Repair of a late endoleak following complete proximal endograft fixation strut separation

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ABSTRACT

Introduced as an alternative endograft for those with unfavorable anatomy, bare metal suprarenal fixation barbs have been widely used for endovascular abdominal aortic repair. Type I endoleaks result in continued perfusion of the aneurysm sac and warrant prompt reintervention. We describe an unusual presentation and endovascular management of a late type IA endoleak secondary to complete separation of the suprarenal fixation struts in a Cook endograft after an uncomplicated, emergent infrarenal endovascular abdominal aortic repair 5 years earlier. (J Vasc Surg Cases and Innovative Techniques 2021;7:315-21.)

Keywords: Endoleak; Fenestrated endograft; Aneurysm; Endoprosthesis

Endovascular abdominal aortic repair (EVAR) is a minimally invasive option for abdominal aortic aneurysm (AAA) repair, with significantly lower short-term perioperative morbidity and mortality compared with open surgical repair.[1] However, EVAR is linked to a unique set of postoperative complications, namely, endoleaks. Endoleaks are persistent blood flow within the aneurysm sac after EVAR and account for 20% to 25% of total complications after EVAR.[2,3] Type I endoleaks are a result of inadequate seal at endograft attachment sites either proximally (type IA) or distally (type IB), allowing ongoing perfusion of the aneurysm sac. Type I endoleaks rarely resolve spontaneously and require intervention to achieve further seal. We report a rare case of proximal stent-strut separation 5 years after an otherwise uncomplicated EVAR for a large symptomatic infrarenal AAA and the subsequent treatment with a fenestrated endovascular aneurysm repair. Consent for publication and for the images used was obtained from the patient.

CASE REPORT

A 78-year-old man with a background history of atrial fibrillation, hypertension, and asthma presented for routine vascular surgical follow-up after undergoing emergent EVAR repair 5 years prior. In 2015, at age 73, he presented with acute abdominal and back pain. Computed tomography angiography (CTA) demonstrating a large, 95-mm infrarenal AAA. The infrarenal neck was suboptimal, with a bulbous configuration measuring 28 mm in maximal diameter and 25 mm in total length (12 mm from lowest renal artery [RA] to the bulbous segment). The neck was angulated (approximately 15°) to the right side (Fig 1). The infrarenal AAA was treated emergently with a bifurcated Cook Zenith Alpha Abdominal endograft (Cook Inc, Bloomington, Ind) with suprarenal fixation struts. The endograft main body (ZIMB 36-98) was deployed from the right groin, with limb extensions into both common iliac arteries (left ZISL 16-90, right ZISL 16-74). An on-table completion angiogram confirmed the patency of bilateral RA and internal iliac arteries, with no endoleaks (Fig 2). His lower limbs remained well-perfused, with bilateral dorsal pedal pulses palpable at case completion. His subsequent postoperative course was uncomplicated. He was followed postoperatively at 1, 6, and 12 months with no complications or endoleaks evident on surveillance duplex ultrasound examination as per the unit's standard practice, with interval scans demonstrating regressing in sac size. A CTA performed at 18 months postoperatively demonstrated a regression in sac size and no endoleaks (Fig 3). He was followed up biannually thereafter with duplex ultrasound examination.[4]

On-routine follow-up at year 5.5, his surveillance ultrasound examination demonstrated an endoleak arising from the proximal graft with an increase in sac size from 59 mm to 65 mm in maximum anterior-posterior diameter. An urgent high-resolution CTA was performed that demonstrated an endoleak secondary to a separation between the suprarenal fixation struts and the covered stents, with aneurysm disease progression and

