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CASE REPORT

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Complex management of multiple aneurysms in a patient with significant atherosclerosis and vascular comorbidities

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Abstract

This report presents the comprehensive treatment and management of a 63-year-old male patient with a history of hypertension, smoking, chronic obstructive pulmonary disease (COPD), and generalized atherosclerosis, who was admitted to hospital with chronic ischemia of the lower right limb. The patient underwent multiple vascular interventions over the course of several years, including iliofemoral bypass, aorto-biiliac prosthesis implantation, aneurysmectomy, and endovascular stent graft procedures as well as skin plastic surgery. The management involved the use of various prosthetic materials and techniques, and despite the complexity of the case, the patient experienced favorable outcomes with resolution of symptoms and aneurysms exclusion. This case emphasizes the importance of a multidisciplinary approach in treating patients with extensive vascular pathologies.

Keywords: aneurysm; stent graft; by-pass; balloon angioplasty; stent

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Introduction

Cardiovascular diseases continue to be a significant cause of morbidity and mortality worldwide [1]. Among the various vascular conditions, peripheral arteriosclerosis along with aneurysms of the abdominal aorta and peripheral arteries, stand out due to their potential life-threatening consequences [2]. Understanding the pathogenesis and treatment options for these conditions is essential for better patient treatment outcomes. The most important risk factors for these conditions are smoking, older age, diabetes, and dyslipidemia [3]. Despite the significant progress in diagnostic techniques and the development of visionary treatment methods, patients from the high-risk group, burdened with numerous comorbidities, can be a real challenge for the practicing surgeon [4]. Especially when it comes to reoperations. Modern vascular surgery gives us the opportunity to combine classical and endovascular methods, which may be a good choice in particularly complicated patients [5]. This scientific essay aims to delve into the current hybrid angiosurgical possibilities as well as to explore the methods of treatment for particular vascular abnormalities.

Case report

We present the case of a 63-year-old male tobacco smoker with a significant medical history of hypertension, COPD, and generalized atherosclerosis, with a claudication distance < 100 m who exhibited symptoms of chronic ischemia of the lower right limb. In 2008, computed tomography (CT) initial evaluation revealed occlusion of the right external iliac artery (EIA) prompting the attempt of balloon angioplasty, which proved ineffective due to severe, calcified athe-

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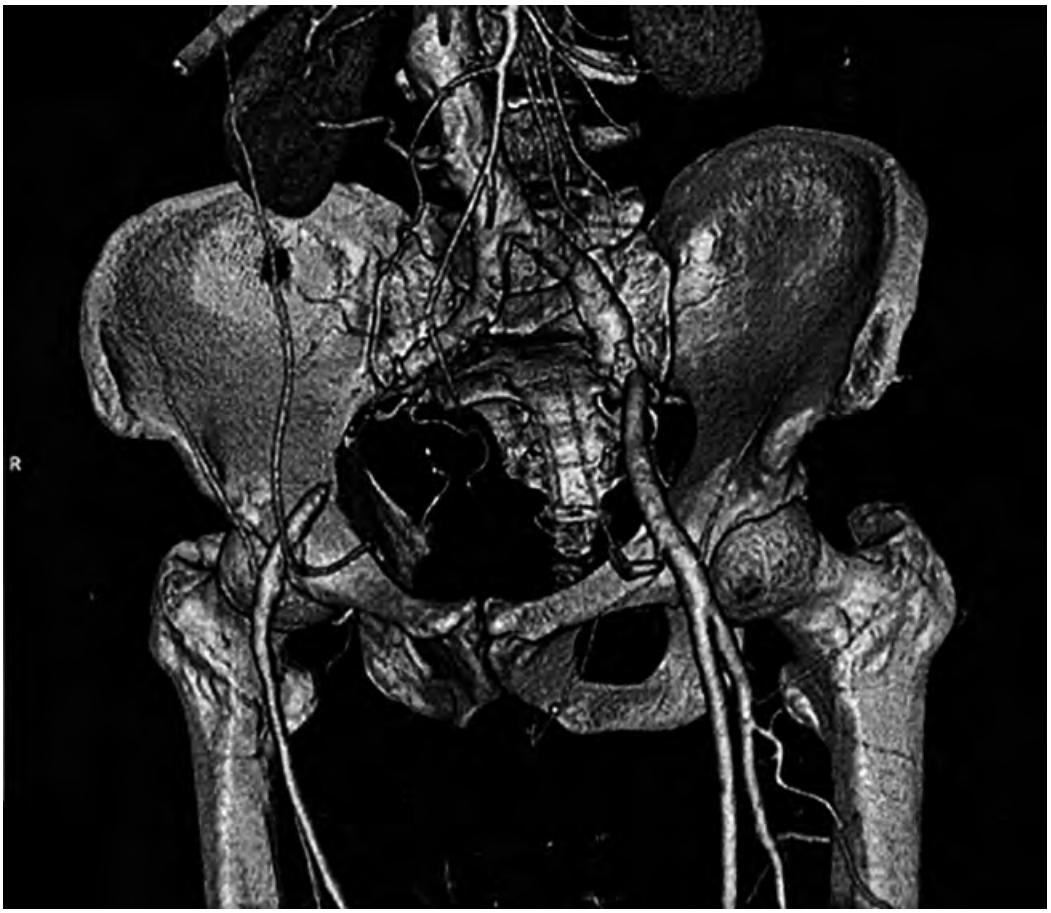

Figure 1. Occlusion of the right external iliac artery (2008)

rosclerotic lesions (Fig. 1). Consequently, a right-sided ilio-femoral bypass was performed using an 8 mm silver-plated prosthesis with end-to-side anastomosis to the common iliac artery (CIA) and common femoral artery (CFA), resulting in successful revascularization. The postoperative course was uncomplicated. Pulse palpable in the arteries of the foot was obtained. The patient was discharged home in good general condition.

