Radiology Case Reports 19 (2024) 6165–6174

Available online at www.sciencedirect.com

ScienceDirect

journal homepage: www.elsevier.com/locate/radcr

Case Report

Retrograde embolization of internal iliac artery aneurysms that enlarged after proximal ligation: A report of 5 patients ☆,☆☆

Akira Ikoma, MD, PhD, Atsufumi Kamisako, MD, Ryuta Okuhira, MD, Kodai Fukuda, MD, Shota Ueda, MD, Nobuyuki Higashino, MD, Hirotatsu Sato, MD, PhD, Hiroki Minamiguchi, MD, PhD, Tetsuo Sonomura, MD, PhD*

Department of Radiology, Wakayama Medical University, Wakayama, Japan

ARTICLE INFO

Article history:
Received 5 July 2024
Revised 31 August 2024
Accepted 3 September 2024

Keywords:
Retrograde approach
Transcatheter arterial embolization
Internal iliac artery aneurysm
Proximal ligation

ABSTRACT

The transarterial approach is generally feasible for endovascular treatment of internal iliac artery aneurysms (IIAAs). However, this approach becomes difficult in patients who have undergone exclusion surgery (proximal ligation). We report our experience of performing transcatheter arterial embolization (TAE) using a retrograde approach from the deep femoral artery (DFA) for IIAAs that had enlarged after exclusion surgery. This case series includes 5 male patients (mean age, 57 years; range, 66-81 years) who underwent TAE of IIAAs between March 2015 and March 2024. The procedures were performed at a mean of 47 months (range, 33-108 months) after aortoiliac repair. Preoperative contrast-enhanced computed tomography (CT) or CT during aortography was performed before TAE in all cases to evaluate the development of collateral pathways. TAE was performed via the DFA using a retrograde approach with coils and cyanoacrylate glue in all cases. The procedure was technically successful in all 5 patients (100%). Intra-aneurysmal packing and embolization of the branched vessel was performed in all cases. The follow-up ranged from 6 to 66 months. All patients developed gluteal claudication but no major complications occurred during the follow-up period. No cases of aneurysm dilatation have been recorded to date. In conclusion, retrograde TAE of excluded IIAAs was a feasible and effective treatment in these 5 patients, after evaluating the development of collateral pathways on pretreatment contrast-enhanced CT.

☆ Competing Interests: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

☆☆ Acknowledgments: This study was not supported by any funding.

* Corresponding author.
E-mail address: w-akira@wakayama-med.ac.jp (A. Ikoma).

https://doi.org/10.1016/j.radcr.2024.09.011

Introduction

Internal iliac artery aneurysms (IIAAs) have a high mortality rate when they rupture, and aggressive treatment is considered if the aneurysm is growing or if the aneurysm diameter is large and it is at risk of rupture [1,2]. Although surgical treatment has usually been selected, in recent years less-invasive treatments are more commonly preferred due to lower perioperative risk, and the number of reports of endovascular treatment is increasing [1,3,4]. Normally, the aneurysm is reached via a transarterial approach, but this approach is difficult in patients who have undergone exclusion surgery (proximal ligation) [5]. Here, we report 5 cases in which transcatheter arterial embolization (TAE) was performed using a retrograde approach via the collateral circulation from the deep femoral artery (DFA) for IIAAs that had grown after exclusion surgery. The characteristics of the 5 cases are summarized in the Table 1.

Case reports

Patient 1

This 66-year-old asymptomatic male patient underwent Y-graft replacement for an abdominal aortic aneurysm (AAA) and left internal iliac artery aneurysm (IIAA) exclusion 3 years and 8 months earlier. Follow-up computed tomography (CT) (Aquilion ONE GENESIS Edition; Canon Medical Systems, Otawara, Japan) showed an enlarged, left IIAA measuring 35 × 37 mm (Figs. 1A and B). The left proximal internal iliac artery (IIA) was proximally ligated, hindering an antegrade approach. Therefore, endovascular treatment using a retrograde approach via the left DFA was attempted. The left common femoral artery (CFA) was punctured at an antegrade location and a 4 Fr Brite Tip sheath (Cordis, Hialeah, FL, USA) was inserted into the left DFA. A 4 Fr catheter (tempo®; Cordis) was advanced into the median femoral circumflex artery (MFCA) (Fig. 1C). Using a triple coaxial system with a 2.9 Fr steerable microcatheter (LEONIS Mova® high flow; Sumitomo Bakelite, Tokyo, Japan), a 1.9 Fr microcatheter (Carnelian® MARVEL, Tokai Medical Products, Aichi, Japan) and a 0.014 inch microguidewire (chikai V®; Asahi Intecc, Aichi, Japan) were inserted. The 1.9 Fr microcatheter was advanced to the IIAA and the left inferior gluteal artery (IGA), which was embolized with 3 coils (target XL® 360 soft 4 mm/12 cm; Stryker Inc., Tokyo, Japan). Next, the microcatheter was advanced to the left superior gluteal artery (SGA), and the area from the SGA to the orifice of the iliolumbar artery was embolized with 6 coils (Target XL® 360 soft: four 8 mm/30 cm coils; two POD® packing coils [Penumbra, Alameda, CA, USA]: one 60 cm coil, one 45 cm coil). Subsequently, the aneurysmal sac was embolized with approximately 0.8 mL of 25% *N*-butyl-2-cyanoacrylate (NBCA) (Histoacryl®; B. Braun, Melsungen, Germany)–Lipiodol (Ultra-Fluide®; Guerbet, Roissy, France) mixture (NL) (Fig. 1D). After surgery, the patient experienced gluteal claudication, but no major complications occurred. The patient has been followed up for 3 years and 6 months, and no change has been noted in the aneurysm diameter, which measured 33 × 35 mm at the last follow-up (Fig. 1E).