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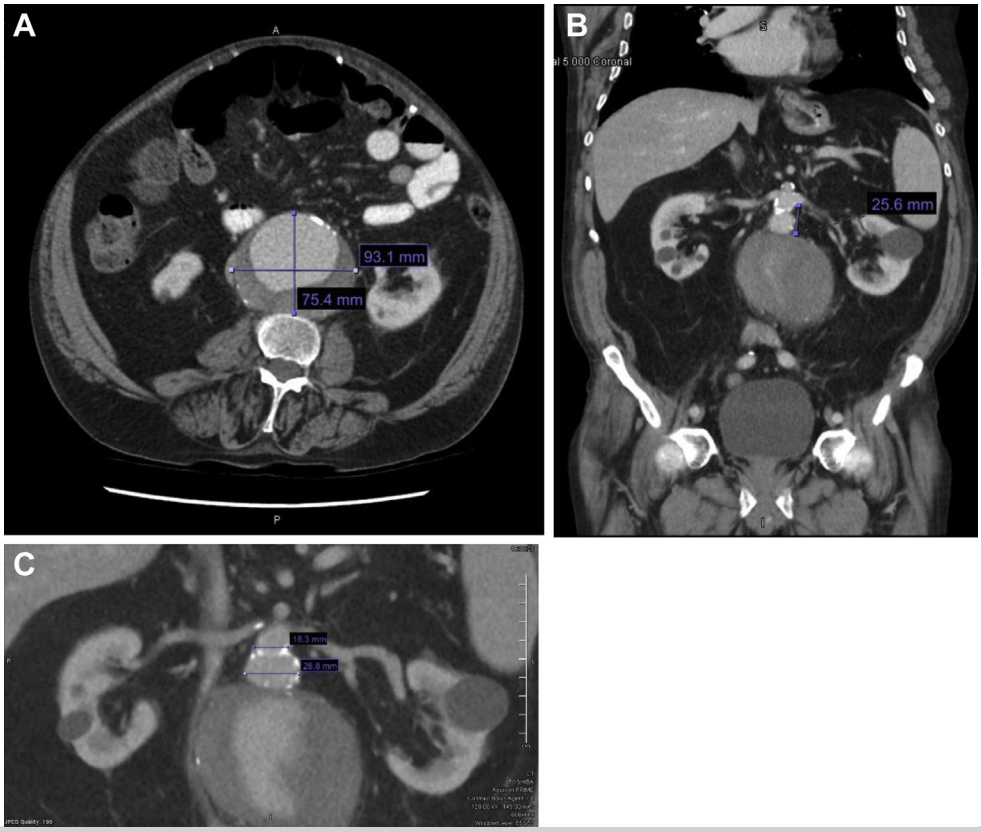

Fig 1. Computed tomography angiography (CTA) from the initial emergency presentation demonstrating a large infrarenal abdominal aortic aneurysm (AAA) measuring 93 mm × 75 mm on the axial section **(A)** with adequate neck length for endovascular repair, measuring approximately 25 mm (ie, >15 mm) **(B)**. Of note, however, is the unfavorable configuration of the infrarenal aortic neck with a distal bulbous segment and surrounding calcification **(C)**.

a separation distance of approximately 17 mm posteriorly and 23 mm anteriorly (Fig 4). Given the separation of graft components proximally resulting in an inadequate proximal seal, this was labelled a type IA endoleak. His visceral vessel anatomy was aberrant, with two small hepatic arteries arising separately from the aorta, adjacent to the splenic artery. A multidisciplinary team case review was conducted with a consensus that treatment with a custom-made fenestrated extension cuff for the patient's anatomy with stenting of the RA and mesenteric arteries was appropriate.

Preoperatively, a decision was made to sacrifice the smaller of the two hepatic arteries with the stent graft, and only attempt stenting of the splenic artery, if no seal was achieved on stenting the RA and superior mesenteric artery (SMA). A Cook custom-made (to the patient's anatomy) low-profile four-vessel fenestrated, 20F sheath device (CMD-32-38-139) was deployed via the right groin. Despite the suprarenal struts of the existing bifurcated graft crossing the orifices of the SMA and RA, cannulation was achieved easily. Lifestream (Bard Peripheral Vascular, Tempe, Ariz) stent extensions were deployed into the visceral arteries (left RA 7 × 26 mm, right RA 6 × 26 mm, and SMA 8 × 26 mm). Distally, the graft landed and sealed within the existing bifurcating graft approximately 8 mm above the existing main body graft bifurcation to provide adequate overlap and seal. A completion angiogram confirmed no endoleak and patency of all visceral arteries (Fig 5). His postoperative course was uneventful, and he was discharged on day 5 with no endoleak evident on 30-day surveillance CTA.