For several years the patient did not appear for follow-up visits. In 2012, four years after the implantation of the iliofemoral bypass, the patient was readmitted to the department with symptoms of acute ischemia of the lower right limb and a large tumor in the right groin area. CT revealed occlusion of the previously implanted prosthesis and the presence of a clotted, large pseudoaneurysm at the distal anastomosis (Fig. 2). Urgent surgical intervention was performed involving thrombectomy of the thrombosed prosthesis, as well as pseudoaneurysm excision and the reconstruction of the distal anastomosis with an 8 mm silver-plated prosthesis insert. Thrombectomy of the femoral artery and arteries of the shin was performed, and fibrinolysis was administered to the arteries of the shin. The symptoms of ischemia subsided and the pulse present on the dorsal artery of the foot was obtained. The patient was discharged home in good general condition.

Subsequently, two years after the previous operation, the patient was admitted to the department due to pulsating tumor in the abdominal area. CT revealed a large infrarenal abdominal aortic aneurysm (AAA) with a diameter of 62 mm (Fig. 3). Classical surgery was performed, utilizing an 18 × 9 aorto-biiliac prosthesis implantation to the end of the aorta and to the sides of both CIA. Notably, on the right side, the distal anastomosis of the prosthesis was positioned approximately 2 cm above the proximal anastomosis of the previously implanted iliofemoral bypass. This procedure was successful, and the patient recovered well.

After a year, in 2015, the patient was admitted with a pulsating tumor in the right groin, indicating the presence of a 50 mm pseudoaneurysm at the distal anastomosis of the iliofemoral bypass. Aneurysm excision was performed, the orifice of the superficial femoral artery (SFA) and the deep femoral artery (DFA) were refreshed. The anastomosis was reconstructed using an

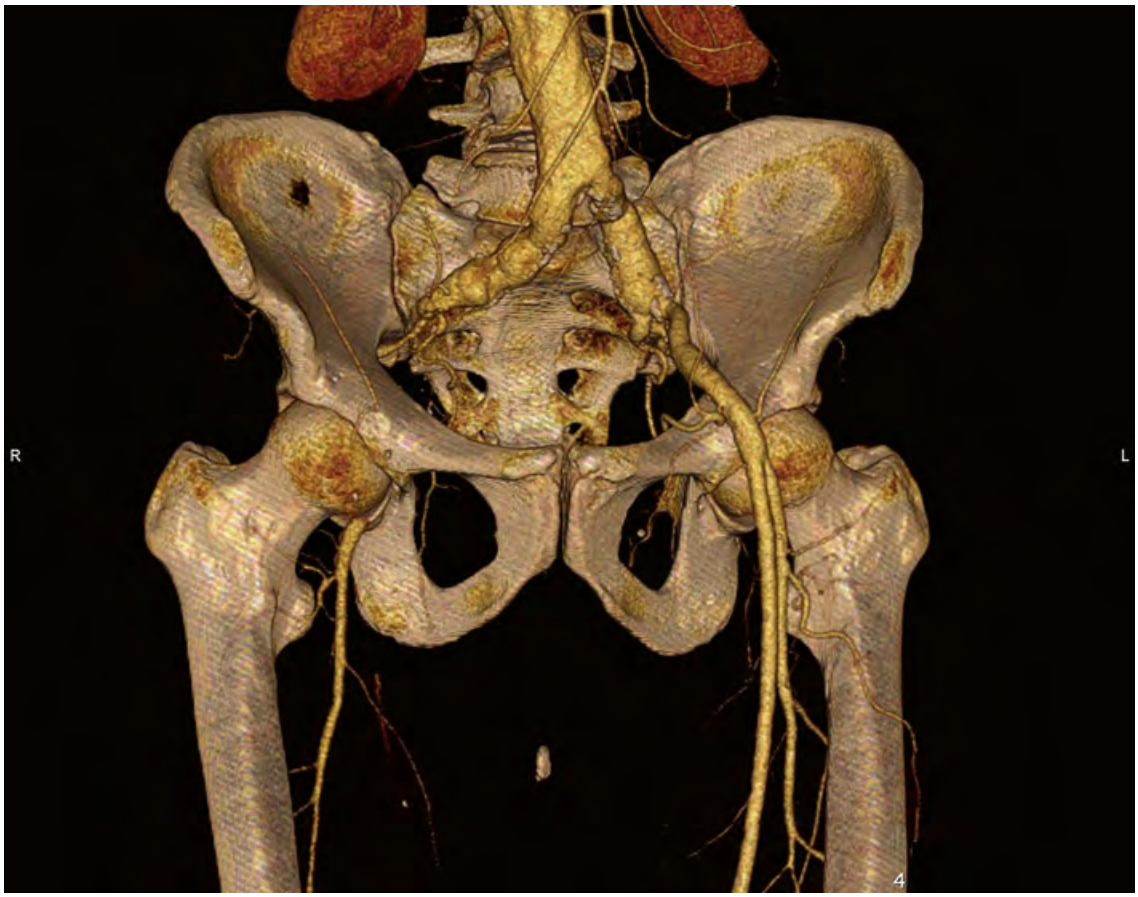

Figure 2. Occlusion of the ilio-femoral by-pass (2012)

8 mm silver-plated prosthesis. The patient experienced a smooth recovery, with a restored foot pulse.

