Successful treatment of a persistent type IA endoleak with endoanchors following chimney endovascular aortic repair

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ABSTRACT

The chimney endovascular aortic repair technique has become an increasingly used option for the treatment of juxtarenal aortic aneurysms; however, type IA and gutter endoleaks complicate this approach in up to 5.9% of cases. Successful treatment of these leaks is challenging. We report a case of a patient who underwent two-vessel chimney endovascular aortic repair in the treatment of a 5.9-cm juxtarenal aortic aneurysm and developed a type IA endoleak. The endoleak was successfully treated with Heli-FX EndoAnchor placement. Resolution of the endoleak was noted at continued follow-up through 54 months. (J Vasc Surg Cases Innov Tech 2022;8:854-8.)

Keywords: Aortic aneurysm; ch-EVAR; Endoanchors; Endoleak; Type 1a

A persistent type IA endoleak can develop in up to 5.9% of patients after endovascular aneurysm repair with concomitant parallel visceral, or chimney, stents (chimney endovascular aortic repair [ch-EVAR]). A variety of strategies, including glue or coil embolization or proximal aortic cuff extension with additional chimney stent placement, have been described in this situation, but none is well-established and each is potentially complex and costly. The average base cost of endoanchors is typically $5385 per case. Coils have a wide range of costs depending on the respective type used. The average base cost of platinum embolization coils (Cook Medical Inc, Bloomington, IN) is $3936. The cost of an abdominal aortic cuff depends on the vendor and institutional contracts, but typically ranges roughly from $4612 to $5855. We describe a novel approach to the treatment of a type IA endoleak after ch-EVAR using Heli-FX EndoAnchors. Patient consent and institutional review board approval were obtained.

CASE REPORT

A 77-year-old woman with a history of multiple abdominal surgeries and chronic obstructive pulmonary disease presented with expansion of a known abdominal aortic aneurysm (AAA) from 48 to 59 mm. Her infrarenal AAA neck measured 2 mm in length. Her iliofemoral arterial access was prohibitively narrow for fenestrated EVAR and her cardiopulmonary status precluded open surgical repair. Ch-EVAR was planned to include proximal main body coverage up to but not including the superior mesenteric artery with parallel stents planned for the right and left renal arteries, respectfully.

The proximal aortic seal zone measured approximately 20 mm in length and was uniformly 21 to 22 mm in diameter. A 28-mm main body aortic device was landed just below the superior mesenteric artery. After surgical exposure of the right axillary artery, two 5 × 39-mm VBX (W. L. Gore & Associates, Flagstaff, AZ) stents were deployed in the right and left renal arteries (Fig 1). A completion angiogram demonstrated a type IA endoleak that persisted after simultaneous proximal aortic and renal artery stent graft balloon angioplasty (Fig 2). The decision was made to observe the endoleak given the documented thrombosis rate of intraoperative type IA and gutter leak during index ch-EVAR. Computed tomography angiography at 1 month demonstrated a persistent, anterior type IA endoleak (Fig 3).

Reintervention was planned to include Heli-FX EndoAnchor fixation of the proximal. anterior aspect of the main body endograft. A diagnostic aortogram was performed which showed the type IA endoleak at the anterolateral position (Fig 4, A). Care was taken during endoanchor delivery to avoid the parallel renal stents using a two-step process: the main body endograft was first engaged by the deployment system, which was then viewed in orthogonal planes before each anchor release to prevent renal stent disruption (Fig 4, B and C). Five total anchors were deployed and they were localized along the anterior surface of the endograft. These anchors were placed approximately 1 cm below the proximal edge of the endograft and within millimeters of the renal stents, with care taken to remain safely anterior to them. A completion angiogram demonstrated resolution of the endoleak.
preserved integrity of the renal stents, and normal target vessel perfusion (Fig 4, D). Computed tomography angiography at 12 months showed no type IA endoleak, decreased AAA sac size to 51 mm, and bilateral renal stent patency (Fig 5).