DISCUSSION

Since the first description of EVAR in 1991 by Parodi, endoprostheses have seen a shift from physician-made to the sophisticated fourth-generation models currently available.[5,6] Constructed from woven polyester

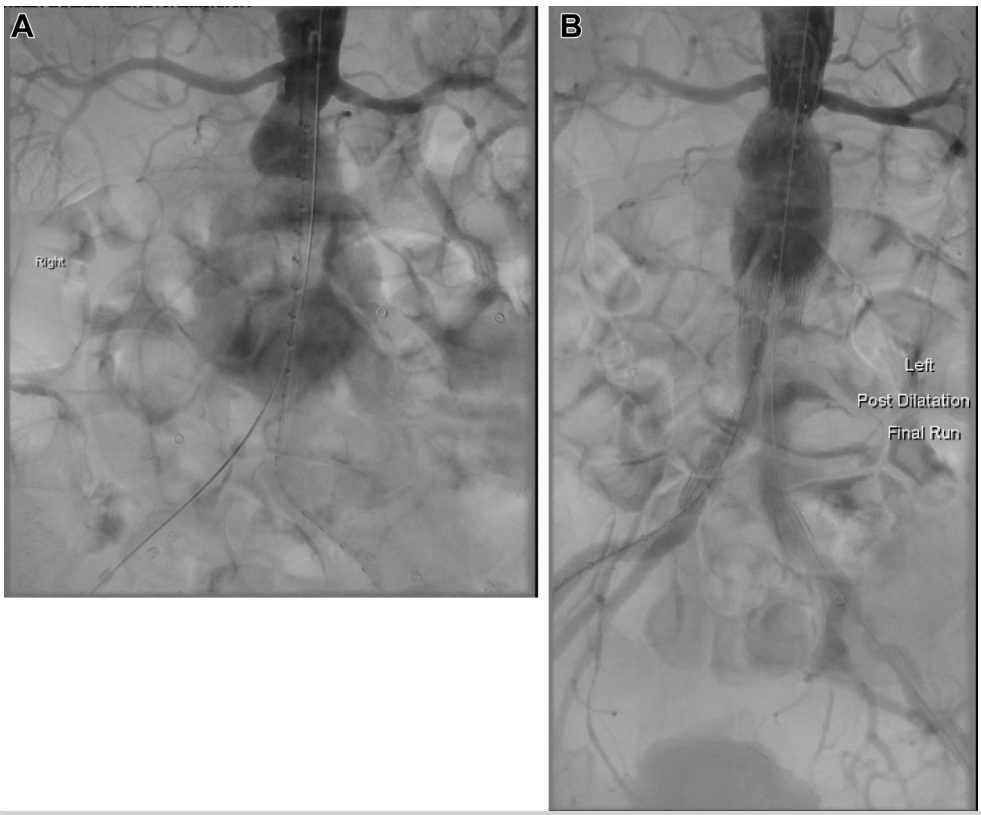

Fig 2. Intraoperative digital subtraction angiography (DSA) using a measuring pigtail catheter from the left iliac artery demonstrating the infrarenal aneurysm **(A)**. On-table completion check angiogram **(B)** demonstrating good flow both iliac arteries, patency of bilateral internal iliac arteries and renal arteries.

fabric sewn to self-expanding nitinol stents, the Zenith Alpha Abdominal Endovascular Graft created in 2003 consists of three components, namely, a main body and two iliac limbs sutured using braided polyester and monofilament polypropylene sutures.[6] Introduced as an effective EVAR option in those with unfavorable anatomy, such as short infrarenal neck length, severe angulation, or neck width, suprarenal fixation struts with barbs (hooks) for proximal fixation are of similar safety and efficacy to infrarenal fixation.[7] Renal infarction, RA occlusion, visceral compromise, and arterial occlusion have been reported as complications associated with the use of suprarenal fixation endografts.[7-9] Despite advancements in endoprosthesis manufacturing, fabric/component failure remains a potential complication leading to endoleak, graft migration and possible sac enlargement and rupture. Strut fractures have been described, hypothesized to be a result of stress fatigue and metal corrosion; however, the clinical relevance remains unclear as the majority of strut fractures remain asymptomatic.9 Although the principal cause remained unclear, hypotheses such as increased graft stress secondary to increasing angulation of aortic neck may have contributed to the consequent strut separation. A number of reports have been made of separation between the covered and uncovered portion of the cook endograft. In 2002, double suturing was implemented by the manufacturer to increase stability between the main body and uncovered segment.[10-12] As EVAR has superseded open aortic repair for aneurysmal disease, device failure has become more commonly reported. A major