Patient 2

This 70-year-old asymptomatic male patient underwent Y-graft replacement and right IIAA exclusion for AAA 3 years and 5 months earlier. Follow-up CT (Aquilion ONE GENESIS Edition; Canon Medical Systems, Otawara, Japan) revealed an enlarged, right IIAA measuring 43 × 50 mm and the presence of multiple collateral blood vessels (Figs. 2A and B) The right proximal IIA was ligated proximally, which hindered an antegrade approach. Therefore, endovascular treatment using a retrograde approach via the right DFA was attempted. The right CFA was punctured at an antegrade location and a 4 Fr Brite Tip sheath was inserted into the right DFA. A 4 Fr tempo® catheter was advanced into the MFCA (Fig. 2C). Using a triple coaxial system with a 2.9 Fr steerable microcatheter (LEONIS Mova® high flow), a 1.9 Fr microcatheter (Carnelian MARVEL) and a 0.014 inch microguidewire (chikai V®) were inserted, and the 1.9 Fr microcatheter was advanced into the excluded IIAA. Subsequently, the right SGA, IGA, and the aneurysm were embolized with a total of 15 coils (Target XL®360 soft: three 2 mm/6 cm coils, one 3 mm/9 cm coil, one 4 mm/12 cm coil, one 6 mm/20 cm coil, one 10 mm/40 cm coil; Delta fill® [CERENOVUS, Irvine, CA, USA]: three 3 mm/12 cm coils, two 6 mm/25 cm coils, one 8 mm/35 cm coil, two 10 mm/40 cm coils). After confirming blood flow from the right deep circumflex iliac artery (DCIA), a 125 cm microcatheter (Veloute®; Asahi Intecc Co., Aichi, Japan) was inserted into the right DCIA via a crossover approach from the left CFA, and embolization was performed using approximately 0.7 mL of 20% NL glue (Fig. 2D). After surgery, the patient experienced gluteal claudication, but no major complications occurred. The patient has been followed up for 5 years and 6 months, and the aneurysm diameter remained unchanged at 40 × 45 mm at the last follow-up (Fig. 2E). The patient is still under observation.

Patient 3

This 81-year-old asymptomatic male patient underwent Y-graft replacement and right IIAA exclusion for AAA 2 years and 9 months earlier. A follow-up CT (Aquilion ONE GENESIS Edition; Canon Medical Systems, Otawara, Japan) revealed an enlarged, right IIAA measuring 76 × 84 mm (Fig. 3A). The right proximal IIA was ligated proximally, which hindered an antegrade approach. Endovascular treatment was performed using a retrograde approach via the right DFA. The right CFA was punctured at an antegrade location and a 4 Fr Brite Tip sheath was inserted into the right DFA. A 4 Fr tempo® catheter was advanced into the MFCA (Fig. 3B). A 150 cm microcatheter (Veloute®) was delivered using a 0.014 inch microguidewire (chikai V®) into the right IIAA (Fig. 3C). The SGA and aneurysmal sac were embolized using 22 coils (Target XXL®360 [Stryker Inc.]: six 24 mm/50 cm coils, six 22 mm/50 cm coils, five 20 mm/50 cm coils; Deltamaxx® [Johnson & Johnson, New Brunswick, NJ, USA]: three 24 mm/60 cm coils; tornado® coils [Cook Medical, Bloomington, IN, USA]: two 2 mm/60 mm coils) (Fig. 3D). Residual blood flow was embolized

Table – Patient characteristics before and after embolization.

Case	Age (y)/sex	Previous surgery	Time between primary repair and embolization	IIAA diameter before TAE (mm)	Access	Collateral pathway	Embolic level		Embolic material	Duration of follow-up after embolization	IIAA diameter on follow-up (mm)
							Distal and proximal	Sac			
1	66/M	Open aortobiiliac graft, proximal left IIA ligation	3 y 8 mo	35 × 37	Ipsilateral CFA	MFCA	+	+	Coil, glue	3 y 6 mo	35 × 35
2	70/M	Open aortobiiliac graft, proximal right IIA ligation	3 y 5 mo	43 × 50	Ipsilateral CFA	MFCA	+	+	Coil, glue	5 y 6 mo	40 × 45
3	81/M	Open aortobiiliac graft, proximal right IIA ligation	2 y 9 mo	76 × 84	Ipsilateral CFA	MFCA	+	+	Coil, glue	6 mo	76 × 84
4	67/M	Open aortobiiliac graft, proximal right IIA ligation	9 y	40 × 40	Ipsilateral CFA	MFCA	+	+	Coil, glue	2 y	36 × 38
5	71/M	Open aortobiiliac graft, proximal right IIA ligation	8 years	44 × 45	Ipsilateral CFA	LFCA	+	+	Coil, glue	6 mo	43 × 45

CFA, common femoral artery; IIA, internal iliac artery; IIAA, internal iliac artery aneurysm; LFCA, lateral femoral circumflex artery; M, male; MFCA, median femoral circumflex artery; TAE, transcatheter arterial embolization; y, years; mo, months.

