The Imperative of Preserving the Internal Iliac Artery: A Paradigm Shift?

A look at the various techniques and devices that have been developed to better treat internal iliac artery disease.

BY JAN BRUNKWALL, MD, PHD, FEBVS, AND SPYRIDON MYLONAS, MD, FEBVS

The presence of a common iliac artery (CIA) aneurysm might pose considerable challenges in achieving an effective seal and distal fixation for conventional endovascular aneurysm repair (EVAR). A screening program in the United Kingdom revealed that among patients with abdominal aortic aneurysms (AAAs), 16% had unilateral and 12% had bilateral CIA aneurysms ≥ 2.4 cm in diameter.[1] A further epidemiologic study of AAA patients revealed that the aortic aneurysmal disease also extended into one or both CIAs in approximately 25% of AAA patients older than 65 years; in 7% of those, the disease also involved the internal iliac arteries (IIAs).[2] Moreover, a review of patients with iliac aneurysms revealed that only 11% presented without a concomitant aortic aneurysm.[3] Despite this association with AAAs, isolated iliac artery aneurysms are rare (< 1% of aortoiliac aneurysm repairs), and their prevalence in the general population has been estimated at 0.03%.[4,5]

Because no rupture of a CIA aneurysm ≤ 3.8 cm has been reported, the threshold for elective repair of asymptomatic patients with CIA aneurysms has been generally accepted to be ≥ 3.5 cm.[6,7] A study by Santilli et al[8] and a recent survey study by Williams et al[9] suggested that it is safe to wait until the common iliac diameter is 4 cm before intervention. Moreover, a recent study on IIA aneurysms settled the threshold for intervention at 4 cm.[10] However, Buck et al[11] investigated the management trends of the isolated iliac aneurysms between 1988 and 2011 and found an increase in treatment, especially after the introduction of the endovascular approach. The most recent set of published guidelines from the European Society for Vascular Surgery on the management of aortoiliac aneurysmal disease recommends that iliac aneurysms should be repaired once the diameter is > 3 cm.[12]

Several studies have demonstrated 30-day mortality rates ranging between 1.8% to 6% for open repair and 0% to 2% for endovascular repair.[5-7,11] However, a CIA is estimated to increase in diameter by 5.7% (± 0.5%) each year in patients with AAA.[13] This aneurysmal degeneration of the distal sealing zone after EVAR and the consequent type Ib endoleak, as well as the development of a para-anastomotic aneurysm after open aortoiliac reconstruction, are further frequent phenomena that can complicate the follow-up of AAA patients and increase the risk of posttreatment rupture.[14,15] Moreover, endovascular exclusion of isolated CIA or IIA aneurysms that involve the iliac bifurcation, although rare, are associated with considerable secondary intervention rates when compared with conventional open reconstruction.[4,7,16] Therefore, several strategies have been initiated to provide a viable option for patients with complex aortoiliac aneurysmal disease.

IIA OCCLUSION

The most frequently used approach for IIA occlusion has been to extend the endograft landing zone by sacrificing the unilateral IIA and expanding the endograft into the external iliac artery (EIA).[17] Such an embolization can be performed with standard coils or occlusion plugs (Amplatzer II, Abbott Vascular, formerly St. Jude Medical). In most anatomic circumstances, this is most easily performed in an antegrade fashion from the contralateral femoral artery. If the angle between the hypogastric artery and the EIA is less acute than usual, an ipsilateral retrograde approach can be used. In either case, the key is to provide a stable delivery platform for the coils or plugs.

Although usually well tolerated, occlusion of the IIA can cause ischemic manifestations after EVAR, such as buttock claudication, sexual dysfunction, and colonic ischemia.[18-20] Using data from 18 studies on IIA embolization before EVAR, Rayt et al found that buttock claudication occurred in 55% of patients overall, with 52% occurring after unilateral embolization and 63% occurring after bilateral embolization. New erectile dysfunction occurred in 17% of the overall patient population (17% of those who underwent unilateral embolization and 24% who underwent bilateral embolizations).[21]

In addition, rare but serious complications, such as spinal cord ischemia or gluteus necrosis, may occur in up to 1% to 3% of bilateral IIA occlusion cases.[22,23] Therefore, the European Society for Vascular Surgery established the clinical practice guidelines for the management of AAAs, wherein it is recommended that bilateral interruption of the IIA, at least in standard-risk patients, should be avoided.[12]