**DISCUSSION**

Type IA gutter endoleaks remain a challenge during ch-EVAR, with an incidence of 10.7%. Various methods have been reported to treat type IA endoleak after ch-EVAR, including embolization with coils, liquid embolic agents.
and glue3,6 via multiple anatomic approaches including transarterial, translumbar, transabdominal, and transcaval.7 Choi et al8 described transarterial and transabdominal approaches using N-butyl cyanoacrylate in seven patients, including five type IA endoleaks, one type IB endoleak, and one combined type IA/IB endoleak in which a primary attempt to exclude the type I endoleak failed.8 They reported achieving technical success in 86%, with six of seven patients having shrinkage or stability of the aneurysm sac diameter.

The translumbar technique is feasible, but challenging, especially in patients with obesity or cardiopulmonary comorbidities, because patients need to be prone. Massimi et al9 reported an effective transcaval approach for a proximal gutter endoleak in a three-vessel ch-EVAR case. Their technique included the use of intravascular ultrasound examination with concomitant biplane fluoroscopy to select the point of maximal inferior vena cava and aortic sac apposition. A transjugular liver biopsy set was used to access the sac via the inferior vena cava with coils delivered along the gutter between the superior mesenteric artery stent and the aortic endograft. Fenestrated and branched endovascular aortic repair (F/BEVAR) also offer solutions in addition to ch-EVAR.
for these challenging juxtarenal aortic aneurysms. A recent report describing redo F/BEVAR to treat type IA endoleaks after initial F/BEVAR repair has shown promising results.10 The use of endoanchors to treat patients with AAA and unfavorable aortic neck anatomy was assessed in the Aneurysm Treatment Using the Heli-FX Aortic Securement System Global Registry (ANCHOR).11,12 However, endoanchors used in combination with ch-EVAR procedures has not been described widely,13 although the use of endoanchors in the treatment of juxtarenal AAAs and type IA endoleaks has increased within the last 6 years.14,15 Persistent type IA endoleaks after ch-EVAR are a tough problem. Donas et al16 researched gutter-related type IA endoleaks after ch-EVAR. Their conclusions were that, although gutter-related endoleaks were common, they generally resolved spontaneously. Therefore, these endoleaks may be more benign than previously thought. However, a more recent paper by Major et al17 showed that a persistent type IA endoleak was associated with a significantly increased likelihood of developing a persistent type IA (P < .01) and decreased median survival (P < .01), but there was no known aneurysm-related mortality.

We present a unique technique to treat a persistent type IA endoleak after ch-EVAR. A hostile proximal aortic neck is a persistent and challenging problem that possibly increases the risk of type IA endoleak or gutter leak during ch-EVAR. EndoAnchors provide an alternative and potentially more efficient, less expensive approach to achieving fixation in this unique situation. Also, an edge of endoanchor application is that it may prevent aortic dilatation at the proximal seal zone, which could decrease the risk of future aneurysmal degeneration, endoleak, and secondary intervention.18 Relative contraindications to the use of EndoAnchors include diffuse aortic thrombus and calcification. EndoAnchor implants should be implanted only into areas of aortic tissue free of calcified plaque or thrombus, or where such pathology is diffuse and less than 2 mm thick.

CONCLUSIONS
Type IA endoleak after ch-EVAR remains a clinical challenge without a reliably effective solution. We present a case of a significant, persistent type IA endoleak after ch-EVAR that was successfully treated with endoanchors. A stepwise deployment process with orthogonal views was used to avoid parallel renal stent damage. Although the use of endoanchors in this situation has been rarely described previously, their selective application may provide a valuable and less complex alternative to other treatment modalities.

