# Salvage antegrade visceral revascularization and antegrade aortic stenting for type I and III endoleaks after fenestrated juxtarenal aneurysm repair

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**A 73-year-old man developed type I and III endoleaks from a fractured right renal stent with downward migration of a fenestrated endograft, 6 years after endovascular repair of a juxtarenal aneurysm. Endovascular treatment attempts were unsuccessful. He underwent aortic debranching and antegrade visceral artery revascularization via a left thoracolaparotomy incision and an extraperitoneal approach to the visceral aorta. An antegrade aortic stent covered the endoleak, with technical and clinical success at 9 months. Failure of complex endografts presents particular problems, potentially not amenable to totally endovascular repair. Continued surveillance is mandated as late, asymptomatic sac expansion can occur. (J Vasc Surg 2012;56:1731-3.)**

Total endovascular repair of hostile necked infrarenal, juxtarenal,[1] and thoracoabdominal[2-4] aortic aneurysms using custom-made fenestrated, scalloped, and branched stents is becoming increasingly popular with advances in expertise and stent technology. Reasonable short- to mid-term results have been reported. Type I and III endoleaks reportedly occur after around 18% of complex endovascular procedures,[5] and their management can be technically challenging. We present a case of a patient with type I and III endoleaks after fenestrated stent graft repair, treated with antegrade open visceral revascularization and stenting following failed endovascular rescue.

## CASE REPORT

A 68-year-old male patient presented in 2005 with a 59-mm juxtarenal aortic aneurysm. He had previously undergone an anterior resection for colorectal carcinoma with anastamotic leak and eight subsequent laparotomies and end-ileostomy, and was left with a hostile abdomen. He also had myelodysplasia (with thrombocytopenia) and chronic kidney disease with an estimated glomerular filtration rate of 45. Despite 6-mm external iliac arteries, an endovascular approach was felt to offer the safest solution.

He underwent an endovascular repair via an iliac conduit using a custom-made stent graft (Cook Medical Inc, Bloomington, Ind) with renal fenestrations and a scallop for the superior mesenteric artery. A 6-mm covered stent (Atrium, Hudson, NH) was used in the left renal artery and an uncovered stent (Bard Medical, Covington, Ga) was deployed in the right renal artery.

He entered post-endovascular aneurysm repair (EVAR) surveillance with annual computerized tomography (CT) scanning, and the sac size remained static until 2011, when he was asymptomatic, but noted to have a rapidly enlarging aortic sac diameter, increasing from 59 to 76 mm associated with type I and III endoleaks (Fig 1). The endograft had tilted and migrated distally secondary to right renal stent fracture. Two attempts to cannulate the right renal artery through the fractured stent were unsuccessful (Fig 2). Proximal extension of the aortic stent to cover the endoleaks would have also required coverage of the visceral arteries. Following multidisciplinary team review and extensive discussion with the patient and family, the decision was made to proceed with a combined open and endovascular procedure.

Using a left thoracolaparotomy incision and extraperitoneal approach (in view of the presumed extensive intraperitoneal adhesions), antegrade 8-mm bifurcated Dacron grafts were taken from the mid-descending thoracic aorta and anastomosed on to the celiac axis and superior mesenteric artery with a 6-mm jump graft to the left renal artery, which were subsequently ligated at their origins. Grafts were tunneled through the diaphragm in a periaortic plane. A 34-mm diameter, 100-mm length stent (Talent Captivia; Medtronic, Minneapolis, Minn) was then delivered in an antegrade fashion (via a 10-mm conduit sewn onto the origin of the hybrid grafts) and deployed to cover both renal stents and extend into the distal thoracic aorta. A preoperative decision was made to sacrifice the right renal artery. Balloon molding was avoided to reduce the risk of fabric tearing from the fractured renal stent and postdeployment angiography revealed no evidence of endoleak and patent grafts. Following a short stay in the intensive care unit, the patient made an excellent recovery and was discharged from hospital on day 16 (with a delay to organize social support at home). Prior to discharge, CT angiography demonstrated patent visceral grafts, with no endoleak (Fig 3). Surpris-

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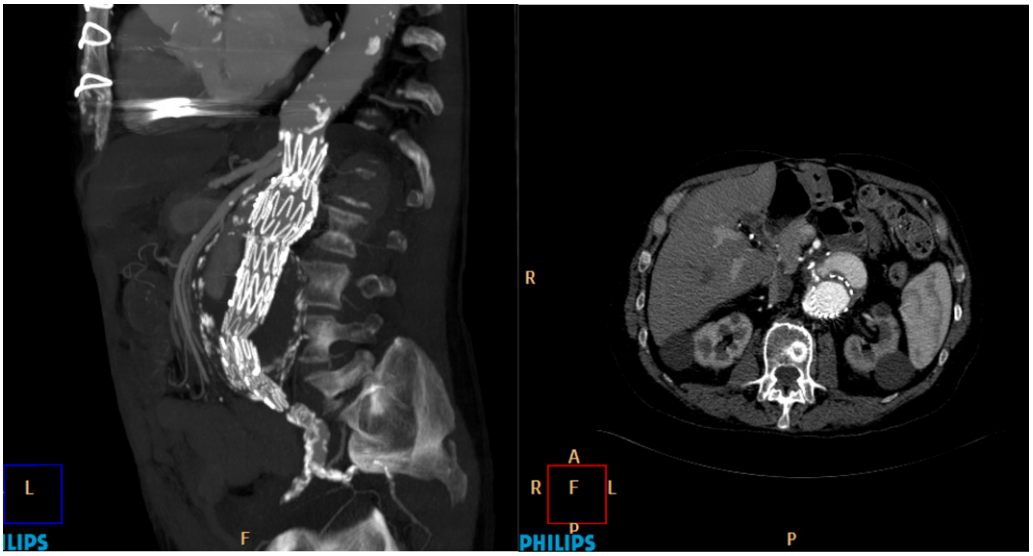