BELL-BOTTOM TECHNIQUE

Another endovascular technique used to treat a hostile distal landing zone is the bell-bottom technique. Although relatively simple, this technique can be applied to seal an iliac artery of up to 25 mm in diameter, given that the largest diameter of stent grafts on the market for this segment is 28 mm.[24] Attention should be paid to the quality of the distal landing zone, as well as the assessment of calcification, thrombus, and the length of the distal landing zone. During long-term follow-up, the bell-bottom technique has shown increased frequency in the need for a secondary intervention, mainly due to the progression of artery dilatation and the sequential development of a type Ib endoleak.[25,26]

OFF-LABEL TREATMENT OPTIONS

Off-label combinations of various endovascular devices have been suggested for the preservation of pelvic flow in cases of complex aortoiliac aneurysmal disease.[27-33] During the early years of the endovascular era, a hybrid approach was suggested for the preservation of the pelvic flow in patients with aortoiliac aneurysms. The *reverse-U technique* includes the placement of a retrograde external iliac-to-hypogastric artery endograft, followed by contralateral hypogastric coil embolization and the implantation of an aorto-uni-iliac stent graft extending to the contralateral EIA and completion with a femorofemoral bypass, perfusing both the lower limb and the pelvis (the latter in retrograde fashion).[29]

Another option for pelvic flow preservation is to bridge the standard aortic endograft's distal limb into the IIA via a covered stent. After unilateral IIA embolization and the deployment of the aortic endograft's main body, a covered stent is deployed into the contralateral IIA via a brachial approach. The unperfused EIA is ligated to avert backflow into the aneurysm sac, and a femorofemoral crossover bypass provides flow to the contralateral limb.[34,35]

Moreover, the chimney graft concept and its modification, the sandwich technique, were developed to preserve flow to the abdominal aortic branches in aneurysms with an unfavorable proximal neck for endovascular repair. The idea of this concept is aligning two iliac extensions at the proximal landing zone in the infrarenal abdominal aorta at the same level (double barrel), whereas an endograft to the IIA that lands 1 cm more proximally (chimney) has also been applied for the treatment of bilateral CIA aneurysms.[32,36] However, the efficacy and durability of these configurations have only been described in case reports or small case studies.

ENDOVASCULAR ANEURYSM SEALING

The principal of endovascular aneurysm sealing (EVAS) has recently been used for the treatment of aortoiliac aneurysmal disease. The endobags fill and obliterate both the abdominal and CIA volume, providing positional fixation of the endograft and sealing of the aneurysm proximally, distally, and throughout its length. Distal sealing can be achieved in CIAs with lumen diameters up to 35 mm.

Krievins et al reported on 68 patients with concomitant AAAs and CIA aneurysms (33 of which were bilateral) that were treated via EVAS. Complete CIA exclusion was achieved in 40 (39.6%) patients, partial CIA exclusion occurred in 33 (32.7%), and there was no CIA treatment in 28 (27.7%) patients, whereas the flow was preserved in all IIAs. During the 5-year follow-up period (median follow-up, 24.7 months; range, 11.5–61.7 months), three patients required secondary treatment with hypogastric occlusion and graft extension to the external iliac. Thus, internal iliac flow was maintained in 98% of at-risk hypogastric arteries.[37] Moreover, Youssef et al combined EVAS with the implantation of an iliac branch device for the treatment of aortoiliac aneurysms involving the iliac bifurcation, with promising results.[38]

ILIAC SIDE BRANCH DEVICES

In the past decade, iliac side branch devices (ISBDs) have been introduced for the treatment of complex