Three years later, the patient exhibited symptoms of infection in the right groin, resulting in the revision of the distal anastomosis of the ilio-femoral prosthesis. A skin fistula with purulent drainage was found. Bacteriological cultures were performed and the result was negative. Plastic surgery of the infected skin was performed, pus was evacuated and the fistula was excised. The patient was discharged home in good general condition. However, after 5 months, the patient was readmitted to the department due to lymphorrhea from the right groin. A skin fistula was found, which was excised. After 3 months, the patient was again admitted to the department with symptoms of infection in the right groin area with the presence of a pulsating tumor. CT revealed the presence of a 45 mm pseudoaneurysm in the distal anastomosis of the iliofemoral bypass. The patient was operated on urgently. The aneurysm was excised, the orifice of the SFA and the DFA were refreshed. The previously implanted insert from the 8 mm prosthesis was removed and replaced with a polyester 10 mm prosthesis. The operation was without complications. A dorsal foot pulse was obtained. After 7 days of antibiotic therapy, the patient was discharged home in good general condition.

After 4 years, in February 2022, the patient was admitted to the department with a ruptured aneurysm in the abdominal area. CT showed the presence of a 65 × 54 mm symptomatic pseudoaneurysm of the right CIA, situated in the area between the distal anastomosis of aortoiliac by-pass and the proximal anastomosis of the iliofemoral by-pass and a 38 mm aneurysm of left CIA (Fig. 4). The patient was operated on urgently. Due to previous multiple vascular interventions, a decision was made to endovascularly manage the ruptured aneurysm. Access from the axillary artery was used for the procedure. The guidewire was passed through the aortoiliac and iliofemoral prostheses. The Fluency 12 × 80 stentgraft was implanted into the distal anastomosis of the aortoiliac by-pass and the BeGraft 10 × 57 stentgraft was implanted in the proximal anastomosis of ilio-femoral by-pass. Angiography showed the presence of a leak at the junction of the stentgrafts. A BeGraft 9 × 57 stentgraft was implanted in this area. Angiography showed no leakage and the aneurysm was

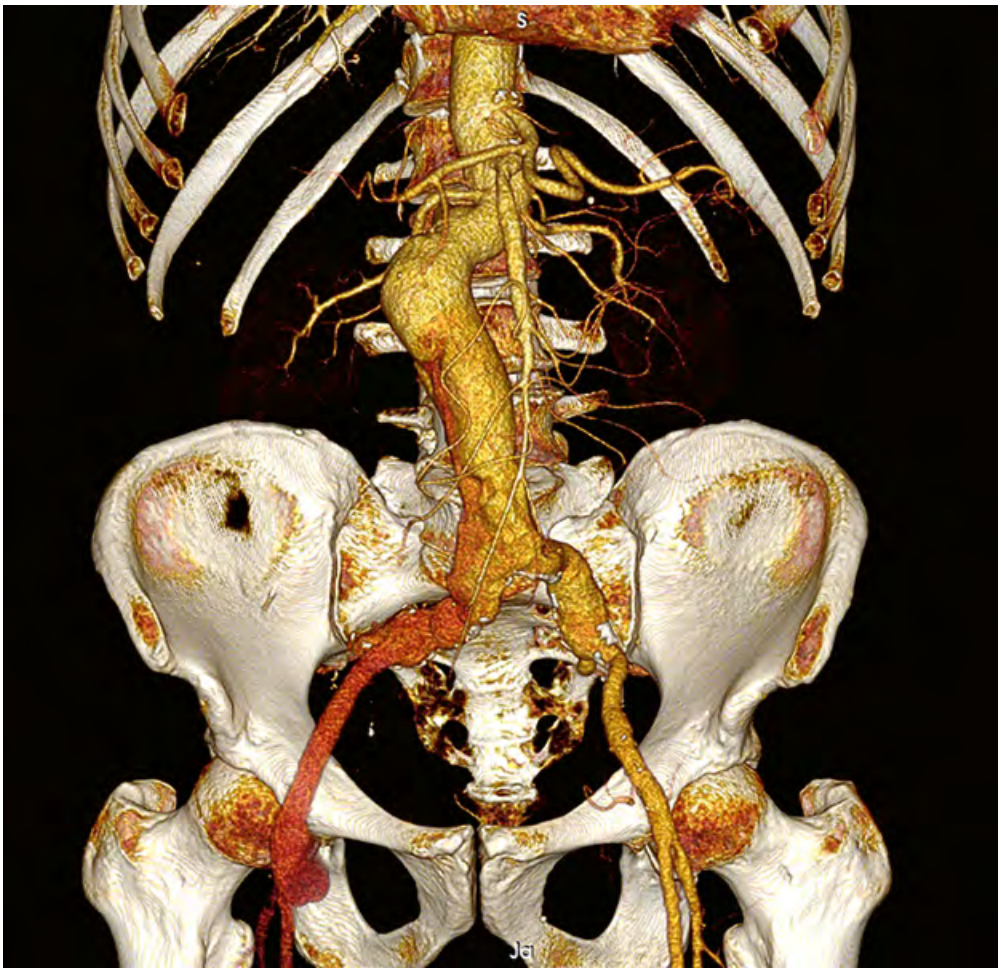

Figure 3. Abdominal aortic aneurysm (2014)