REFERENCES
1. Taneva GT, Lee JT, Tran K, Dalmia R, Torsello G, Fazzini S, et al. Long-term chimney/snorkel endovascular aortic aneurysm repair experience for complex abdominal aortic pathologies within the PERICLES registry. J Vasc Surg 2021;73:1942-9.
2. Chaudhuri A. Is an Ounce of EndoAnchors Worth More Than Many Pounds for Reintervention? J Endovasc Ther 2019;26:101-4.
3. Ryer EJ, Garvin RP, Webb TP, Franklin DP, Elmore JR. Comparison of outcomes with coils versus vascular plug embolization of the internal iliac artery for endovascular aortoiliac aneurysm repair. J Vasc Surg 2012;56:1239-45.
4. O’Brien-IRR MS, Harris LM, Dosluoglu HH, Cherr CS, Rivero M, Noor S, et al. Factors that affect cost and clinical outcome of endovascular aortic repair for abdominal aortic aneurysm. J Vasc Surg 2017;65:997-1005.
5. Brinster CJ, Millner R. Rationale for choice of infrarenal versus suprarenal fixation during complex endovascular aortic repair. Vascular and Endovascular Consensus Update 2017.
6. Donas KP, Lee JT, Lachat M, Torsello G, Veith FJ. PERICLES investigators. Collected world experience about the performance of the snorkel/chimney endovascular technique in the treatment of complex aortic pathologies the PERICLES registry. Ann Surg 2015;262:546-53.
7. Moulakakis KG, Mylonas SP, Averinos E, Papapetrou A, Kakisis JD, Bronztos EN, et al. The chimney graft technique for preserving visceral vessels during endovascular treatment of aortic pathologies. J Vasc Surg 2012;55:1497-503.
8. Choi SY, Lee DY, Lee K, Ko Y, Choi D, Shim W, et al. Treatment of type I endoleaks after endovascular aneurysm repair of infrarenal abdominal aortic aneurysm: usefulness of N-butyl cyanoacrylate embolization in cases of failed secondary endovascular intervention. J Vasc Interv Radiol 2011;22:155-62.

9. Massimi TM, Kostun ZW, Woo EY. Transcaval embolization of a type I gutter endoleak after three-vessel chimney endovascular aneurysm repair. J Vasc Surg 2017;65:1515-7.

10. Karelis A, Haulon S, Sonesson B, Adam D, Kolibel T, Oderich G, et al. Editor’s Choice - Multicentre Outcomes of Redo Fenestrated/ Branched Endovascular Aneurysm Repair to Rescue Failed Fenestrated Endografts. Eur J Vasc Endovasc Surg 2021;62:738-45.

11. Jordan WD Jr, Mehta M, Varnagy D, Moore WM, Arko FR, Joye J, et al. Results of the ANCHOR prospective, multicenter registry of EndoAnchors for type Ia endoleaks and endograft migration in patients with challenging anatomy. J Vasc Surg 2014;60:885-92.e882.

12. Jordan WD Jr, Mehta M, Ouriel K, Arko FR, Varnagy D, Joye J, et al. One-year results of the ANCHOR trial of EndoAnchors for the prevention and treatment of aortic neck complications after endovascular aneurysm repair. Vascular 2016;24:177-86.

13. Donselaar EJ, van der Vijver-Coppen RJ, van den Ham LH, Lardenoye JW, Reijnen MM. EndoAnchors to Resolve Persistent Type Ia Endoleak Secondary to Proximal Cuff With Parallel Graft Placement. J Endovasc Ther 2016;23:225-8.

14. Goudeketting SR, van Noort K, Ouriel K, Jordan WD Jr, Panneton JM, Slump CH, et al. Influence of aortic neck characteristics on successful aortic wall penetration of EndoAnchors in therapeutic use during endovascular aneurysm repair. J Vasc Surg 2018;68:1007-16.

15. Knowles M, Timaran CH. Analysis of EndoAnchors for endovascular aneurysm repair by indications for use. J Vasc Surg 2015;61:1658.

16. Donas KP, Torsello GB, Piccoli C, Pitoulias GA, Torsello GF, Biselas T, et al. The PROTAGORAS study to evaluate the performance of the Endurant stent graft for patients with pararenal pathologic processes treated by the chimney/snorkel endovascular technique. J Vasc Surg 2016;63:1-7.

17. Major M, Long GW, Eden CL, Studzinski DM, Callahan RE, Brown OW. Long-term outcomes and interventions of postoperative type Ia endoleak following elective endovascular aortic aneurysm repair. J Vasc Surg 2022;75:136-43.e131.

18. Gandhi RT, Katzen BT. Treating a Type Ia Endoleak Using EndoAnchors: Successful endoleak resolution after endovascular abdominal aortic aneurysm repair. Endovascular Today 2014;59:24-6.