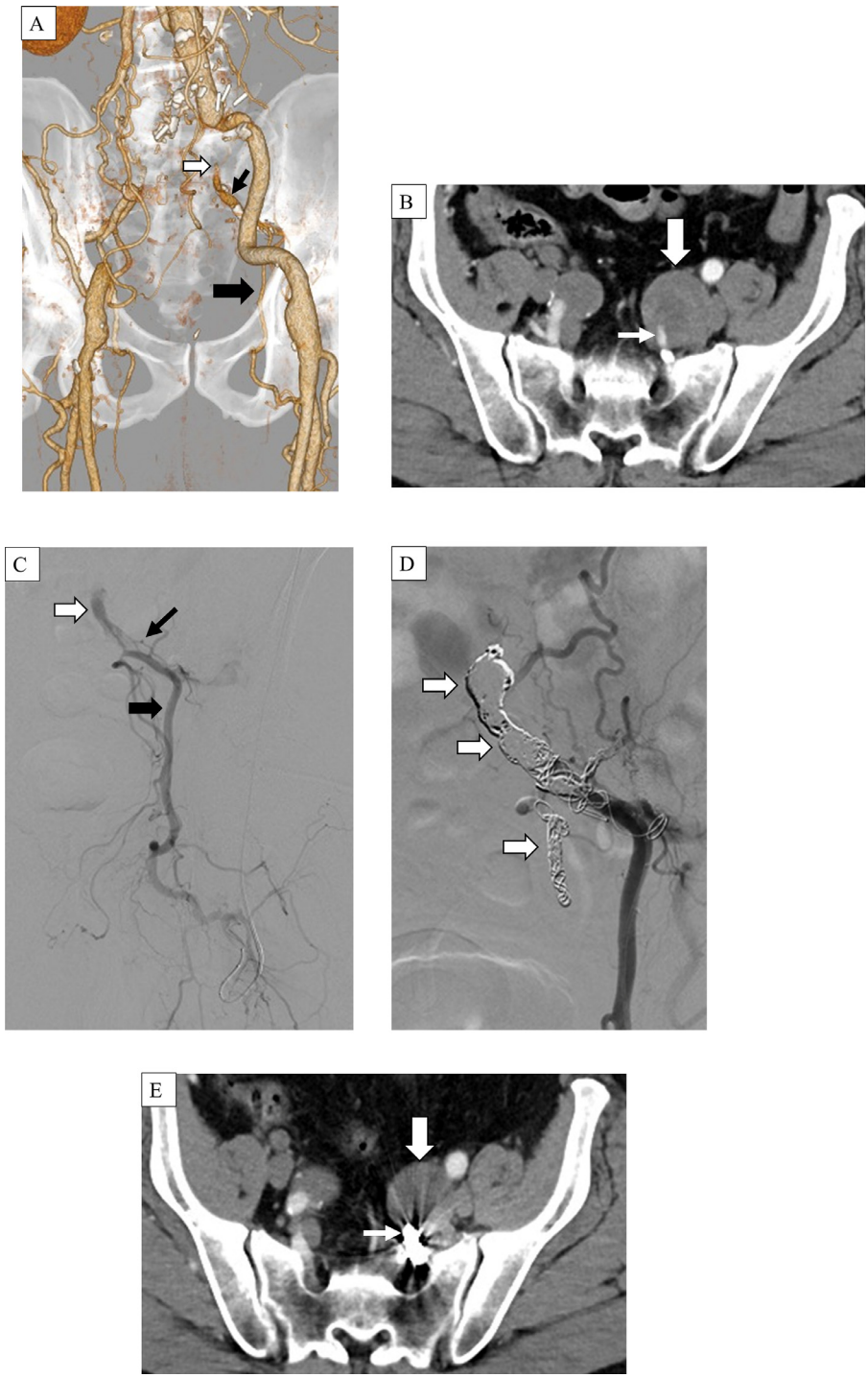

Fig. 1 – (A) Three-dimensional computed tomography (CT) shows the dilated inferior gluteal artery (IGA; thick black arrow) and superior gluteal artery (SGA; thin black arrow) continuous with the remaining blood flow of the excluded internal iliac artery aneurysm (IIAA; white arrow). (B) Contrast-enhanced CT (arterial phase) shows the excluded IIAA (thick white arrow) and the area with remaining blood flow (thin white arrow). (C) Angiography from the median femoral circumflex artery shows the dilated IGA (thick black arrow) and SGA (thin black arrow) continuous with remaining blood flow of the excluded IIAA (white arrow). (D) After coil embolization (white arrows), angiography showed no recurrence of blood flow. (E) Contrast-enhanced CT (arterial phase) performed 3 years and 6 months later confirmed that the coils (thin white arrow) were present in the area of remaining blood flow, and there was no change in the size of the aneurysm (thick white arrow).