excluded from circulation (Fig. 5). Postoperative course was without complications. The patient was discharged home in good general condition.

In December, a follow-up angioCT examination was performed. Imaging revealed proper patency of previously implanted grafts and the presence of an enlarged 46 mm aneurysm of the left iliac artery (Fig. 6).

In March 2023, the patient was admitted to the clinic for endovascular treatment of the aneurysm of the left iliac artery. The patient underwent elective surgery using an iliac branch stent graft Zenith IBD. The body of the iliac branch graft was connected to the left arm of the aorto-biiliac prosthesis, 2 BeGraft stentgrafts were implanted into the left EIA and IIA. Control angiography showed no endoleak. The patient was discharged home in good general condition. The patient experienced quick recovery, with a preserved foot pulse. After 3 months a control CT examination was performed. It showed proper patency of the grafts with no endoleaks (Fig. 7).

Discussion

True aneurysms result from a weakening of the arterial wall, leading to localized dilation and ballooning of the vessel [6]. In the abdominal aorta and peripheral arteries, true aneurysms are often associated with atherosclerosis, a chronic inflammatory condition characterized by the buildup of plaque on the arterial walls [7]. The inflammation and oxidative stress within the arterial wall weaken its structural integrity, predisposing it to dilation and aneurysm formation [8]. Pseudoaneurysms differ from true aneurysms as they involve a rupture or disruption of the arterial wall, leading to the formation of a hematoma contained by the surrounding tissues [9]. Traumatic injury, iatrogenic procedures (e.g., arterial punctures, surgeries), or infections are common causes of pseudoaneurysm formation [10]. The breached arterial wall triggers an inflammatory response, and the resulting hematoma may expand, causing compression of surrounding structures or rupture if left untreated.

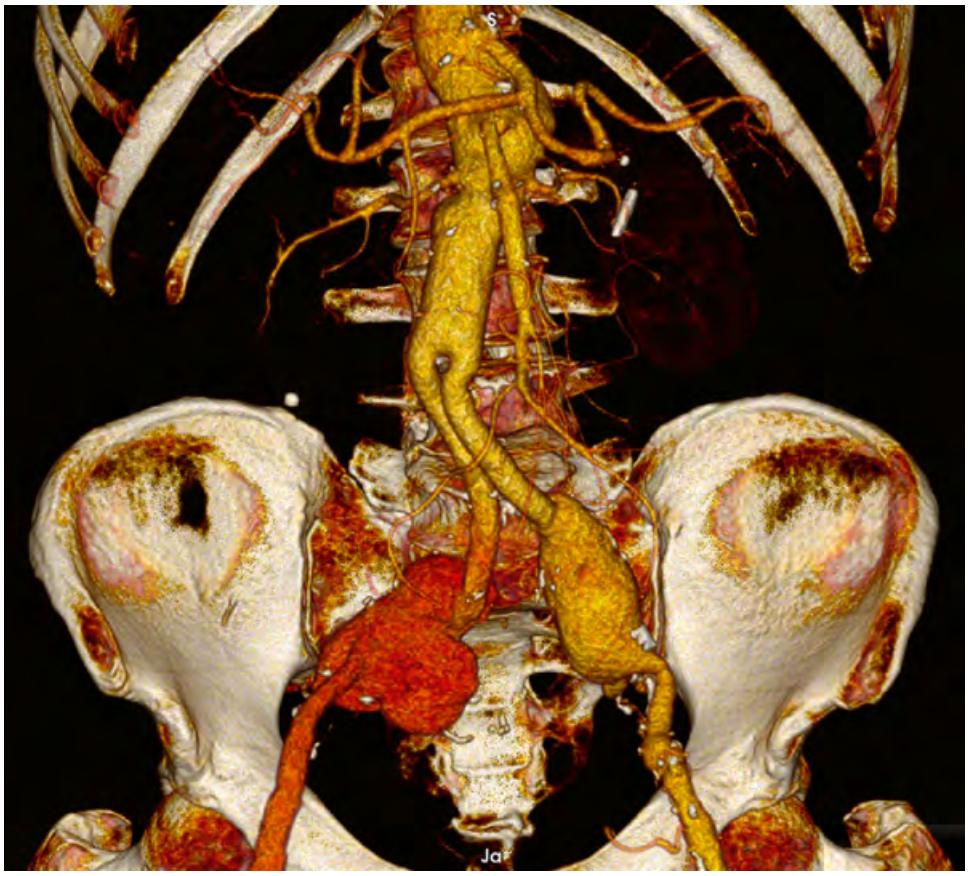

Figure 4. Raptured aneurysm of right CIA and aneurysm of left CIA (Feb. 2022)