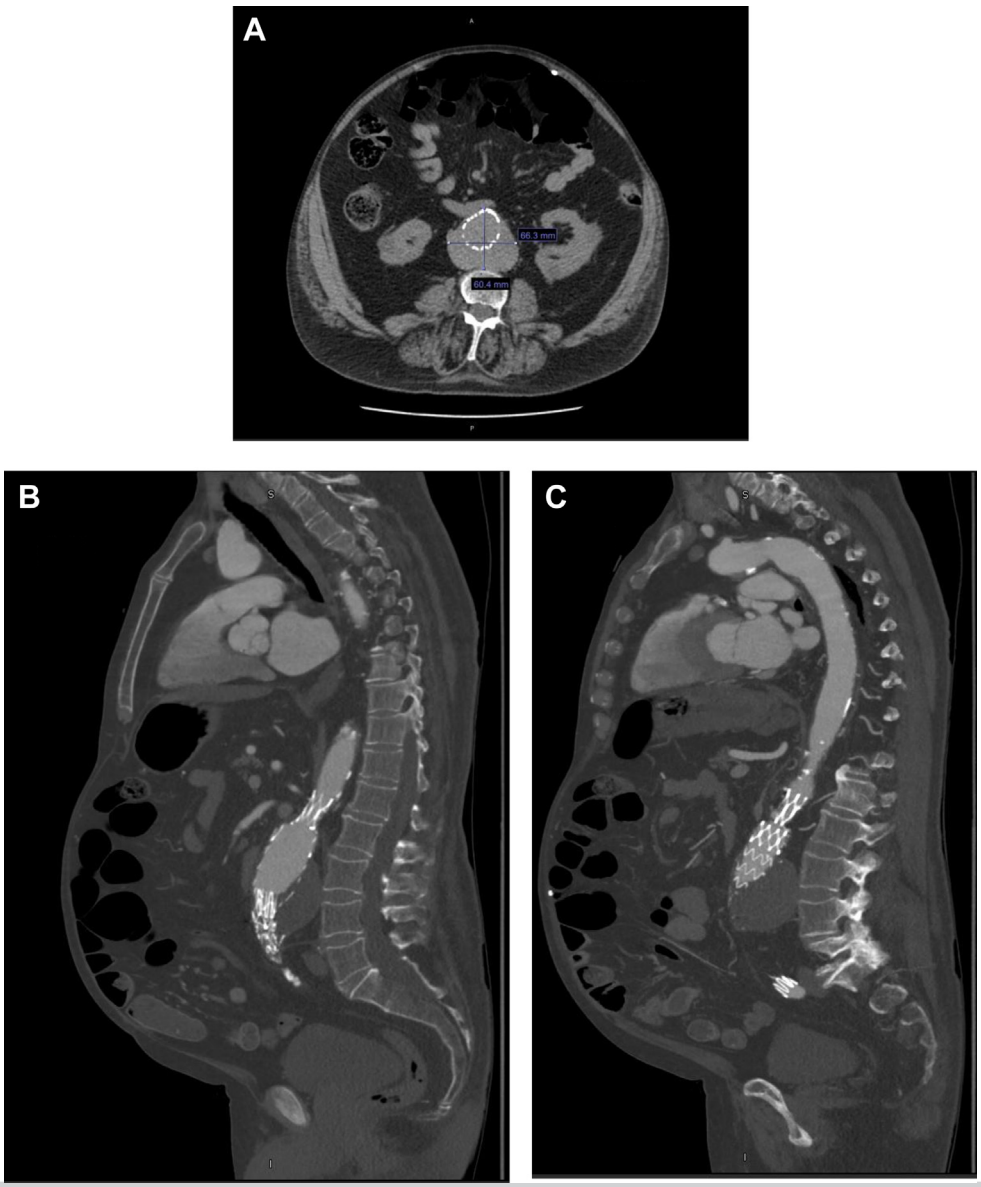

Fig 3. Computed tomography angiography (CTA) 18 months after endovascular abdominal aortic repair (EVAR) demonstrating a decrease in sac size to 66 × 60 mm in the maximal anterior-posterior diameter **(A)** with the proximal aspect of the EVAR stent graft intact and no identifiable endoleaks **(B** and **C)**.