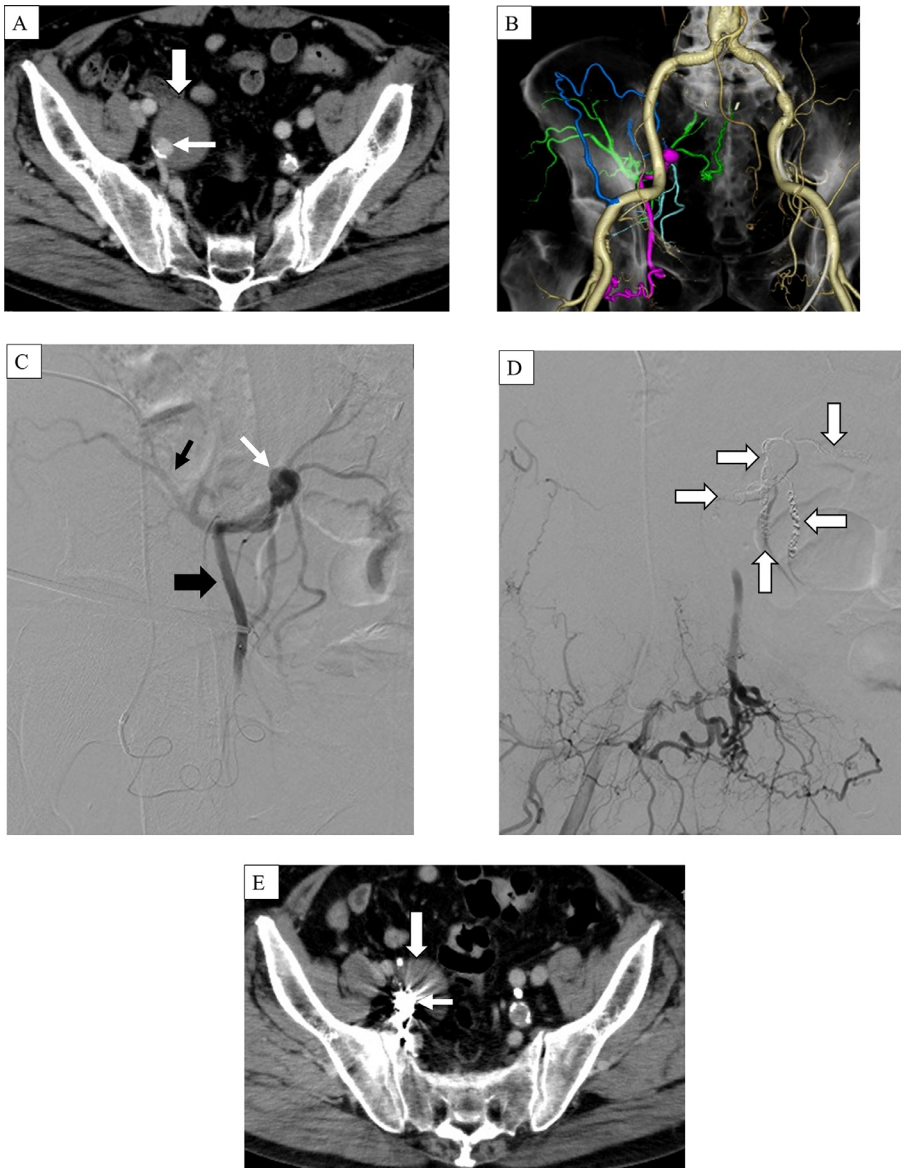

Fig. 2 – (A) Contrast-enhanced computed tomography (CT) (arterial phase) shows the excluded internal iliac artery aneurysm (IIAA; thick white arrow) and the area with remaining blood flow (thin white arrow). (B) Three-dimensional CT shows the dilated inferior gluteal artery (IGA; purple), the superior gluteal artery (SGA) and lateral sacral artery (green), the deep circumflex iliac artery to the iliolumbar artery (blue), and the internal pudendal artery (light blue) continuous with the remaining blood flow of the excluded IIAA (white arrow). (C) Angiography from the median femoral circumflex artery shows the dilated IGA (thick black arrow) and SGA (thin black arrow) continuous with the remaining blood flow of the excluded IIAA (white arrow). (D) After coil embolization (white arrows), angiography showed no recurrence of blood flow. (E) Contrast-enhanced CT (arterial phase) performed 5 years and 6 months later confirmed that the coils (thin white arrow) were present around the area of remaining blood flow, and there was no change in the size of the aneurysm (thick white arrow).

with approximately 3.0 mL of 25% NL. After surgery, the patient experienced gluteal claudication, but no major complications occurred. Six months later, the patient died of pneumonia at another hospital, but no change in the aneurysm diameter was noted (Fig. 3E).

Patient 4

This 67-year-old asymptomatic male patient underwent Y-graft replacement and right IIAA exclusion for AAA 9 years earlier. Follow-up CT (Aquilion ONE GENESIS Edition; Canon Medical Systems, Otawara, Japan) revealed an enlarged right IIAA measuring 40 × 40 mm and multiple collateral blood vessels (Figs. 4A and B). The right proximal IIA was ligated proximally, which hindered an antegrade approach. Endovascular treatment was performed using a retrograde approach via the right DFA. The right CFA was punctured in an antegrade location and a 4 Fr Brite Tip sheath was inserted into the right DFA. A 4 Fr tempo® catheter was advanced into the MFCA (Fig. 4C). A 150 cm microcatheter (Veloute®) was delivered