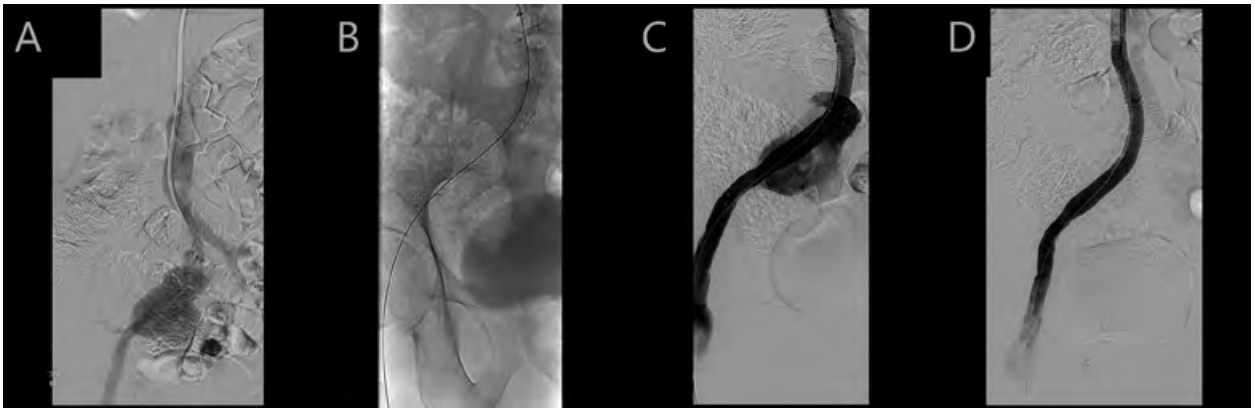

Figure 5. Raptured aneurysm management. **A.** Initial angiography. Visualization of the right arm of the aorto-biiliac prosthesis, a ruptured iliac artery aneurysm, and the iliofemoral prosthesis; **B.** Implanted fluency and BeGraft stentgrafts; **C.** Leakage at the junction of the stentgrafts; **D.** Final angiography. Exclusion of the aneurysm from the circulation (Feb. 2022)

For small asymptomatic aneurysms, close monitoring with regular imaging (ultrasound, CT, or MRI) is often sufficient [11]. However, if the aneurysm exceeds a certain size threshold or becomes symptomatic, intervention is necessary to prevent rupture. There are two main treatment options, one of them is Endovascular Aneurysm Repair (EVAR) which is a minimally invasive procedure where a stent graft is placed inside the aneurysm to exclude it from blood flow, thereby preventing rupture. EVAR offers a quicker recovery time and lower perioperative mortality [12]. The second method is open surgical repair. This involves replacing the diseased segment of the artery with a synthetic graft. Although more invasive, open

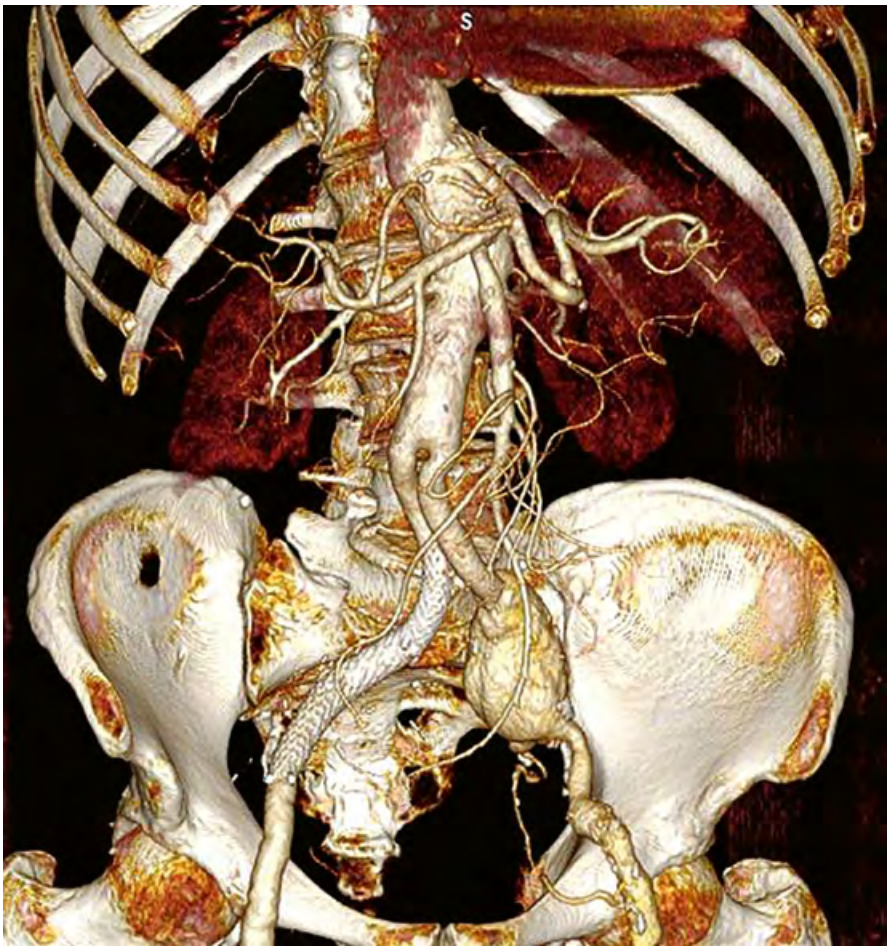

Figure 6. Enlarged aneurysm of the left iliac artery (Dec. 2022)

surgery may be the preferred option for complex or anatomically challenging cases [13].