**Fig 1.** New type I and III endoleaks at year 6 with significant sac expansion.

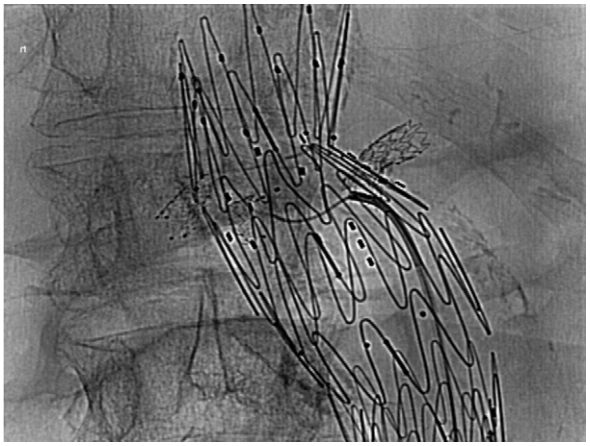

**Fig 2.** Attempted cannulation of fractured right renal stent.

ingly, the right kidney also maintained perfusion from a small accessory renal artery and the postoperative renal function remained essentially unchanged, with an estimated glomerular filtration rate of 42 at 6 months. Subsequent surveillance CT at 9 months shows a stable sac size with no evidence of endoleak.

## DISCUSSION

Endovascular solutions are considered preferable to open repair for many complex aortic pathologies, although the long-term durability of fenestrated and branched custom-made stents is unclear. Under surveillance, a novel and challenging set of complications are being identified in this patient group. Estimates of type I and III endoleaks following fenestrated stent grafting range from 3% to 18.6%.[6] Secondary procedures for complications have a

**Fig 3.** Computerized tomography (CT) demonstrating antegrade arrangement of celiac, superior mesenteric artery, and left renal revascularization grafts and aortic stent.

high failure rate, although the 3-year freedom from any device-related secondary procedure is around 75.5%.[5] We have successfully treated type III endoleaks after fenestrated or branched stent grafting with visceral artery restenting or using a vascular plug to occlude the origin of a disconnected visceral stent. Other endovascular strategies such as the use of chimney stents and partial occlusion of visceral origins with patent foramen ovale closure devices have been reported.[7] In this case, type I and III endoleaks were identified 5 years after fenestrated EVAR causing a significant increase in aortic sac diameter. No endovascular treatment options were successful, and a hybrid solution was considered the most appropriate management option. Although the patient had significant comorbidities and had a slightly worse health status than at the time of the original fenestrated EVAR, this more invasive intervention was deemed preferable to conservative management when faced with a rapidly enlarging aortic sac. It is important to note that the long-term risks of fenestrated EVAR were poorly understood at the time of the original intervention for this patient. However, even with the current, improved understanding of the risk of late endoleaks after complex EVAR procedures,[8] it is unlikely that current management would differ significantly from 6 years ago. Some authors have reported the potential benefits of thrombin injection or sac embolization for the treatment of endoleaks,[9,10] although the value of these options in the presence of a high-pressure endoleak was considered to be limited in this case.

Visceral revascularization is most commonly performed using a retrograde technique, from the distal aorta or iliac arteries. Antegrade revascularization has been described from the ascending aorta, but the descending aorta is an uncommon site from which to take grafts. In this case, the extensive previous abdominal surgery (and intraperitoneal sepsis) precluded a transperitoneal approach. The totally extraperitoneal approach to the abdominal aorta is well described, but has significant limitations. First, the right renal artery is not accessible from the left approach and access to the celiac and superior mesenteric arteries is limited in comparison to the transperitoneal approach. Despite these limitations, the totally extraperitoneal exposure and antegrade revascularization offers a useful option, particularly in patients with a hostile abdomen or unsuitable iliac vessels. In this case, the exposure was adequate to permit comfortable visceral artery access, whereas this may not be the case in patients with obesity or less favorable anatomy.

This case exemplifies the need for long-term follow-up in patients with aortic stent grafts. The renal artery stent fracture and subsequent tilting and migration of the endovascular device caused a rapid sac expansion, which remained asymptomatic and was only identified on annual surveillance. The stent graft failure occurred suddenly 6 years after implantation. This case also highlights that late significant endoleaks arising after complex EVAR may not be amenable to endovascular repair, meaning that specialists involved in the management of this patient group should have the expertise to offer complex open as well as endovascular reinterventions.

The increasing popularity of complex endovascular treatments for aortic aneurysms is likely to mean that vascular specialists will encounter a greater number of unique and challenging complications. Optimal management may involve endovascular, open and hybrid treatment options and should be offered by a multidisciplinary team in a high-volume institution.

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