Treatment of Aortoiliac Aneurysms: Two Case Reports

BY JOERG HECKENKAMP, MD, PHD; AYSEL CAN, MD; AND THORSTEN THEIS, MD

CASE REPORT 1

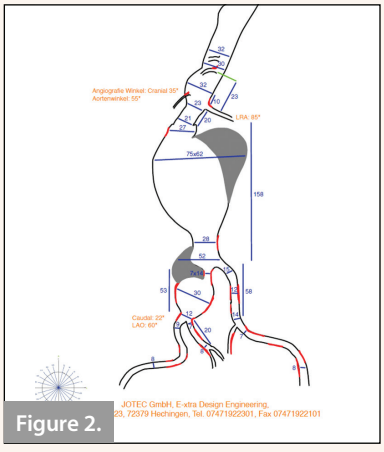
An 87-year-old man presented with an infrarenal aortic aneurysm with a maximum diameter of 68 mm and a right common iliac artery aneurysm with a maximum diameter of 32 mm. The proximal right common iliac artery was calcified and narrow (Figures 1 and 2). His comorbidities were heart insufficiency (New York Heart Association class II), atrial fibrillation, coronary heart disease, and chronic renal insufficiency of a single kidney. His cardiovascular risk factors were arterial hypertension, obesity, and hyperlipidemia. The patient was refused for open repair due to high perioperative risk (American Society of Anesthesiologists classification III–IV).

The intended treatment plan was to offer this patient an endovascular treatment of both infrarenal and iliac aneurysms in one session. Due to the complex anatomy of the iliac aneurysm, endovascular exclusion was not possible with commercially available iliac side branch devices. Therefore, the endovascular procedure was initiated with an E-tegra stent graft system (JOTEC GmbH) for the exclusion of the aortic aneurysm and an individually designed E-xtra DESIGN ENGINEERING stent graft (JOTEC GmbH) to exclude the iliac aneurysm (Figures 3 and 4).

The procedure was performed under general anesthesia. After bilateral cutdown for femoral access and cutdown for the left axillary artery access, the E-tegra main body was first implanted via the left common femoral artery using a standard endovascular technique. After cannulation of the contralateral limb over the right common femoral artery, the custom-made iliac side branch stent graft was inserted via the right inguinal access and connected with the main body over a bridging stent. The internal iliac artery was cannulated via the axillary access using a standard endovascular technique, and thereafter, a balloon-expandable E-ventus BX covered stent (JOTEC GmbH) was introduced. An additional E-ventus BX stent was also used for covering the external iliac artery. After placing the stents in position, both E-ventus BX stents were deployed at the same time using the kissing-stent technique (Figure 5).

A completion angiogram after full deployment of the stent graft showed successful exclusion of the aortic and iliac aneurysm. The access sites were closed surgically. The patient was awake after the procedure and was without complications. The follow-up CT after 1 month showed aneurysm exclusion without endoleak or aneurysm progression (Figure 6).


Figure 1.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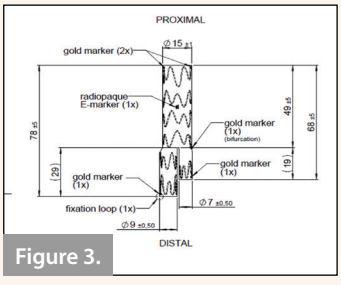

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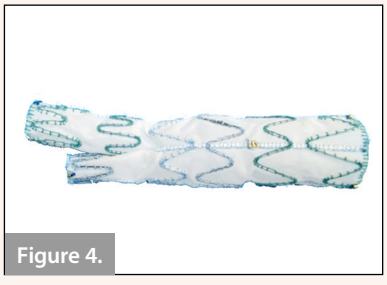
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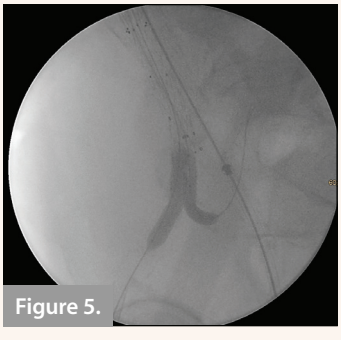
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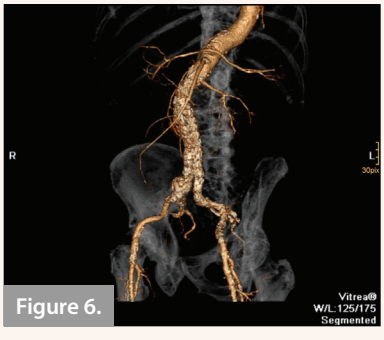
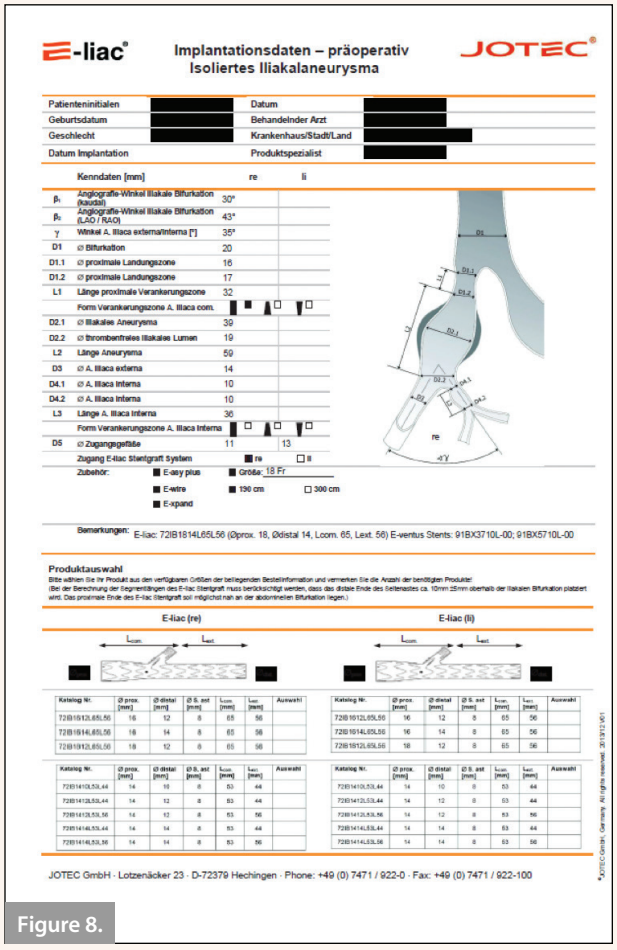