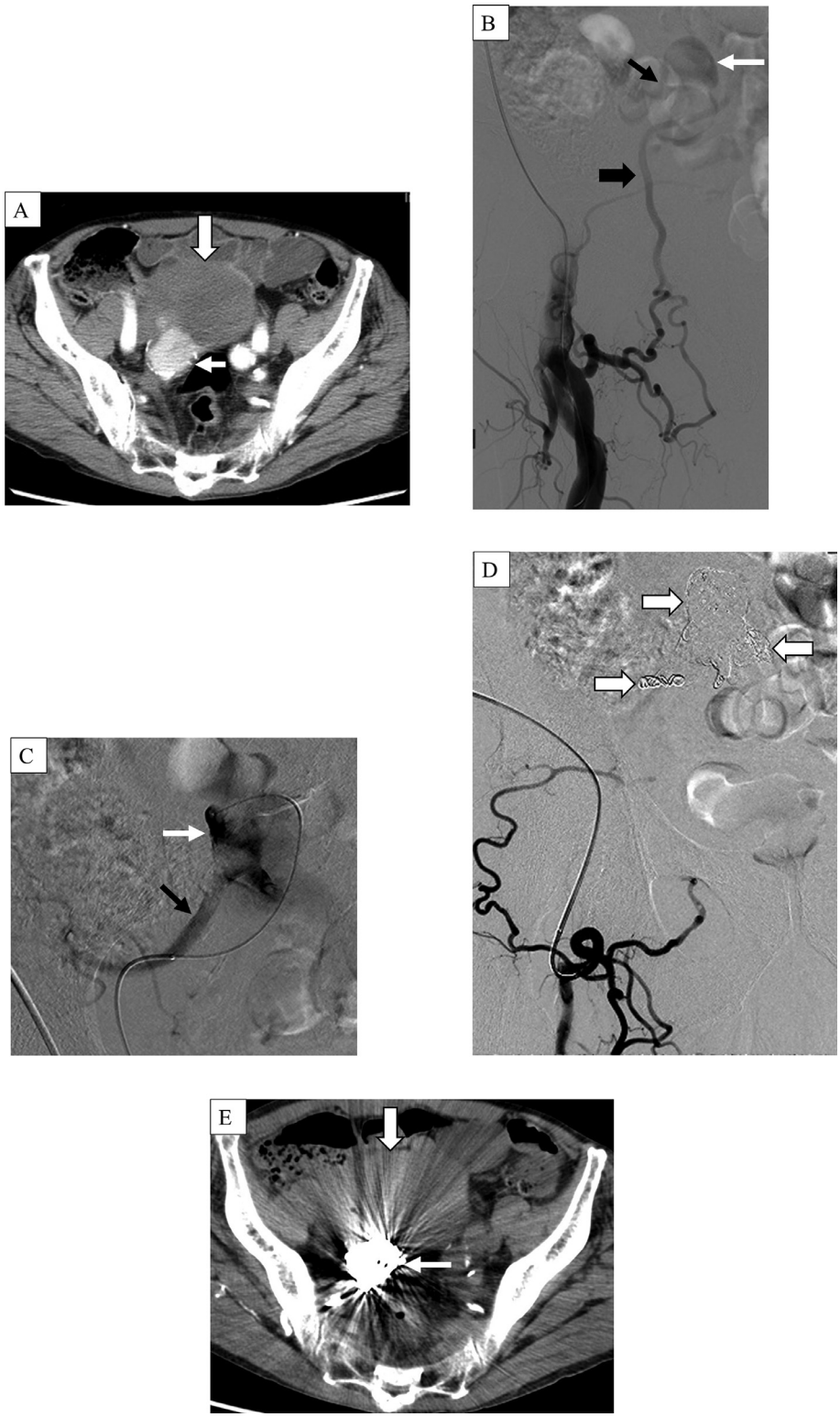

Fig. 3 – (A) Contrast-enhanced computed tomography (CT) (arterial phase) shows the excluded internal iliac artery aneurysm (thick white arrow) and the area with remaining blood flow (thin white arrow). (B) Angiography from the median femoral circumflex artery shows the dilated inferior gluteal artery (IGA; thick black arrow) and superior gluteal artery (SGA; thin black arrow) continuous with the remaining blood flow of the excluded internal iliac artery aneurysm (IIAA; white arrow). (C) Aneurysmal sac angiography shows the remaining blood flow of the excluded IIAA (white arrow) and SGA (thin black arrow). (D) After coil embolization (white arrows), angiography shows no recurrence of blood flow. (E) Plain-enhanced CT performed 6 months later confirmed that the coils (white arrow) were present around the area of remaining blood flow, and there was no change in the size of the aneurysm (thick white arrow).

