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journal homepage: [www.casereports.com](http://www.casereports.com)External aortic wrap for repair of type 1 endoleak<sup>☆</sup>

Anastasia Dean\*, Swee Leong Yap, Venu Bhamidipaty, Franklin Pond

Department of Vascular Surgery, Western Hospital, Gordon Street, Footscray, VIC 3011, Australia

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## ABSTRACT

**INTRODUCTION:** Type 1 endoleak is a rare complication after endovascular abdominal aortic aneurysm repair (EVAR) with a reported frequency up to 2.88%. It is a major risk factor for aneurysmal enlargement and rupture.

**PRESENTATION OF CASE:** We present a case of a 68 year old gentleman who was found to have a proximal type 1 endoleak with loss of graft wall apposition on routine surveillance imaging post-EVAR. An initial attempt at endovascular repair was unsuccessful. Given the patient's multiple medical co-morbidities, which precluded the possibility of conventional graft explantation and open repair, we performed a novel surgical technique which did not require aortic cross-clamping. A double-layered Dacron wrap was secured around the infra-renal aorta with Prolene sutures, effectively hoisting the posterior bulge to allow wall to graft apposition and excluding the endoleak. Post-operative CT angiogram showed resolution of the endoleak and a stable sac size.

**DISCUSSION:** Several anatomical factors need to be considered when this technique is proposed including aortic neck angulation, position of lumbar arteries and peri-aortic venous anatomy. While an external wrap technique has been investigated sporadically for vascular aneurysms, to our knowledge there is only one similar case in the literature.

**CONCLUSION:** Provided certain anatomical features are present, an external aortic wrap is a useful and successful option to manage type 1 endoleak in high-risk patients who are unsuitable for aortic clamping.

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## 1. Introduction

Endovascular abdominal aortic aneurysm repair (EVAR) has been increasingly performed as a less invasive alternative to open repair of abdominal aortic aneurysm pathology.<sup>1</sup> Type 1 endoleak is a significant but uncommon complication of EVAR and is associated with a high risk of aneurysm growth and potential rupture.<sup>2</sup> Treatment for type 1 endoleak commonly includes the use of proximal extension cuff and/or the use of a Palmaz® (Johnson & Johnson Interventional Systems Co., Warren, NJ) stent to maximize infra-renal aortic sealing and graft wall apposition. In cases where endovascular techniques are either unsuccessful or unfeasible, open revision techniques have been recommended and usually necessitate either graft explantation or open sac revision. We describe a successful case of surgical treatment for a proximal type

1 endoleak following EVAR, performed without the use of aortic clamping.

## 2. Presentation of case

A 68 year old gentleman underwent endovascular repair of a 6 cm diameter fusiform infra-renal aortic aneurysm using a Zenith® (Cook Medical, Bloomington, IN) bifurcated device in 2004. He presented to our clinic for review of routine surveillance computed tomography (CT) imaging. The CT angiogram demonstrated caudal graft migration, a proximal type 1 endoleak and loss of graft wall apposition due to ongoing posterior infra-renal neck dilatation, measuring approximately 10 mm. The aneurismal sac size had increased to 7.0 × 5.5 cm from 6.5 × 5.3 cm in 2009; the aneurismal neck was 28 mm in diameter. He had significant co-morbidities including cerebrovascular disease, severe obstructive sleep apnoea (OSA), ischaemic heart disease, type 2 diabetes mellitus, hypertension, hypercholesterolaemia, morbid obesity and a significant smoking history.

Review of his serial imaging confirmed 6 mm of infra-renal aortic neck in which a seal could potentially be achieved using endovascular techniques. As such, the patient was consented for an endovascular repair, being counselled that the risk of an

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\* Corresponding author. Tel.: +61 3 8345 6333; fax: +61 3 83456954.  
E-mail address: [anastasiaedean@gmail.com](mailto:anastasiaedean@gmail.com) (A. Dean).



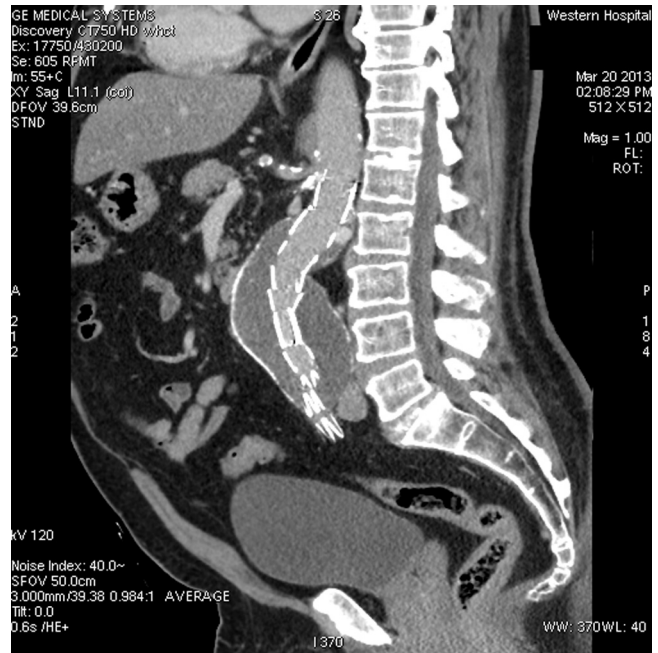
**Fig. 1.** CT scan sagittal slice, showing the infra-renal AAA prior to initial endovascular repair.

unsuccessful procedure and need for conversion to an open repair was high (Figs. 1–5).