contributing factor to failed EVAR devices are their use beyond the advised instructions for use, a practice that has been largely supported by the literature to result in higher rates of device failure.[13]

Subsequently, fenestrated and/or branched endovascular aortic repair fenestrated/branched EVAR (F/BEVAR) has emerged as a safe and feasible salvage endovascular procedure for EVAR failure with similar 30-day adverse event rates, endoleak rates, and reintervention rates between those undergoing salvage F/BEVAR for EVAR failure vs F/BEVAR as an index procedure.[14] Nevertheless, as described in the recent analysis of F/BEVAR as a solution for EVAR device failure, the safety and efficacy of this technique should not compromise adherence to instructions for use for EVAR. Although emergent EVAR can be used as a technique for ruptured aneurysms, this should be followed with rigorous surveillance to ensure early detection of complications.

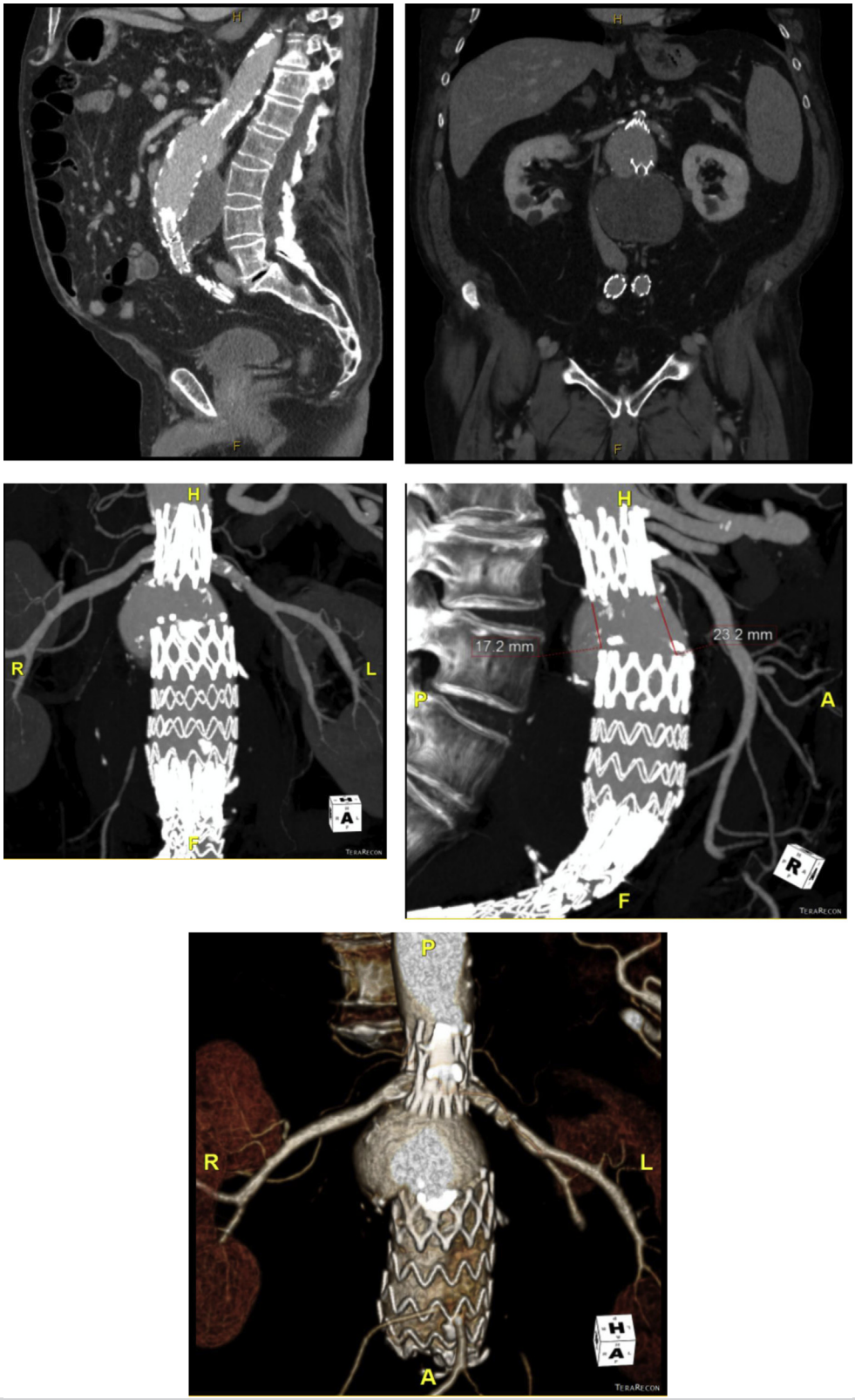

Fig 4. Computed tomography angiogram (CTA) performed 5 years after the initial endovascular abdominal aortic repair (EVAR) demonstrating an endoleak with evidence of complete separation of the suprarenal fixation struts from the endograft covered stent component.

