



## Selected Technique

# A Novel Technique for Sutureless Proximal Aortic Endograft Revision in Type 1A Endoleak

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Management of type 1A endoleaks can be challenging. In the endovascular era, this condition is expected to become more frequent. Conventionally, surgical explant of the endograft remains the “last-resort” surgical treatment when all endovascular or other open options are exhausted. Endograft removal is a difficult and morbid procedure. An alternative technique is described that involves cinching the endograft after disengagement of the proximal fixation hooks. The endograft is redeployed within a prosthetic aortic replacement graft with an overlapping zone. This can reduce complications such as from additional anastomoses, graft bleeding, prolonged clamping, operative time, and associated comorbidities.

## INTRODUCTION

After endovascular aneurysm repair, the reported incidence of type 1 endoleaks is 4.3% at 5 years; in the current practice, 65% of these receive early reinterventions to prevent secondary sac rupture, with a 62% mortality rate.<sup>1</sup> Late explant of an endograft is considered when all other options are exhausted; however, it is a highly morbid procedure with post-operative complication rates reported >50% within 30 days.<sup>2</sup> Conventional open conversion in this setting involves a straight or bifurcated aortic

replacement graft, typically polytetrafluoroethylene or Dacron, and requires suprarenal clamping. Techniques that reduce clamp and operative time would be expected to improve the outcome.

## TECHNICAL NOTE

A 67-year-old man with type 1A endoleak from distal graft migration of the main body presented with sac enlargement from 5.0 to 5.5 cm (Fig. 1). The original graft was a standard bifurcated Medtronic Endurant II aortic graft (Medtronic Endovascular, Minnesota, USA) with a main body diameter of 28 mm. This had been implanted 3 years prior at another medical institution. Following preoperative risk assessment, the patient opted for open repair. Other than being a recent ex-smoker, there was no co-existing cardio-respiratory disease. The superior margin of the bare stent had migrated inferiorly to the level of the right upper renal artery. Written informed consent was obtained for the procedure and this publication.

The repair involved the following steps (Fig. 2):

1. Via a midline laparotomy, the abdominal aorta was exposed transperitoneally
2. The suprarenal and distal aorta were clamped

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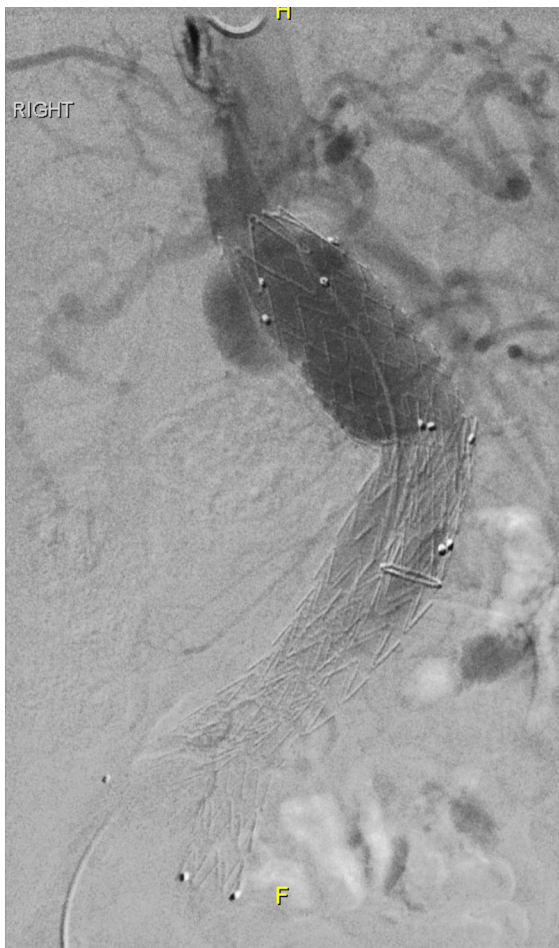
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**Fig. 1.** An image of the preoperative digital subtraction angiogram demonstrating the endoleak.

3. The aneurysm sac was opened and the main body fabric was clamped and divided 3 cm below the upper margin of the covered stent.
4. The proximal segment, along with the bare metal struts, was extracted using previously described techniques of serial cinching, syringe constraint, and wire cutters. The distal endograft was left intact.
5. A 18-mm polyester tube graft (Gelsoft, Vascutek Terumo, Michigan, USA) was anastomosed to the juxtarenal aorta. The graft diameter was determined by the juxtarenal aortic diameter at anastomosis, accounting for acceptable oversizing of the endograft and expected polyester dilatation. The proximal clamp was then transferred to the grafted infrarenal segment. Suprarenal clamp time was approximately 60 min, given the difficulties in removing the proximal stent and anastomosing onto the friable endarterectomized aorta.