He proceeded to undergo an attempt at endovascular salvage of the endoleak. Under general anaesthetic, he underwent a catheter angiogram which confirmed the CT findings of a posterior endoleak. An Endurant® (Medtronic, Inc., Minneapolis, MN) 28 mm × 49 mm cuff was deployed in the immediate infra-renal aortic neck with the graft material slightly protruding across the inferior aspect of both renal arteries to maximize seal. Despite aggressive balloon moulding, the type 1 endoleak persisted. Subsequently, an attempt was made to place a Palmaz® stent. During the deployment process, however, the Palmaz® stent inadvertently migrated off the balloon



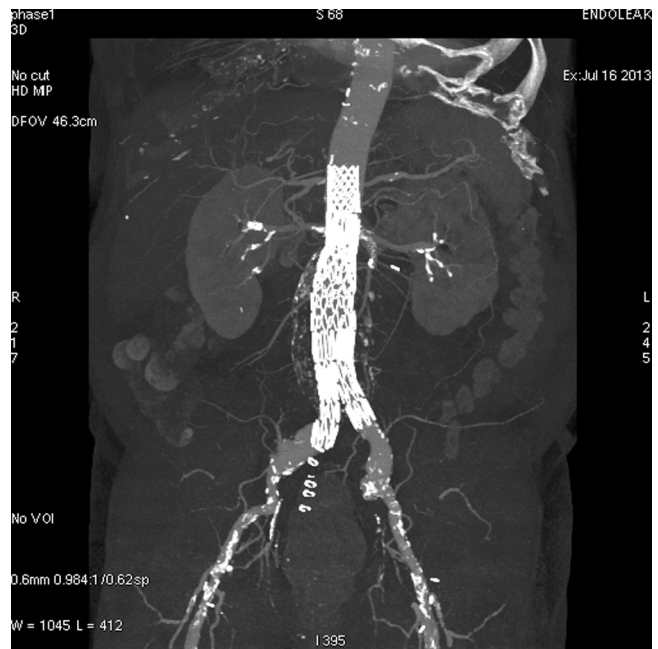
**Fig. 2.** CT scan coronal slice, showing the infra-renal AAA prior to initial endovascular repair.



**Fig. 3.** CT scan sagittal slice, showing a type 1 endoleak post-endovascular repair of AAA with a Zenith® bifurcated device. Note the contrast blush posteriorly into the aneurysmal sac and loss of graft-wall apposition.

and as a salvage manoeuvre the stent was deployed in the visceral aorta extending into the supra-coeliac aortic clamp zone. At this point, the endovascular procedure was aborted.

Despite being advised of the extremely high peri-operative morbidity and mortality risk, the patient was adamant on pursuing further surgical options. Given his poor physiological reserve, comorbid state, and that the Palmaz® stent was seated across the supra-coeliac clamping zone, the vascular team offered to repair the endoleak using a peri-aortic Dacron graft, thus avoiding the need for aortic cross-clamping.



**Fig. 4.** CT scan coronal slice, after the initial endovascular attempt to repair type 1 endoleak with an Endurant® cuff and the Palmaz® stent. Note the position of the Palmaz® stent across the supra-coeliac aortic clamp zone.





**Fig. 5.** CT abdomen, sagittal view, after the external wrap. Note the posterior aortic wall has been hoisted up against the Zenith® graft with resolution of the type 1 endoleak.

Following extensive pre-operative medical optimization, three months after the endovascular attempt, the patient proceeded to open revision. Under general anaesthetic, a midline laparotomy was performed and the bowel was mobilized as per standard infra-renal aortic exposure. Careful dissection was undertaken around the infra-renal aorta, skeletonizing it from the level of the renal vein to the inferior mesenteric artery. Dissection around the posterior aspect of the aorta, again, was done taking great care to avoid injury to the lumbar vessels. Next, a 10 mm Dacron (Gelsoft™, Vas-ctek Ltd, a TERUMO Company, Renfrewshire, UK) tube graft was laid flat and wrapped around the infra-renal aorta immediately below the renal arteries, such that both layers were included in the wrap. The external wrap was sewn together under tension using a haemostat clip using 2/0 Prolene (Ethicon Endo-Surgery Inc., Blue Ash, OH) sutures, effectively hoisting the posterior bulge to allow wall to graft apposition. The subsequent intra-operative completion angiogram, performed via a pigtail catheter in the right femoral artery, showed resolution of the endoleak and a patent aorta in multiple projections. There was a slight but noticeable difference in the wire-form morphology at the proximal end of the stent graft. The operative time was 190 min.