Our case shows that patients at higher risk of cardiovascular disease are prone to relapse, especially if lifestyle modifications are not implemented [14]. The patient continued to smoke and made no dietary modifications. His physical activity was very moderate, and his food intake was high in calories and cholesterol. Multiple revascularization interventions have long been relied upon to alleviate the debilitating consequences of vascular diseases. However, despite their therapeutic intent, these interventions are not without risks, as they can give rise to various complications. Frequent tissue manipulation during repair procedures can impair the protective properties of tissues, rendering them more susceptible to infections and vasodilatation in the future [15]. Furthermore, the accumulation of substantial scar tissue and adhesions can hinder subsequent interventions, posing challenges for medical professionals in achieving favorable patient outcomes. Thus, the optimization of revascularization procedures with a focus on minimizing tissue trauma and damage is vital for ensuring better intervention results in the long term [16].

In recent times, endovascular surgery has emerged as a promising alternative to traditional open procedures, particularly when open interventions prove ineffective or insufficient. As our experience shows even when bypasses are technically sound, the site of anastomosis of the prosthesis with the blood vessel may still pose a real risk for pseudoaneurysms [17]. Pseudoaneurysms, in turn, increase the likelihood of infection and clotting of the prosthesis [18]. Moreover, it should be borne in mind that the use of vascular prostheses — artificial and exogenous materials can contribute to the deposition of atherosclerotic plaques and thrombi within them, further complicating the treatment landscape [19]. While endovascular techniques offer advantages such as reduced invasiveness and shorter recovery times, they also present unique challenges. To address the complications associated with endovascular interventions, special attention must be given to minimizing

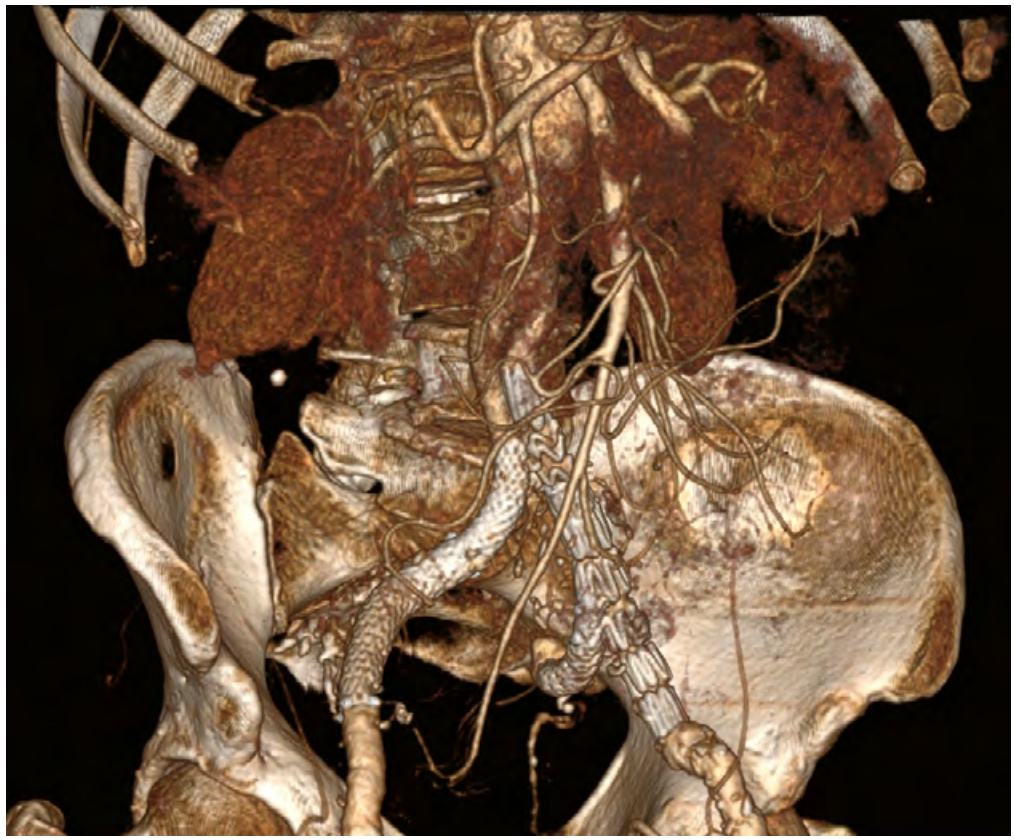

Figure 7. Follow-up CT after iliac branch (June 2023)

leakage during stent-graft aneurysm management procedures. Effective leakage reduction may promote the long-term patency of stent grafts and minimize the likelihood of an aneurysm's sack expansion [20]. Recent studies have even demonstrated that appropriate stent graft positioning and minimal leakage can lead to the strengthening and shrinkage of aneurysm walls, offering new prospects for improved treatment outcomes [21].