Figure 6.

CASE REPORT 2

A 76-year-old man presented with an incidental finding of an isolated common iliac artery aneurysm on his left side with a maximum diameter of 42 mm (Figure 7). His comorbidities were coronary heart disease, chronic renal insufficiency, and popliteal artery aneurysms on both sides. His cardiovascular risk factors were arterial hypertension, hyperlipidemia, and obesity. The patient was offered endovascular treatment of the right iliac artery aneurysm. Due to a good proximal sealing zone, treatment was focused on the iliac pathology. It was planned to exclude the aneurysm with an E-liac iliac side branched stent graft and internal iliac artery extension (Figure 8). The proximal sealing length was 2.5 cm.

Figure 7.


E-liac® Implantationsdaten – präoperativ Isoliertes Iliakalaneurysma JOTEC®

Patienteninitialen	[redacted]	Datum	[redacted]
Geburtsdatum	[redacted]	Behandelnder Arzt	[redacted]
Geschlecht	[redacted]	Krankenhaus/Stadt/Land	[redacted]
Datum Implantation		Produktspezialist	[redacted]

Kenndaten [mm]		re	li
β_1	Angiografie-Winkel Iliakale Bifurkation (kaudal)	30°	
β_2	Angiografie-Winkel Iliakale Bifurkation (LAO / RAO)	43°	
γ	Winkel A. iliaca externa/interna [°]	35°	
D1	Ø Bifurkation	20	
D1.1	Ø proximale Landungszone	16	
D1.2	Ø proximale Landungszone	17	
L1	Länge proximale Verankerungszone	32	
	Form Verankerungszone A. iliaca com.	■ □ □ □ □	
D2.1	Ø iliakales Aneurysma	39	
D2.2	Ø thrombenfreies iliakales Lumen	19	
L2	Länge Aneurysma	59	
D3	Ø A. iliaca externa	14	
D4.1	Ø A. iliaca interna	10	
D4.2	Ø A. iliaca interna	10	
L3	Länge A. iliaca interna	36	
	Form Verankerungszone A. iliaca interna	■ □ □ □ □	
D5	Ø Zugangsgefäße	11	13

Zugang E-liac Stentgraft System ■ re □ li

Zubehör: ■ E-sey plus ■ Größe: 18 Fr ■ E-wire ■ 130 cm □ 300 cm ■ E-xpand

Bemerkungen: E-liac: 72IB1814L65L56 (Øprox. 18, Ødistal 14, Lcom. 65, Lext. 56) E-ventus Stents: 91BX3710L-00; 91BX5710L-00

Produktauswahl

Bitte wählen Sie Ihr Produkt aus den verfügbaren Größen der beiliegenden Bestellinformation und vermerken Sie die Anzahl der benötigten Produkte! (Bei der Berechnung der Segmentlängen des E-liac Stentgraft muss berücksichtigt werden, dass das distale Ende des Seitenastes ca. 10mm (5mm oberhalb der Iliakalen Bifurkation platziert wird. Das proximale Ende des E-liac Stentgraft soll möglichst nah an der abdominellen Bifurkation liegen.)