The post-operative period was uneventful. On day five, a follow-up CT angiogram showed no evidence of type 1 endoleak. He was discharged on post-operative day seven. An arterial duplex ultra-sound one month post-procedure showed resolution of the endoleak and stable aneurismal sac size.

### 3. Discussion

In this case, further endovascular options to repair the type 1 endoleak would have required consideration of snorkel techniques or renal/supra mesenteric artery fenestration and the added technical challenge of cannulating and stenting the renal arteries through two sets of supra-graft struts. Conventional open repair and supra-coeliac aortic clamping, however, was not feasible given the patient's physiological state and the mal-deployed Palmaz® stent sitting in his visceral aorta. Our novel surgical technique is a safe, less-invasive alternative to conventional open repair for type

1 endoleak and to best of our knowledge, there is only one similar case in the literature.

Younis et al. performed an aortic wrap technique for management of a persistent type 1 endoleak following two failed attempts at endovascular repair—firstly using a Palmaz® stent and EndoFit® (LeMaitre Vascular, Inc., Burlington, MA) aortic cuff with suprarenal fixation, and 22 months later using a Palmaz® stent mounted on a Zmed (NuMED Canada Inc., Ontario, Canada) balloon.<sup>3</sup> For their wrap, the investigators used a Hemashield graft (Meadox, Oakland, NJ) secured with 2.0 Ticron (Tyco, Waltham, MA) sutures. They reported resolution of the endoleak and shrinkage of the aneurysm on CT angiogram 12 months post-procedure.

While there have been no other studies in human subjects, Kudo et al. reported the use of an aortic wrap to create a proximal infra-renal aortic landing zone for an endoluminal aortic graft in an animal model.<sup>4</sup> Results showed that the custom-made external wrap was partially adherent at three weeks and fully incorporated into the adventitia at five weeks; histologically, the underlying aortic wall was structurally intact.

Moreover, an external wrap of the aorta itself is not a new idea. In the 1940s, polythene cellophane wrapping was performed as a surgical technique for AAA repair, most notably by Swiss surgeon Rudolph Nissen on Sir Albert Einstein. Types of cellophane had been shown to cause irritation to tissue, and as such, it was theorized that it would cause wall thickening and obliteration of the aneurysm lumen.<sup>5</sup> This technique, however, was superseded by the advent of the first bypass grafts.

Several anatomical factors need to be considered when this technique is proposed. Lumbar arteries pose a technical challenge, both in terms of allowing circumferential and posterior dissection of the aortic neck and when attempting to slide the aortic wrap up to the immediate infra-renal aorta. Pre-operative identification of these vessels is vital to prevent significant bleeding complications. Anterior aortic neck angulation would also favour the use of the wrap technique, not only to allow for dissection behind the aorta and anterior to the anterior longitudinal ligament but also to allow adequate space for identification and ligation of pre-operatively identified lumbar arteries. Variable venous anatomy must be identified pre-operatively, as retro or circum-aortic left renal vein and duplicate inferior vena cavae would pose significant anatomical challenges. Careful dissection and identification of the left lateral border of the inferior vena cava (IVC) and any lumbar veins would avoid inadvertent IVC injury when passing a right-angled instrument around the aortic neck. For posterior aortic dissection, titling of the operation table towards or away from the surgeon would also be a helpful manoeuvre.

At present, we can only theorize about the durability of this treatment. Dilatation of knitted Dacron grafts is commonly reported in the literature with a recent systematic review reporting overall dilation ranged between 18% and 58% in a time period spanning between 12 days and 73 months.<sup>6</sup> However, the same review concluded that the dilation profile and expansion rate is scarcely predictable. Furthermore, as this technique sees the Dacron graft wrapped in a double-layer fashion around the aorta, it is not subject to the same pressures. Importantly, we are proposing this technique as a potential salvage technique only and one which could be suitable for patients who have failed endovascular repair and are not fit for conventional graft explantation with open repair.

### 4. Conclusion

In our experience, using a Dacron graft to plicate the infra-renal aorta is a safe and viable option to manage type 1 endoleak in high-risk patients unsuitable for aortic clamping. Further studies to validate the technique highlighted in this case are unlikely to be

possible or practical. In high-risk patients with a type 1 endoleak, however, provided certain anatomical features are present, an external aortic wrap can be a useful and successful option.

#### Conflict of interest statement

The authors have no proprietary or commercial interest in any material discussed within this report.

Franklin Pond and Mr Venu Bhamidipaty performed the operation and edited the final draft.

#### Disclaimer

The views expressed in this article are the authors' own and not the official position of the institution or funder.

#### Key learning points

- Type 1 endoleak is a rare complication of EVAR.
- Type 1 endoleak is a major risk factor for aneurysmal dilatation and rupture.
- An external aortic wrap is an option to repair type 1 endoleak in high-risk patients.

#### Funding

None.

#### Ethical approval

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

#### Author contributions

Dr Anastasia Dean and Dr Swee Leong Yap reviewed the literature, found the original images and wrote the initial drafts. Mr

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