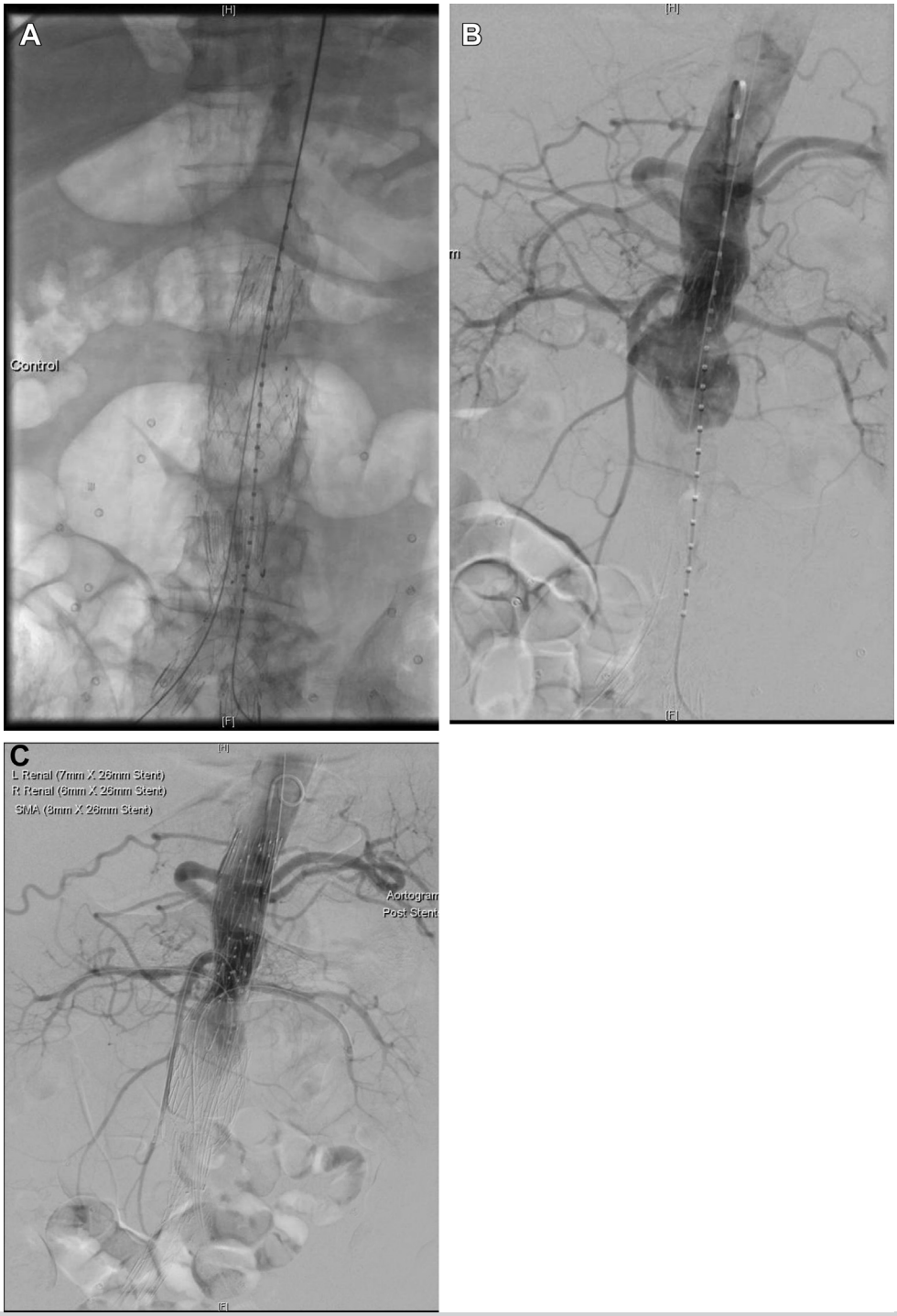

Fig 5. Intraoperative angiogram pictures during the fenestrated endovascular aortic repair. **(A)** Fluoroscopy image demonstrating the fractured graft prior to deployment of the fenestrated cuff. **(B)** Initial digital subtraction angiography (DSA) confirming the presence of a type IA endoleak with continued sac perfusion. **(C)** Completion DSA after deployment of the fenestrated graft and stenting of the visceral arteries demonstrating good seal, with no further endoleaks and patent visceral branches.

REFERENCES

1. Endovascular versus open repair of abdominal aortic aneurysm. N Engl J Med 2010;362:1863-71.
2. Cao P, De Rango P, Verzini F, Parlani G. Endoleak after endovascular aortic repair: classification, diagnosis and management following endovascular thoracic and abdominal aortic repair. J Cardiovasc Surg (Torino) 2010;51:53-69.
3. Maleux G, Poorteman L, Laenen A, Saint-Lèbes B, Houthoofd S, Fourneau I, et al. Incidence, etiology, and management of type III endoleak after endovascular aortic repair. J Vasc Surg 2017;66: 1056-64.
4. Wanhainen A, Verzini F, Van Herzeele I, Allaire E, Bown M, Cohnert T, et al. Editor's choice - European Society for Vascular Surgery (ESVS) 2019 clinical practice guidelines on the management of abdominal aorto-iliac artery aneurysms. Eur J Vasc Endovasc Surg 2019;57:8-93.
5. Tadros RO, Faries PL, Ellozy SH, Lookstein RA, Vouyouka AG, Schrier R, et al. The impact of stent graft evolution on the results of endovascular abdominal aortic aneurysm repair. J Vasc Sur 2014;59: 1518-27.
6. Jackson BM, Carpenter JP. Devices used for endovascular aneurysm repair: past, present, and future. Semin Intervent Radiol 2009;26: 39-43.