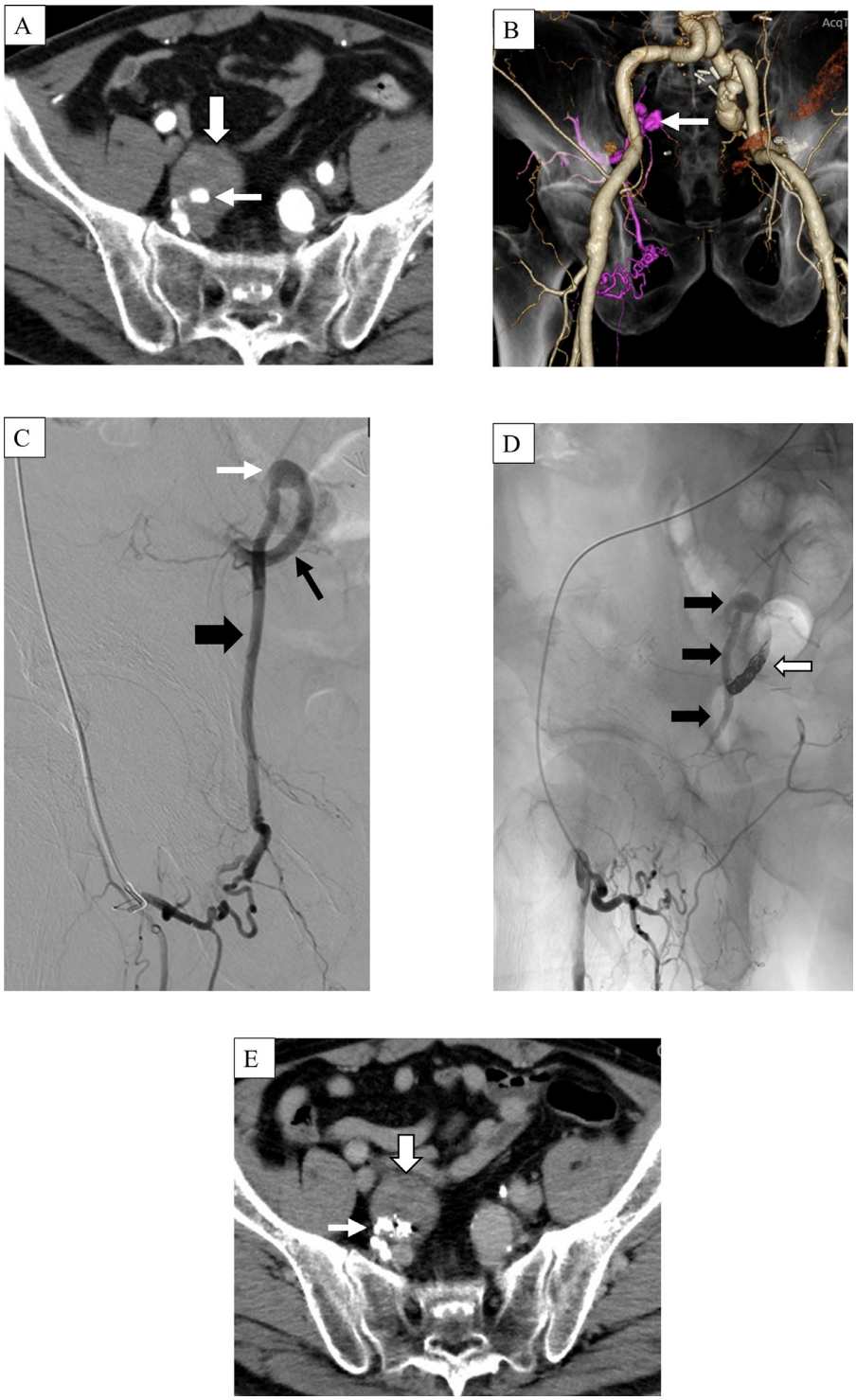

Fig. 4 – (A) Contrast-enhanced computed tomography (CT) (arterial phase) shows the excluded internal iliac artery aneurysm (IIAA; thick white arrow) and the area with remaining blood flow (thin white arrow). (B) Three-dimensional CT shows the dilated inferior gluteal artery (IGA; thick white arrow), superior gluteal artery (SGA; dotted white arrow), and part of the remaining blood flow of the excluded IIAA (white arrow). (C) Angiography from the median femoral circumflex artery shows the dilated IGA (thick black arrow) and SGA (thin black arrow) continuous with the remaining blood flow of the excluded IIAA (white arrow). (D) After embolization with coils (white arrow) and glue (black arrows), angiography showed no recurrence of blood flow. (E) Contrast-enhanced CT (late phase) performed 2 years later confirmed that the coils (thin white arrow) were present around the area of remaining blood flow, and there was no change in the size of the aneurysm (thick white arrow).

using a 0.014 inch microguidewire (chikai V®) into the right IIAA. The right SGA and IGA were embolized with detachable coils (Target XL® 360 soft: five 7 mm/20 cm coils). Afterwards, residual blood flow into the aneurysm was embolized with approximately 1.5 mL of 25% NL (Fig. 4D). After surgery, the patient experienced gluteal claudication, but no major complications occurred. Two years later, the aneurysm diameter had decreased to 36 × 38 mm (Fig. 4E). We are continuing to observe the patient's progress.

Patient 5

This 71-year-old asymptomatic male patient underwent Y-graft replacement and right IIAA exclusion for AAA 8 years earlier. Follow-up CT (Aquilion ONE GENESIS Edition; Canon Medical Systems, Otawara, Japan) showed an enlarged, right IIAA measuring 44 × 45 mm (Fig. 5A). The right proximal IIA was ligated proximally, which hindered an antegrade approach. Endovascular treatment was performed using a retrograde approach via the right DFA. Because the preoperative contrast-enhanced CT (Aquilion ONE GENESIS Edition; Canon Medical Systems, Otawara, Japan) suggested the presence of multiple collateral blood vessels (Fig. 5B), we decided to perform 4-dimensional CT angiography (4D-CTA) (Aquilion ONE; Canon Medical Systems, Otawara, Japan) from inside the artificial blood vessel to understand the blood flow dynamics. The left CFA was punctured and a 4 Fr sheath (Terumo Corp., Tokyo, Japan) was inserted. A 4 Fr pigtail catheter (Medikit, Tokyo, Japan) was inserted into the vascular graft, and 4D-CTA was performed. 4D-CTA imaging depicted the right lateral femoral circumflex artery (LFCA) to the right SGA as an outflow, the right DCIA artery as an inflow, and the right iliolumbar artery to the right fourth lumbar artery. Imaging also revealed the left lateral sacral artery (LSA) as an inflow, anastomoses with the right LSA, and a flow that led into the aneurysm. The IGA was occluded by a thrombosis. For retrograde embolization, the right CFA was punctured at an antegrade location and a 4 Fr Brite Tip sheath was inserted into the right DFA. A 4 Fr tempo® catheter was advanced into the LFCA. Using a triple coaxial system with a 2.9 Fr steerable microcatheter (LEONIS Mova® high flow), a 1.7 Fr microcatheter (Estream® T3; Toray, Tokyo, Japan) was inserted and advanced from the SGA to the aneurysm (Figs. 5C and D). The right SGA and IGA were embolized using 16 coils (Avenir® coil system (Wallaby Medical, Shanghai, China): one 6 mm/16 cm coil, two 10 mm/34 cm coils, two 12 mm/40 cm coils; Target XL®360 soft: two 12 mm/45 cm coils, two 10 mm/40 cm coils, one 4 mm/12 cm coil, one 5 mm/20 cm coil; Azur soft 3D [Terumo]: two 10 mm/36 cm coils, one 7 mm/28 cm coil, one 4 mm/15 cm coil, one 5 mm/20 cm coil). The residual blood flow into the aneurysm was embolized with approximately 0.2 mL of 25% NL (Fig. 5E). After surgery, the patient experienced gluteal claudication, but no major complications occurred. The patient has been followed up for 6 months, and the aneurysm diameter has remained unchanged at 43 × 45 mm.