E-liac (re) E-liac (li)

Katalog Nr.	Ø prox. [mm]	Ø distal [mm]	Ø S. ext [mm]	Lcom. [mm]	Lext. [mm]	Auswahl
72IB1812L65L56	18	12	8	65	56	
72IB1814L65L56	18	14	8	65	56	
72IB1812L65L56	18	12	8	65	56	

Katalog Nr.	Ø prox. [mm]	Ø distal [mm]	Ø S. ext [mm]	Lcom. [mm]	Lext. [mm]	Auswahl
72IB1410L53L44	14	10	8	53	44	
72IB1412L53L44	14	12	8	53	44	
72IB1412L53L56	14	12	8	53	56	
72IB1414L53L44	14	14	8	53	44	
72IB1414L53L56	14	14	8	53	56	

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Figure 8.

The procedure was performed under general anesthesia. Vascular access was performed via bilateral femoral cutdown. The E-liac stent graft was introduced via the right femoral artery up to the iliac bifurcation using a standard endovascular technique. A crossover wire to both femoral access sites was inserted according to the manufacturer's instructions for use. After correct orientation and partial deployment of the E-liac stent graft, a sheath was placed crossover from the contralateral groin access into the internal iliac artery branch of the prosthesis, and the internal iliac artery was cannulated (Figure 9A). Thereafter, a balloon-expandable covered E-ventus BX stent was placed and deployed into the internal iliac artery (Figure 9B). The next step was a complete deployment of the E-liac stent graft.

The final angiogram showed successful exclusion of the iliac artery aneurysm. The vascular access was closed by surgical suture. The patient was awake after the procedure, without complications, and discharged on day 4 after the procedure. The follow-up CT scan after 6 and 12 months (Figure 10) showed good perfusion of both branches without an endoleak or progression of the aneurysm.

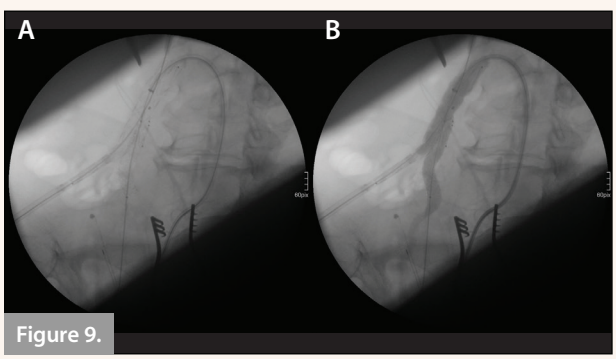

Figure 9.

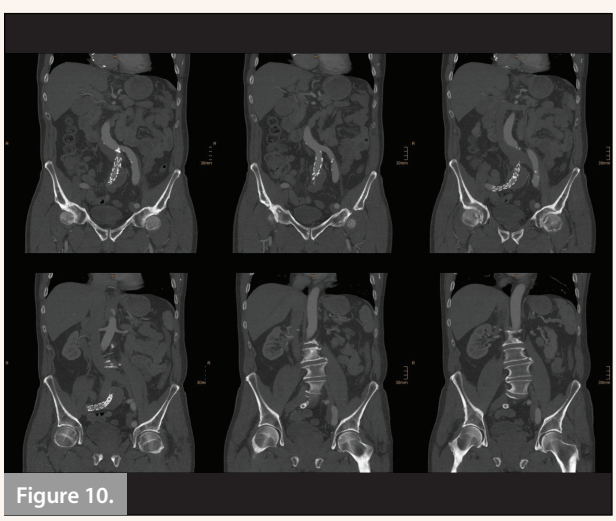
Figure 10.

aortoiliac aneurysm disease.[39-42] Currently, there are several designs that are commercially available in Europe for the treatment of aneurysms involving the iliac bifurcation. Three of these are patented by Cook Medical: a straight-branch ISBD, a helical-branch ISBD (H-ISBD), and a bifurcated ISBD (B-ISBD). A study on the H-ISBD and B-ISBD by Wong et al reported a patency rate of 82% at 5 years.[39] Furthermore, Loth et al[40] found an IIA patency rate of 81% and a freedom from endoleak rate of 76% on an intention-to-treat basis at a mean follow-up of 32 months by using the Zenith branched iliac system (S-ZBIS; Cook Medical).