7. Walker TG, Kalva SP, Yeddula K, Wicky S, Kundu S, Drescher P, et al. Clinical practice guidelines for endovascular abdominal aortic aneurysm repair: written by the Standards of Practice Committee for the Society of Interventional Radiology and endorsed by the Cardiovascular and Interventional Radiological Society of Europe and the Canadian Interventional Radiology Association. J Vasc Interv Radiol 2010;21:1632-55.
8. Parmer SS, Carpenter JP. Endovascular aneurysm repair with suprarenal vs infrarenal fixation: a study of renal effects. J Vasc Surg 2006;43:19-25.
9. Roos JE, Hellinger JC, Hallet R, Fleischmann D, Zarins CK, Rubin GD. Detection of endograft fractures with multidetector row computed tomography. J Vasc Surg 2005;42:1002-6.
10. Ghanim K, Mwipatayi BP, Abbas M, Sieunarine K. Late stent-graft migration secondary to separation of the uncovered segment from the main body of a zenith endoluminal graft. J Endovasc Ther 2006;13:346-9.
11. Torres-Blanco Á, Molina-Nácher V, Sala-Almonacil V, Ortiz-Monzón E. A rare complication after endovascular aneurysm repair: Disconnection of the suprarenal stent of a zenith endograft. J Endovasc Ther 2016;23:307-10.
12. Ueda T, Tajima H, Murata S, Iwata K, Saitou H, Miki I, et al. An extremely rare complication: abdominal aortic aneurysm rupture caused by migration of a zenith main body years after repair of the suprarenal stent separation. J Endovasc Ther 2019;26:269-72.
13. Schanzer A, Greenberg RK, Hevelone N, Robinson WP, Eslami MH, Goldberg RJ, et al. Predictors of abdominal aortic aneurysm sac enlargement after endovascular repair. Circulation 2011;123:2848-55.
14. Schanzer A, Beck AW, Eagleton M, Farber MA, Oderich G, Schneider D, et al. Results of fenestrated and branched endovascular aortic aneurysm repair after failed infrarenal endovascular aortic aneurysm repair. J Vasc Surg 2020;72:849-58.

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