6. The remaining main body stent was secondarily cinched in the proximal segment with 0-silk (Ethicon Inc., New Jersey, USA) controlled by a 3-cm-length infant nasogastric tube at 2 levels (Fig. 3). The polyester graft was shortened to ensure a minimum 5 cm overlap distance between the polyester and the endograft. The polyester graft was everted to allow the endograft to be placed superiorly (Fig. 4).
7. The polyester graft was unsleeved, and the cinching sutures were released to redeploy the endograft within the polyester graft ensuring adequate oversizing. The stent graft was not sutured to the polyester graft.
8. The overlap zone was reinforced with a 6-mm nylon tape (Ethicon Inc., New Jersey, USA) at multiple levels to ensure adequate support and hemostasis (Fig. 5). This technique required about 3 min to complete.

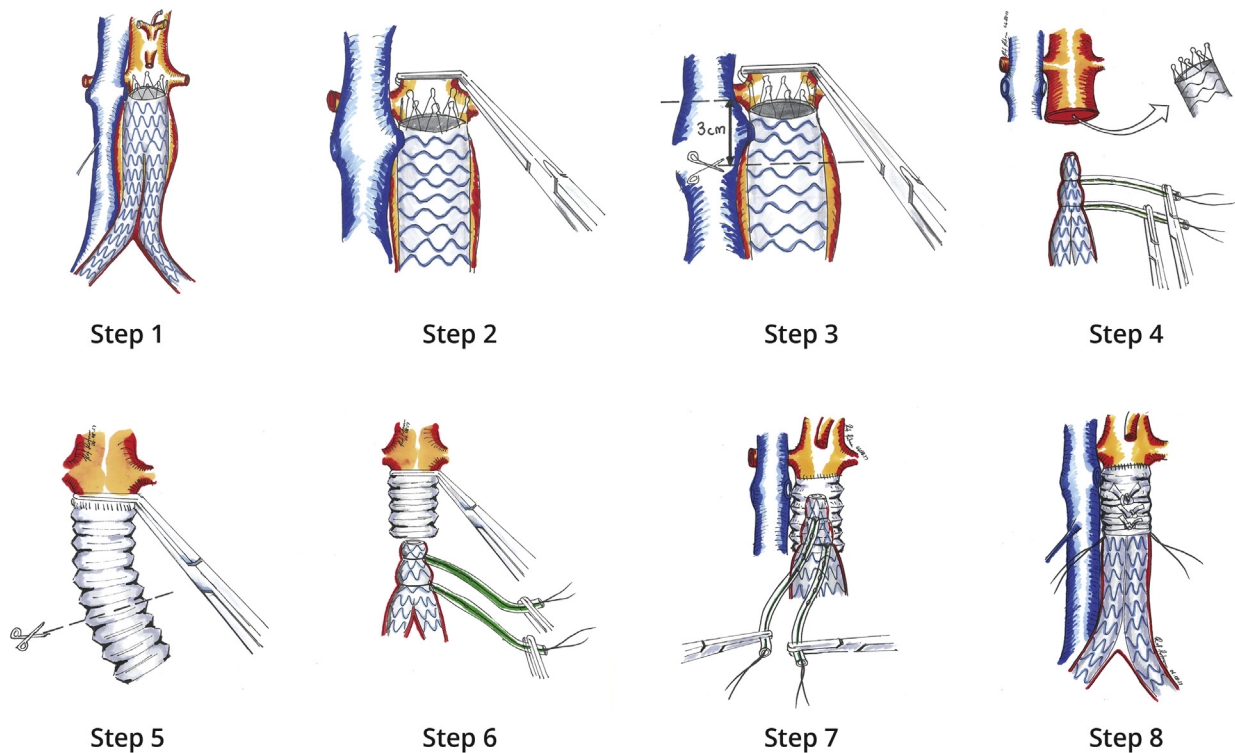
This technique is modifiable using a number of adjuvant techniques including tacking sutures to secure the 2 grafts together and minimize future component separation. However, this may increase suture-hole bleeding. Optionally, a short longitudinal incision could be employed in the polyester graft to facilitate eversion. The stent graft could be recinched using the original 0-silk ties and infant nasogastric tube, and the steps could be repeated without difficulty to ensure ideal deployment position. In addition, a 2-cm band could be secured across the overlapping zone with polyester material and 5/0 prolene (Ethicon Inc., New Jersey, USA) to ensure hemostasis, all at the discretion of the surgeon.

Once satisfied with the position, the 0-silk ties and nasogastric tube were released and removed. The prosthetic material was covered by the aortic sac, and hemostasis was obtained, paying particular attention to guttering or endoleak between the 2 graft materials. The remainder of the operation was unremarkable.

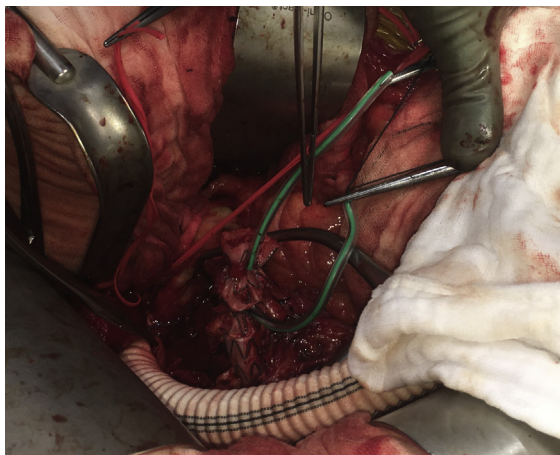
The patient was discharged on day 10 after management of transient acute renal failure attributed to suprarenal clamping. Six-week and 6-month follow-up ultrasound scans showed satisfactory outcomes with no stent-related abnormalities detected. Imaging surveillance will continue as per standard after endovascular aneurysm repair surveillance.

