Successful laparoscopic repair of refractory type Ia endoleak after endovascular abdominal aortic aneurysm repair

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Type I endoleaks associated with sac enlargement after endovascular abdominal aortic aneurysm repair mandate urgent intervention. Endoluminal treatments are generally considered first, but when these fail, open surgery has been advocated as a last resort. Open surgery is associated with significant mortality and morbidity, and thus, approaches that reduce this risk would be of interest. We report a successful case of laparoscopic treatment of a refractory type Ia endoleak after endovascular abdominal aortic aneurysm repair in an 83-year-old man. (J Vasc Surg 2015;61:275-9.)

Type Ia endoleaks are caused by a failure to achieve a seal between the neck of the aneurysm and the proximal end of the stent graft. 1,2 They generally mandate urgent reintervention because of the risk of pressurized sac expansion and eventual rupture. 2,3 Endoluminal treatment options for persistent type I endoleaks include balloon angioplasty, extension stent grafts or cuffs, bare stents, or embolization. 1,4 Where such treatments fail, open surgical techniques are advocated but can be associated with procedural mortality rates of 15% to 45%. 2,3,6 Approaches such as laparoscopic surgery, which could reduce this risk and enhance postoperative recovery, would therefore be of interest.

CASE REPORT

An 83-year-old man was referred to our unit for laparoscopic repair of a refractory type Ia endoleak after endovascular abdominal aortic aneurysm repair (EVAR). Informed consent was gained for the publication of this report, and Institutional Review Board approval was not considered necessary.

The patient had undergone primary EVAR at another institution 42 months previously. The initial preoperative morphologic assessment had revealed a 60-mm-diameter, fusiform-shaped infrarenal abdominal aortic aneurysm with a short (17-mm), conical (23-mm to 27-mm flare), angulated (90° C14°) neck, and dual renal arteries on the left. Patient comorbidity contributed to the decision to perform endovascular rather than open repair.

The surgery was performed under general anesthesia through bilateral groin cutdowns. A 28-mm-diameter Aorfix bifurcated stent graft (Lombard Medical Technologies, Didcot, UK) was inserted. A type Ia endoleak was noted immediately after stent graft deployment, but this resolved with repeat balloon molding.

The endoleak was noted to have recurred without appreciable stent graft migration on a surveillance computed tomography (CT) angiogram 6 weeks later, and therefore, a giant Palmaz stent (Cordis, Miami Lakes, Fla) was deployed and dilated within the neck of the aneurysm. The endoleak recurred on surveillance CT angiogram 6 weeks later and was associated with an increase in sac size to 2 mm (Fig 1, A).

A diagnostic catheter angiogram revealed a left-sided anterior leak with a small gap between the Palmaz stent and the stent graft that persisted despite repeat balloon molding and then Onyx (ev3 Endovascular, Inc, Plymouth, Minn) embolization of the proximal sac cavity. On-going dilatation of the aortic neck was evident because the Aorfix stent graft eventually attained a circular configuration rather than the immediate postprocedural fish-mouth shape. After the Onyx injection, further surveillance with contrast-enhanced duplex ultrasound imaging demonstrated an ongoing type Ia endoleak with an increase in sac size to 65 mm during the following 12 months (Fig 1, B).

Fenestrated stent extension was judged to be technically unfeasible due to the unfavorable renal artery anatomy (Fig 1, C),
and thus, it was felt that endoluminal options had been exhausted. Surgical intervention was considered and a laparoscopic approach deemed preferable to open surgery.

Surgery was undertaken with the patient placed at an 80° right lateral tilt and his right arm in extension. A 12-mm port was introduced in the left upper quadrant using a Hasson technique. Four additional 10-mm ports and a 5-mm blunt port were inserted para-rectally under vision. A left common femoral artery cutdown was performed to allow catheter angiography and passage (after administration of 2000 units of systemic heparin) of an aortic occlusion balloon to the suprarenal aortic lumen as a fail-safe measure.

The aneurysm sac was approached in the retrocolic retrorenal plane after a left total medial visceral rotation, and the neck was dissected to allow visualization of both left renal arteries. An on-table angiogram and contrast ultrasound study confirmed a left anterior type Ia endoleak. The endoleak was sealed by sutures though the aortic neck, underlying stent graft, and Palmaz stent using nonabsorbable 1 Ti-Cron sutures (Covidien, Mansfield, Mass; Fig 2, A). The aortic occlusion balloon was concurrently inflated to buttress the aortic neck while knots were tied intracorporeally over Teflon (DuPont, Wilmington, Del) pledgets and 5-mm Ligaclips (Ethicon, Somerville, NJ) applied beyond the knots to prevent slippage (Fig 2, B).

The occlusion balloon was left deflated in the suprarenal position during suture placement and then intermittently pulled down to the suture line and inflated to a predetermined size (equal to the inner aortic diameter on CT) to aid suture tightening—a process that took ~1 hour. A full row of periaortic sutures was inserted from the left posterolateral aspect around anteriorly to the right posteromedial aspect of the aortic neck. Video footage of the procedure is presented as a Supplementary Video (online only).

Hemostasis was aided with the application of Tisseel fibrin sealant (Baxter, Deerfield, Ill) and absorbable Surgicel hemostatic ribbon (Ethicon) to the aneurysm neck. Dissection of the inferior part of the sac was completed and the inferior mesenteric artery occluded with cautery using the Ultracision Harmonic Scalpel (Ethicon). Completion on-table angiography and contrast duplex ultrasound imaging confirmed abolition of the endoleak (Fig 3, A and B).