Discussion

In cases of AAA, if the iliac artery stent graft leg lands in the external iliac artery (EIA), antegrade TAE of the IIA is commonly performed to prevent retrograde blood flow. Recently, however, it has been questioned whether it is necessary to occlude the proximal IIA when extending the graft into the EIA [6]. In that study, embolization failed in 11 patients, with a mean follow-up period of only 19.7 months. The finding that perfused IIAAs can enlarge and rupture after a long time emphasizes the importance of proximal and distal control of the IIA by ligation or embolization [7–9]. Previous studies have reported approaches for embolizing IIAAs associated with ligation, including TAE via collateral channels [5], like in the present cases, CT-guided transabdominal or transosseous direct puncture of the aneurysm [10,11], and surgical or percutaneous ultrasound-guided access via the SGA [12]. Direct puncture of an aneurysm under CT guidance is a safe and reliable method for reaching the aneurysm if important organs can be avoided. However, if other key vessels or the sciatic nerve enter the puncture path, the puncture becomes more difficult, and is not always feasible for anatomical reasons. Hybrid transarterial techniques are more invasive and require general anesthesia and a surgical environment. In some cases, the SGA may not be suitable to access the transluminal feeding vessel due to proximal occlusion, tortuosity, or small size.

The choice of embolic material is determined by the interventionist's personal experience, individual vessel anatomy, local availability of specific embolic materials, and the size of the catheter used to reach the target [5]. In the present 5 cases, we performed embolization using coils and liquid embolic material. When using coils alone, it is usually necessary to use many coils, which poses a medical and economical problem. It is thought that the embolic effect of coils can be enhanced by using liquid embolic substances such as NBCA. In these 5 cases, there was no obvious increase in the aneurysm diameter, and we believe that there was no problem with embolic materials used in each case.

In one of our cases, the ipsilateral LSA provided inflow due to arterial communication from the contralateral LSA. Collateral pathways include the LFCA to the SGA, the DCIA to the iliolumbar artery, and the LFCA and MFCA to the IGA [13]. The contralateral LSA to the ipsilateral LSA is another important collateral pathway. Accurately identifying the collateral circulation by contrast-enhanced CT, prior to embolization, is key to successful endovascular treatment.

When performing TAE via collateral channels for excluded IIAAs, it is necessary to embolize all of the collateral channels as far as possible, but they are generally tortuous and embolization is often difficult due to the long distances involved. To overcome this problem, we believe it is necessary to use a triple coaxial system. Indeed, we used such a system in 3 of the 5 patients in this series. In this situation, the tip of the steerable microcatheter can bend freely, making it extremely useful when approaching a branch vessel with a tight bend.