## DISCUSSION

Open management techniques for type 1A endoleak include periaortic banding and complete explant of



**Fig. 2.** Step-by-step procedure for proximal aortic endograft revision.



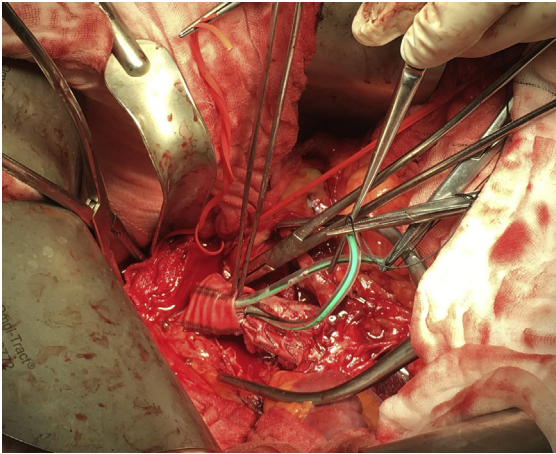
**Fig. 3.** A photograph taken intraoperatively to demonstrate the polyester graft anastomosed to the aorta and the endograft cinched at 2 levels.

the endograft; the latter remains extremely challenging and exerts more physiological stress than conventional aortic surgery involving a period of suprarenal and infrarenal clamping. Contemporary series report that renal failure after infrarenal aortic aneurysm repair occurs in 1 to 13% of cases.<sup>3</sup> As such, it was unsurprising that renal failure resulted

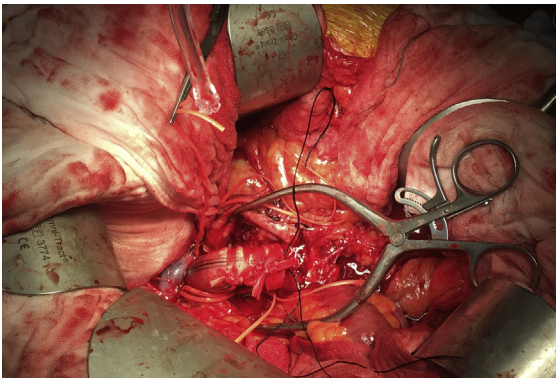
from prolonged suprarenal clamping during this procedure. This could have worsened if the infrarenal clamp time was also prolonged. Infrarenal clamping is associated with reduced renal clearance and perfusion by up to 40%.<sup>4</sup> Nevertheless, elective open surgical conversions for type 1A endoleaks is not associated with increased morbidity and mortality when compared with open juxtarenal aortic aneurysm repairs in appropriately selected patients.<sup>5</sup>

Techniques for endograft explant are inadequately described with only 4 case reports identified. These described applying various devices, such as a cylindrical syringe or a disposable proctoscope, to resheath the endograft to explant the stent; a cutter to divide the suprarenal struts; or to preserve the first covered stent as a “neo neck” to facilitate proximal anastomosis.<sup>6–9</sup>

The innovative technique described in this article eliminates the requirement for a second end-to-end anastomosis between the polyester tube graft and the endograft. This translates to improved physiological state with reduction in clamp and operative time, coagulopathy, and blood loss from anastomotic bleeding between the 2 prosthetic grafts. While the principle of this technique is simple, there



**Fig. 4.** A photograph to demonstrate that the cinched endograft was inserted into the everted polyester tube graft.



**Fig. 5.** A photograph to demonstrate the nylon tapes applied around the overlapping zone to ensure adequate support and hemostasis. Note the silk ties were left in situ to allow recinching and repositioning of the endograft if required.

is a learning curve as demonstrated in this experience.

This approach can be considered when preservation of the distal portion of the aortic stent graft is possible. The technique would be applicable to any conventional self-expanding stent graft once the bare supra-aortic struts had been removed, but the benefit is greatest in those patients where it would facilitate reduced suprarenal clamp time. Non-redeployable rigid balloon-mounted aortic stents or polymer seal stent graft systems such as Nellix (Endologix Inc, Irvine, USA) would not be suitable

for this method. Similarly, aortic morphology with severe angulation may pose a risk of graft dislodgement. In addition, stent grafts with tenuous distal fixation or requiring complete explantation for infection would be unsuitable. An aortic stent with a longer main body or length above the flow divider may be more amenable. The Endurant endograft has a relatively short distance above the flow divider (i.e., 50 mm), with most commercial stents possessing at least 40 mm. Nonetheless, transecting the aortic stent 5–10 mm higher should still be ergonomically feasible.

## CONCLUSION

Endograft explantation is a challenging and difficult exercise. This alternative technique is a valuable option for open repair of persistent type 1A endoleak while avoiding sutured anastomoses, graft bleeding, or prolonged operative time and its associated comorbidities.

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