Despite remarkable progress in surgical and endovascular techniques, medical revascularization may not always yield complete resolution of symptoms in patients with chronic ischemia [22]. This is especially evident in cases where severe microvascular disease coexists. Despite extensive efforts to enhance perfusion through medical therapies, chronic limb ischemia remains a challenging condition to treat successfully. Experimental approaches involving the administration of angiogenic cytokines, whether as recombinant proteins or through gene therapy, as well as cell therapy, have shown promise in early studies [23]. However, these investigations often lacked sufficient control groups, highlighting the need for larger, randomized clinical trials to determine their true therapeutic potential [24]. In the context of peripheral arterial disease (PAD), patients with ischemic lower extremity symptoms, such as intermittent claudication or critical limb ischemia resulting from atherosclerosis, should be offered platelet antiaggregation with either low-dose aspirin or clopidogrel or both [25]. Moreover, a combined treatment approach involving aspirin, clopidogrel, and low-dose direct oral anticoagulant (DOAC) may be considered in symptomatic PAD patients deemed at high risk for recurrent ischemic events or in those who have undergone endovascular or open surgical interventions for PAD. However, the decision to adopt such an approach must be weighed carefully against the risk of bleeding [26].

Given the complexity of peripheral arteriosclerosis and aneurysms, a comprehensive understanding of their pathogenesis is crucial for developing optimal management and treatment strategies [27]. Over the years, advancements in endovascular techniques have provided less invasive alternatives to traditional open-surgical approaches, leading to improved patient outcomes and a higher quality of life for those affected by these vascular abnormalities. Nonetheless, early detection, preventive measures, and aggressive management remain essential in mitigating the impact of these challenging cardiovascular conditions, ensuring the best possible outcomes for patients.

Conclusions

This case highlights the challenging management of a patient with extensive atherosclerosis and vascular comorbidities, leading to multiple vascular interventions over time. Through a combination of open surgical and endovascular approaches, successful outcomes were achieved, emphasizing the importance of a multidisciplinary approach in complex vascular cases. Long-term follow-up and continued monitoring are vital to ensure the ongoing health and well-being of such patients.

Conflict of interest

None.

Founding

This research received no external funding.

Ethical issues

The study was conducted in accordance with the Declaration of Helsinki, the participant gave written informed consent.

Data availability

The data presented in this study are available on request from the corresponding author.

Statement

We confirm that neither the manuscript nor any parts of its content are currently under consideration or published in another journal. All authors have approved the manuscript and agree with its submission to Acta Angiologica.

References

1. Bulder RMA, van der Vorst JR, van Schaik J, et al. Persistent high long-term excess mortality after elective AAA repair especially in women: a large population-based study. Ann Surg. 2023; 278(5): 815–822, doi: 10.1097/SLA.0000000000006044, indexed in Pubmed: 37497631.
2. Williamson PN, Docherty PD, Yazdi SG, et al. Review of the development of hemodynamic modeling techniques to capture flow behavior in arteries affected by aneurysm, atherosclerosis, and stenting. J Biomech Eng. 2022; 144(4), doi: 10.1115/1.4053082, indexed in Pubmed: 34802061.
3. Libby P. The changing landscape of atherosclerosis. Nature. 2021; 592(7855): 524–533, doi: 10.1038/s41586-021-03392-8, indexed in Pubmed: 33883728.
4. Shovel L, Morkane C. Prehabilitation for vascular surgery patients: challenges and opportunities. Can J Cardiol. 2022; 38(5): 645–653, doi: 10.1016/j.cjca.2022.02.017, indexed in Pubmed: 35240251.
5. Huffman J, Nichols WK, Bath J. Current hybrid interventions in vascular surgery: merging past and present. Mo Med. 2021; 118(4): 381-386, indexed in Pubmed: 34373675.
6. Quintana RA, Taylor WR. Cellular mechanisms of aortic aneurysm formation. Circ Res. 2019; 124(4): 607–618, doi: 10.1161/CIRCRESAHA.118.313187, indexed in Pubmed: 30763207.
7. Trollope AF, Golledge J. Angiopoietins, abdominal aortic aneurysm and atherosclerosis. Atherosclerosis. 2011; 214(2): 237–243, doi: 10.1016/j.atherosclerosis.2010.08.051, indexed in Pubmed: 20832800.
8. Sánchez-Infantes D, Nus M, Navas-Madroñal M, et al. Oxidative stress and inflammatory markers in abdominal aortic aneurysm. Antioxidants (Basel). 2021; 10(4), doi: 10.3390/antiox10040602, indexed in Pubmed: 33919749.
9. Vogel J, Räber L, Makaloski V. Pseudoaneurysm repair with a septal occluder. vasc endovascular surg. 2022; 56(6): 628–630, doi: 10.1177/15385744221095922, indexed in Pubmed: 35466833.
10. Stolt M, Braun-Dullaeus R, Herold J. Do not underestimate the femoral pseudoaneurysm. Vasa. 2018; 47(3): 177–185, doi: 10.1024/0301-1526/a000691, indexed in Pubmed: 29439611.
11. Sharples L, Sastry P, Freeman C, et al. Aneurysm growth, survival, and quality of life in untreated thoracic aortic aneurysms: the effective treatments for thoracic aortic aneurysms study. Eur Heart J. 2022; 43(25): 2356–2369, doi: 10.1093/eurheartj/ehab784, indexed in Pubmed: 34849716.
12. Greenhalgh RM, Brown LC, Kwong GPS, et al. EVAR trial participants. Comparison of endovascular aneurysm repair with open repair in patients with abdominal aortic aneurysm (EVAR trial 1), 30-day operative mortality results: randomised controlled trial. Lancet. 2004; 364(9437): 843–848, doi: 10.1016/S0140-6736(04)16979-1, indexed in Pubmed: 15351191.
13. Green SY, Safi HJ, Coselli JS. A history of open thoracoabdominal aortic aneurysm repair: perspective from Houston. J Cardiovasc Surg (Torino). 2021; 62(3): 191–202, doi: 10.23736/S0021-9509.21.11776-8, indexed in Pubmed: 33496425.
14. Lechner K, von Schacky C, McKenzie AL, et al. Lifestyle factors and high-risk atherosclerosis: pathways and mechanisms beyond traditional risk factors. Eur J Prev Cardiol. 2020; 27(4): 394–406, doi: 10.1177/2047487319869400, indexed in Pubmed: 31408370.
15. Zhao AH, Kwok CH, Jansen SJ. How to prevent surgical site infection in vascular surgery: a review of the evidence. Ann Vasc Surg. 2022; 78: 336–361, doi: 10.1016/j.avsg.2021.06.045, indexed in Pubmed: 34543711.
16. Lutwick L, Al-Maani AS, Mehtar S, et al. Managing and preventing vascular catheter infections: A position paper of the international society for infectious diseases. Int J Infect Dis. 2019; 84: 22–29, doi: 10.1016/j.ijid.2019.04.014, indexed in Pubmed: 31005622.
17. Dallas J, Block JJ, Bastas G. Femoral artery bypass graft pseudoaneurysm rupture in a transfemoral amputee. Am J Phys Med Rehabil. 2018; 97(11): e104–e106, doi: 10.1097/PHM.0000000000000908, indexed in Pubmed: 29420314.
18. Li Ke, Beckerman WE, Luo X, et al. Graft infection after prosthetic bypass surgery for infectious femoral artery pseudoaneu-