Estimated blood loss from the surgery was 600 mL. The patient was transferred to the high dependency unit for postoperative monitoring. Apart from a brief 12-hour period of inotrope administration immediately after the operation, no other organ support was required. The patient recovered well and was medically fit for discharge on postoperative day 5.

A CT angiogram at 8 weeks demonstrated continued abolition of the endoleak and 6-mm reduction of sac diameter to 64 mm (Fig 3, C). Contrast ultrasound imaging at 1 year confirmed a continued reduction in aneurysm diameter to 62 mm and no recurrence of the endoleak. The patient remains well at 18 months from surgery.
DISCUSSION

Optimal treatment strategies for type Ia endoleaks depend on the cause of the leak, which can be primary and related to adverse morphology, device, or operator failure, or secondary due to aneurysm remodelling causing progressive neck dilatation. We hypothesize that the leak in this patient occurred because of poor apposition caused by adverse neck morphology and continued dilatation of the aortic neck, as evidenced by the loss of the fish-mouth configuration of the Aorfix device, which might have been exacerbated by the Palmaz stent. Although the Aorfix device has demonstrable utility in neck angulation (indeed, it is the only device licensed in both the United States and in Europe for neck angulation of up to 90°), overcoming adverse neck morphology, particularly combinations of features such as conicity and angulation, remains a challenge in the on-going development of stent graft technology.

This case illustrates use of the full range of endovascular reintervention for endoleak, with the exception of fenestrated extension and stapling devices. Fenestrated extension was judged to be unfeasible for reasons already described, and although we had the HeliFX EndoAnchor System stapling device (Aptus Endosystems, Sunnyvale, Calif) on stand-by during the operation, we felt that the significant lack of apposition between the stent graft and
aortic neck, which was exacerbated by the presence of Onyx material between the two, precluded the use of endoanchoring as a first-line salvage option.

When endoluminal options are exhausted, open repair is generally considered the only option in patients deemed fit for surgery. Several open techniques have been used, ranging from application of circumferential ligatures around the proximal aortic neck to formal stent graft explantation and insertion of a surgical graft with or without suprarenal control. Although several authors have reported high mortality rates, this is not a universal finding.

Systematic review of the literature concerning laparoscopic aortic surgery has confirmed the feasibility of the procedure, but the quality of the evidence is acknowledged to be poor and fails to show a convincing advantage over open surgery using conventional metrics. This observation, combined with the longer operating times, associated steep learning curve of the laparoscopic approach, and the massive adoption of endoluminal techniques, has perhaps deterred widespread uptake of the technique. Proponents of laparoscopy would argue that its role is not as an alternative to endovascular surgery but may offer advantages over traditional open surgery in selected cases. Selection of suitable cases represents balancing patient fitness and aneurysm morphology with appropriate technical experience in laparoscopic aortic surgery.

Thus, laparoscopic surgery has been successfully used to treat complications of EVAR, with reports describing clipping of feeding vessels in type II endoleaks and even reports of total laparoscopic stent graft explantation to treat proximal type I endoleak after distal migration. Although laparoscopic suturing of the endograft to the proximal aortic neck has been reported in the context of graft migration, the technique described here is novel for a number of reasons. This case describes an endoleak in the context of a stable but relatively undersized endograft with a dilating aortic neck. It is conceivable, therefore, that simple suturing of the endograft to the neck might not have been sufficient to create a seal. Our technique combines suturing with a buttress in the form of the Teflon pledget and Ligaclip and thus provides a compressive effect similar to that achieved by periaortic ligatures. The compressive effect was further enhanced with the inflation of an aortic occlusion balloon intermittently to support the aortic wall during suture tightening.

The amount of blood loss we experienced was greater than expected because the periaortic tissues in the retrocolic, retroversal plane were fibrosed and adherent, presumably due to the presence of the endograft. The underlying Palmaz stent was an additional technical hurdle to overcome because the initial sutures using a smaller-caliber nylon material snapped when pulled tight against the underlying metal struts. Although we were able to suture ~75% of the aortic neck circumference, the Palmaz stent likely provided some degree of reinforcement to the neck and may have provided a seal in the most posterior quadrant where sutures were difficult to insert.

The entire procedure was practiced in a dry laboratory setting using a laparoscopic simulator with an endograft inserted into a segment of bovine aorta (The ICENI Centre, Colchester, UK). This preprocedural planning stage included sizing of the needle to be used (a half-circle 27-mm needle positioned perpendicular to the aortic wall and rotated on a constant axis was noted to follow an arc with a 9-mm radius), determination of the level for suturing (a site where the combined depth of the aortic wall, endograft, and Palmaz stent was noted to be 4 mm), and confirmation that tactile feedback of the needle passing through both aortic wall and synthetic material could be felt using laparoscopic needle holders.

The technique of laparoscopic circumferential banding was also practiced using the simulator and might have been used had the suturing technique failed. In our opinion though, banding of the neck should be accompanied with suturing to secure the band to the aortic wall to prevent intraluminal displacement of the endograft when the band is tightened.

CONCLUSIONS

We acknowledge the limitations associated with this report and technique. Thus, laparoscopic aortic surgery has a steep learning curve, is technically demanding, and is associated with longer operating times than open surgery. The technique described here requires application to further cases to demonstrate reproducibility. We anticipate further refinements in the technique but present this case as an example of the possible utility of laparoscopic surgery in managing complications after EVAR.

REFERENCES


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Additional material for this article may be found online at www.jvascsurg.org.