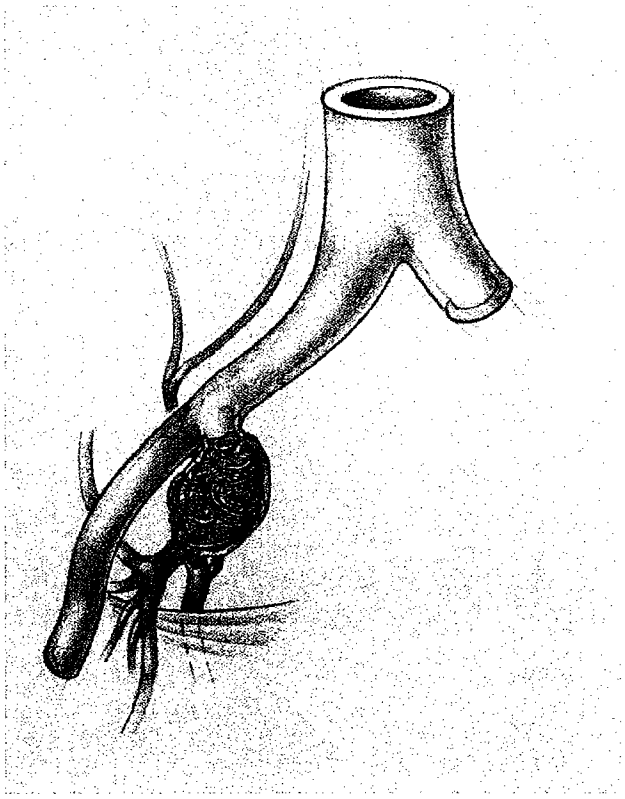

Figure 5. Internal iliac artery aneurysm without proximal neck (*Type IIc*). This anatomic variant can be treated by coil packing.

terms of material costs, the expenses of the treatments with the use of a stent graft were 4000 Euros (€) per case, while those relying only on embolization amounted to 1300 Euros (1 € = 1 $-US).

During the mean follow-up of 20.9 months, MD-CTA showed that the aneurysm size remained unchanged in all but 5 patients (5/19) i.e., 74%. The mean postoperative diameter of the CIAA's (n = 15) was 5.1 cm (range 3.3–9.5), which was unchanged compared to the preoperative diameter. The mean postoperative diameter of the IIAA's (n = 4) decreased from 4.5 cm to 3.7 cm (range 3.9–5.5). In those 4 CIAA patients with an increasing aneurysm diameter this was attributed in two cases each to the development of a reperfusion leak and to the migration and disconnection of an extender stent-graft. Three of these 4 patients had *Type Ib* aneurysms treated initially by implantation of a bifurcated stent graft and embolization of the ipsilateral IIA. The fourth patient had a *Type Ia* aneurysm, treated by implantation of a tube stent-graft and embolization of the ipsilateral IIA. All these secondary failures could be treated by transarterial emboliaztion or stent-graft interpositionning. The fifth patient with an increasing aneurysm diameter had a *Type IIc* morphology, originally addressed by coil packing. In this case no further therapy was performed because of limited life expectancy due to progression of comorbid medical conditions.

Discussion

Patients with abdominal aortic aneurysms have an involvement of the iliac arteries in 10–20% of cases [4]. Conversely, isolated aneurysms of the iliac arteries are infrequent [1]. Lawrence et al. [2] described the prevalence of iliac artery aneurysms in the United States as 3.6/100,000 persons.

Similar to abdominal aortic aneurysms, isolated iliac artery aneurysms occur more often in elderly men with a history of nicotine abuse. CIAA's and IIAA's can present uni - or bilaterally. Aneurysmal disease of the external iliac artery is much less frequent than the CIA or the IIA. Asymptomatic isolated iliac artery aneurysms are most often accidentally detected by abdominal sonography or computed tomography (CT). Occasionally, these aneurysms can cause unspecific abdominal pain as a result of their mass effect. The rupture risk is high since they are usually discovered at an advanced stage. Even if the aneurysms are symptomatic, their correct clinical diagnosis can be difficult, which might explain their high mortality rate [4]. Until the late 90's, open surgery was the primary treatment for IAA but the rate of morbidity and mortality has been increased, especially when comorbid conditions existed. The fast growing commercial availability of a variety of endovascular stent-grafts in recent years, and the patients' demand for minimally invasive alternatives are some of the factors explaining the increased use of endovascular options for iliac aneurysms [12–14].