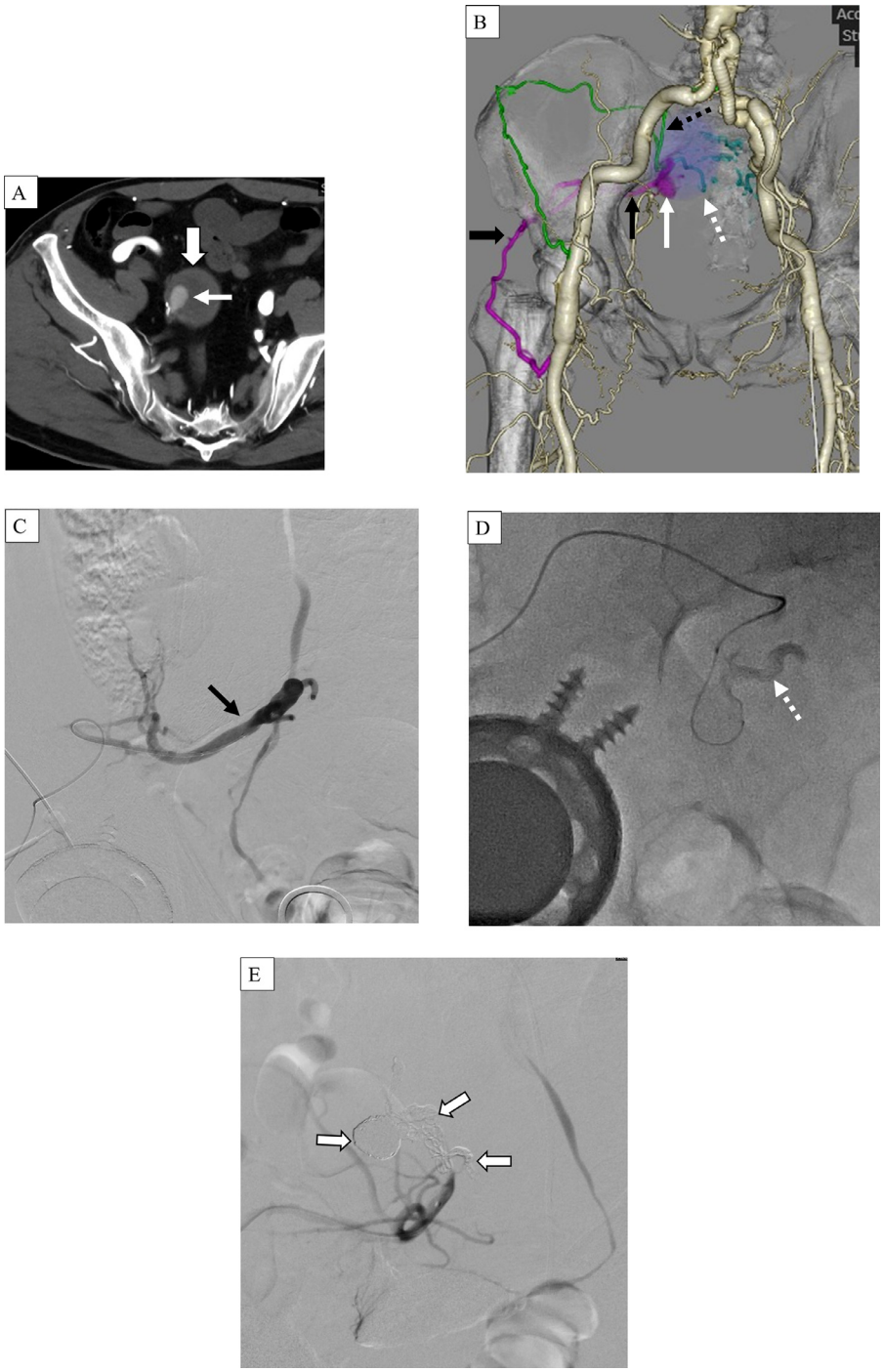

Fig. 5 – (A) Contrast-enhanced computed tomography (CT) (arterial phase) shows the excluded internal iliac artery aneurysm (IIAA; thick white arrow) and area with remaining blood flow (thin white arrow). (B) Three-dimensional CT shows the dilated superior gluteal artery (SGA; thin black arrow) connected to the lateral femoral circumflex artery (LFCA; thick black arrow), iliolumbar artery (dotted thin black arrow) connected to the deep circumflex iliac artery (DCIA), ipsilateral lateral sacral artery (LSA; dotted white arrow) connected to the contralateral LSA and part of the remaining blood flow of the excluded IIAA (white arrow). (C) Angiography from the SGA via the LFCA shows a dilated outflow vessel and the aneurysms cannot be visualized. (D) Aneurysmal sac angiography shows the LSA (white dotted arrow). (E) After coil embolization (white arrows), angiography from SGA shows no recurrence of blood flow.

Conclusion

By accurately evaluating the anatomy of the collateral pathways using contrast-enhanced CT in 5 patients, we show that retrograde TAE is a feasible and effective treatment of excluded IIAAs.

Ethical approval

This study involved a human participant and was therefore performed in accordance with the ethical standards of the institutional and national research committees and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

AI declaration

The authors did not use any generative AI or AI-assisted technologies in the writing process.

Patient consent

The patients provided oral and written informed consent for the preparation and publication of this case report. Written consent for publication has been obtained from the patient(s), their next of kin, their legal representative(s), or, where none of these parties is traceable, that approval to publish has been given by my organization/institution, its legal representative and an ethics committee, and in accordance with local legislation.

REFERENCES

[1] Dix FP, Titi M, AI-Khaffaf H. The isolated internal iliac artery aneurysm: a review. Eur J Vasc Endovasc Surg 2005;30(2):119–29. doi:10.1016/j.ejvs.2005.04.035.

[2] Richardson JW, Greenfield LJ. Natural history and management of iliac aneurysms. J Vasc Surg 1988;8(2):165–71.

[3] Razavi MK, Dake MD, Semba CP, Nyman UR, Liddell RP. Percutaneous endoluminal placement of stent-grafts for the treatment of isolated iliac artery aneurysms. Radiology 1995;197(3):801–4. doi:10.1148/radiology.197.3.7480759.

[4] Millon A, Paquet Y, Ben Ahmed S, Pinel G, Rosset E, Lermusiaux P. Midterm outcomes of embolisation of internal iliac artery aneurysms. Eur J Vasc Endovasc Surg 2013;45(1):22–7. doi:10.1016/j.ejvs.2012.10.006.

[5] Abderhalden S, Rancic Z, Lachat ML, Pfammatter T. Retrograde hypogastric artery embolization to treat iliac artery aneurysms growing after aortoiliac repair. J Vasc Interv Radiol 2012;23(7):873–7. doi:10.1016/j.jvir.2012.04.008.

[6] Bharwani N, Raja J, Choke E, Belli AM, Thompson MM, Morgan RA, et al. Is internal iliac artery embolization essential prior to endovascular repair of aortoiliac aneurysms? Cardiovasc Intervent Radiol 2008;31(3):504–8. doi:10.1007/s00270-007-9260-x.

[7] Sahgal A, Veith FJ, Lipsitz E, Ohki T, Suggs WD, Rozenblit AM, et al. Diameter changes in isolated iliac artery aneurysms 1 to 6 years after endovascular graft repair. J Vasc Surg 2001;33(2):289 284. doi:10.1067/mva.2001.112702.

[8] Deb B, Benjamin M, Comerota AJ. Delayed rupture of an internal iliac artery aneurysm following proximal ligation for abdominal aortic aneurysm repair. Ann Vasc Surg 1992;6(6):537–54. doi:10.1007/BF02000827.

[9] Brings HA, Murray JD, Light JT, Hemp JR, Ranbarger KR. Internal iliac artery aneurysm following aortic reconstruction. Ann Vasc Surg 1996;10(1):59–62. doi:10.1007/BF02002343.

[10] Cartwright-Terry M, Ashleigh R, Martin D, Nasim A. CT-guided embolization of an isolated internal iliac artery aneurysm 8 years after AAA repair. J Endovasc Ther 2006;13(4):561–4. doi:10.1583/06-1825R.1.

[11] Gemmete JJ, Arabi M, Cwikiel WB. Percutaneous transosseous embolization of internal iliac artery aneurysm type II endoleak: report of two cases. Cardiovasc Intervent Radiol 2011;34(Suppl 2):S122–5. doi:10.1007/s00270-010-9809-y.

[12] Magishi K, Izumi Y, Tanaka K, Shimizu N, Uchida D. Surgical access of the gluteal artery to embolize a previously excluded, expanding internal iliac artery aneurysm. J Vasc Surg 2007;45(2):387–90. doi:10.1016/j.jvs.2006.10.040.

[13] Barksdale PA, Elkins TE, Sanders CK, Jaramillo FE, Gasser RF. An anatomic approach to pelvic hemorrhage during sacrospinous ligament fixation of the vaginal vault. Obstet Gynecol 1998;91(5 Pt 1):715–18. doi:10.1016/s0029-7844(98)00051-9.