An ISBD based on the Excluder platform (Gore & Associates) was recently developed. To date, only early results on the device are available. Ferrer et al[43] reported technical success and branch patency rates of 100% in a single-institution cohort of five patients. In one of the two bilateral cases, an endovascular relining with bare stents was required due to a compression of iliac legs at the level of the aortic bifurcation. A multicenter retrospective study from The Netherlands on 51 CIA aneurysms in 46 patients treated with the Excluder iliac branch system reported a technical success rate of 93.5% and a 6-month patency rate of the internal component of 94%.[44]

In 2014 the E-liac stent graft system, a novel ISBD, was CE Mark approved and launched by JOTEC GmbH. The asymmetrical spring configuration was designed to allow good conformability to the vessel shape, which minimizes the risk of kinking in angulated anatomies while maintaining appropriate longitudinal stiffness. The low-profile hydrophilic-coated 18-F delivery system is adapted for crossover maneuvers and offers excellent pushability and enhanced flexibility. Furthermore, the system also includes the well-proven Squeeze-to-Release deployment mechanism for stepwise or continuous release of the stent graft, while focusing on precise positioning and safe handling. In a multicenter retrospective study of 70 patients, the E-liac stent graft showed promising mid-term results.[42] Technical success was achieved in 100% of the revascularized IIAs. During a median follow-up period of 12 months, the rates of survival (98.5%), freedom from occlusion (92.0%), and freedom from endoleak (87.0%) were comparable with studies of other ISBDs.[39,40]

Moreover, the efficacy of the E-liac device in treating bilateral iliac aneurysms was also investigated. In 12 patients, where bilateral treatment was preformed, we found that implantation was feasible and had a 100% technical success rate. Two of these patients presented with complications during the follow-up period: an asymptomatic occlusion of the right EIA was observed 6 months postoperatively in one patient, and a type Ib endoleak was observed on a 1-month CT scan in another patient and treated by extension with covered stent in the IIA (an EIA occlusion on the same side was observed at 3-month follow-up). Similarly, Loth et al reported a complete technical success of S-ZBIS in four patients with bilateral CIA aneurysms.[40]

Another challenging issue for ISBD deployment is the presence of an IIA aneurysm, which is commonly encountered in 29% of patients with a CIA aneurysm and dilatation of the IIA.[6,45] In a study by Parlani et al of 100 patients treated with the S-ZBIS, the presence of a small or tortuous EIA or the concurrence of a large IIA with an inadequate distal sealing length (< 10 mm) were the main predictors of a negative outcome.[41] Extension of the internal iliac branch stent graft into a divisional artery, such as the superior gluteal artery, while plug/coil embolizing the other smaller branch to avoid type II endoleak has been proposed as an option to acquire an adequate distal landing zone.[46,47] In a study by Mylonas et al, this technique was successfully applied with the E-liac device in six patients.[42]

Results showing improved safety are anticipated from the postmarket registry (PLIANT clinical trial) in patients with iliac aneurysms undergoing endovascular exclusion with the E-liac stent graft. ■

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Jan Brunkwall, MD, PhD, FEBVS
Professor and Chairman
Past President, European Society for Vascular Surgery
Past President, World Federation of Vascular Societies
Department of Vascular and Endovascular Surgery
University Clinics
Cologne, Germany
Disclosures: None.

Spyridon Mylonas, MD, FEBVS
Consultant
Department of Vascular and Endovascular Surgery
University Clinics
Cologne, Germany
Disclosures: None.

CASE REPORT AUTHORS

Joerg Heckenkamp, MD, PhD
Professor and Department Head
Department of Vascular and Endovascular Surgery
Marienhospital Osnabrueck
Osnabrueck, Germany
joerg.heckenkamp@mho.de
Disclosures: None.

Aysel Can, MD
Physician
Department of Vascular and Endovascular Surgery
Marienhospital Osnabrueck
Osnabrueck, Germany
Disclosures: None.

Thorsten Theis, MD
Physician
Department of Vascular and Endovascular Surgery
Marienhospital Osnabrueck
Osnabrueck, Germany
Disclosures: None.