In this series, preoperative imaging workup still included MD-CTA and digital subtraction angiography with a calibrated catheter via the ipsilateral femoral access. Having had this experience, we think DSA may be omitted for intervention planning in the future, if MD-CTA, including 3D-postprocessing tools reliably depicting the aneurysm neck and efferent artery anatomy, is available.

On the basis of these angiographic anatomic findings, the isolated iliac aneurysms were subdivided in an attempt to suggest a therapeutically relevant classification. We believe that almost all cases of isolated iliac artery aneurysms will fit into any of the five morphologic types described and therefore, can be addressed transluminally. While grossly half of the CIIAAs in our series had a proximal neck allowing safe tube stent-graft anchorage *(Type Ia),* all of them extended to the CIA-bifurcation. This means that as long as bifurcated iliac stent-grafts are not generally available, the internal iliac artery origin will be covered by the stent-graft as the device is anchored in the external iliac artery. In addition, preceding embolization of the IIA should be performed to prevent late reperfusion of the CIAA, which may be associated with late rupture [4]. To our knowledge, there is no commercially available stent-graft designed specifically for CIAA's. In our experience the contralateral iliac limb of the Excluder® (modular bifurcated abdominal aortic aneurysm device) has

proven to be advantageous for this purpose for several reasons. This stent-graft tapers from 16 mm at the proximal end to 12 or 14.5 mm at the distal end and therefore fits to most of the proximal CIAA necks and external iliac arteries. In addition, due to its flexibility it conforms well to the tortuous, elongated iliac vessels associated with CIAA's. Complete modular abdominal aortic aneurysm devices were used if a proximal CIAA neck was missing *(Type Ib)* or there were bilateral CIAA's. This approach adds device costs to the procedure and likely will result in additional morbidity due to the femoral arteriotomy. In our series these bifurcated devices were less durable than the unilateral stent-grafts due to the fact that two of the three failing bifurcated devices had been placed in our first 2 patients treated for CIAA (longest follow-up, learning curve) and that early generation devices (Vanguard II®) had been inserted in both patients. All secondary stent-graft failures could be treated percutaneously.

All our patients with CIAA's or IIAA's underwent coil embolization of the internal iliac artery, whether it was aneurysmatic or located ipsilaterally to a CIAA. It has to be kept in mind that in a significant number of patients embolization of the IIA is associated with symptoms, whether transient or problematic [15, 16]. The two most common chronic symptoms are claudication of the buttocks and sexual dysfunction. Depending on the neck anatomy we subdivided the IIAA's into three types. Iliac stent-grafting is necessary just when the aneurysm encompasses the IIA origin (no neck, *Type IIa*), which occured in 2 of our 4 IIAA cases. If there is a suitable neck, IIAA's can be excluded by transarterial embolization alone, which may be technically more challenging but will significantly reduce material costs *(Type II b,c)*. The single IIAA included in this series treated by coil packing showed persisting growth although no opacification was visible on MD-CTA. Since stent-grafts have become widely available, all the IIAA's might be better addressed by a combination of over-stent-grafting of the internal artery orifice and embolization of the internal iliac artery branches. However, no long-term data on iliac stent-grafts are available. As for abdominal aortic aneurysms long-term clinical and CT- or ultrasound follow-up seems mandatory.

To our knowledge, there is no classification for isolated iliac artery aneurysms combining anatomical characteristics and endoluminal treatment options. Nor it is surprising, that at present there is not enough data to suggest a standardized endoluminal treatment for these aneurysms. If patients are grouped according to a classification such as the one suggested, the long-term outcomes of specific treatment modalities for isolated iliac artery aneurysms might be compared and standardized in the future.

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