rysm in intravenous drug users: manifestation, management, and prognosis. Ann Vasc Surg. 2021; 70: 449–458, doi: 10.1016/j.avsg.2020.06.058, indexed in Pubmed: 32634568.

19. Char S, Rudnicki P, Mackey W, et al. Ethnicity-based differences in thrombosis in lower extremity vascular bypass: a review of current literature. Int Angiol. 2022; 41(6): 533–540, doi: 10.23736/S0392-9590.22.04811-8, indexed in Pubmed: 36285528.
20. Qiao F, Su C, Han Q, et al. Hybrid reconstruction of the aortic arch using a double-branched stent-graft in a canine model. J Invest Surg. 2019; 32(6): 491–500, doi: 10.1080/08941939.2018.1436206, indexed in Pubmed: 29469632.
21. Ito E, Toya N, Fukushima S, et al. Aneurysm wall enhancement detected by contrast computed tomography scan is associated with aneurysm shrinkage after endovascular aneurysm repair for abdominal aortic aneurysm. Circ J. 2018; 82(2): 340–345, doi: 10.1253/circj.CJ-17-0786, indexed in Pubmed: 28954946.
22. Farber A, Menard M, Conte M, et al. Surgery or endovascular therapy for chronic limb-threatening ischemia. N Engl J Med. 2022; 387(25): 2305–2316, doi: 10.1056/nejmoa2207899, indexed in Pubmed: 36342173.
23. Mantsounga CS, Lee C, Neverson J, et al. Macrophage IL-1β promotes arteriogenesis by autocrine STAT3- and NF-κB-mediated transcription of pro-angiogenic VEGF-A. Cell Rep. 2022; 38(5): 110309, doi: 10.1016/j.celrep.2022.110309, indexed in Pubmed: 35108537.
24. Annex BH, Cooke JP. New directions in therapeutic angiogenesis and arteriogenesis in peripheral arterial disease. Circ Res. 2021; 128(12): 1944–1957, doi: 10.1161/CIRCRESAHA.121.318266, indexed in Pubmed: 34110899.
25. Gottsäter A. Antithrombotic treatment in lower extremity peripheral arterial disease. Front Cardiovasc Med. 2021; 8: 773214, doi: 10.3389/fcvm.2021.773214, indexed in Pubmed: 35004888.
26. Bonaca MP, Bauersachs RM, Anand SS, et al. Rivaroxaban in peripheral artery disease after revascularization. N Engl J Med. 2020; 382(21): 1994–2004, doi: 10.1056/NEJMoa2000052, indexed in Pubmed: 32222135.
27. Iłżecki M, Zubilewicz T, Terlecki P, et al. Percutaneous endovascular abdominal aortic aneurysm repair within the infrarenal region. Preliminary report. Pol Przegl Chir. 2013; 85(10): 563–568, doi: 10.2478/pjs-2013-0084, indexed in Pubmed: 24310758.