» **How to Do It** «

Open Reintervention for Aneurysmal Sac Enlargement after EVAR

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We performed a late open reintervention for aneurysmal sac enlargement due to persistent type 2 endoleak (PT2EL) after EVAR for 8 of 286 patients. Surgical techniques are as follows: (1) The entire aneurysmal body was exposed. (2) All the aortic branched vessels were ligated. (3) The aneurysmal sac was opened followed by the performance of complete hemostasis. (4) An equine pericardium was wrapped and sutured to the aneurysmal sac to for reinforcement. This method is considered to be one of the feasible options for the treatment of aneurysmal sac re-enlargement after EVAR.

Keywords: EVAR, endoleak, sac enlargement

Introduction

Endovascular aortic aneurysm repair (EVAR) has been a conventional and standard treatment option for infrarenal abdominal aortic aneurysm (AAA) as a safer and less invasive procedure, compared to open surgery (OS).¹⁾ However, close and continued surveillance after EVAR is necessary because a significant percentage of patients require reintervention for graft-related complications, particularly for an endoleak.²⁾ Chang, et al. demonstrated postoperative endoleak was seen in 30% of patients and was associated with an increase in sac size over time.³⁾ In cases of aneurysmal sac enlargement due to persistent endoleaks refractory to repeated endovascular treatments (EVT) after EVAR, patients may require late open conversion, including complete explants of the endografts followed by aortic graft replacement, and this method is considered

technically demanding to successfully perform because of injuries to the aortic walls when removing the endoprosthesis and surgical site bleeding derived from dissecting the dense adhesion between the aneurysmal wall and its surrounding tissues by systemic heparinization. We reported a modified technique of open surgical treatment for aneurysmal sac enlargement after EVAR in 2012 as a less invasive and effective alternative to late open conversion stated above.⁴⁾ In this article, clinical outcome of this type of modified open repair was reviewed, and technical details and features were demonstrated.

Patients and Methods

We performed open reintervention for aneurysmal sac enlargement after EVAR for 8 of 286 from the beginning of May, 2007 until the end of July, 2013. The indications of open reintervention were as follows; changes in sac diameter >5 mm or maximum sac diameter >60 mm refractory to repeated endovascular surgery (more than two times).

Surgical technique

1. Midline laparotomy was performed to expose the entire aneurysmal body (**Fig. 1A**). 2. All the branched vessels arising from the aneurysmal wall, including

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Fig. 1 (A) The entire aneurysmal body exposed after midline laparotomy. (B) The lumbar artery (black arrow) ligated with the metal clips. (C) Inferior mesenteric artery (black arrow) transected. Massive retrograde blood flow identified.

the inferior mesenteric artery, lumbar arteries, and medial sacral artery were ligated from outside the aneurysmal wall (Fig. 1B and 1C). 3. Proximal infra-renal aortic neck and bilateral common iliac arteries were exposed and encircled. 4. The aneurysmal sac was longitudinally opened. All the bleeding spots inside the aneurysmal sac were carefully inspected and completely controlled after removal of mural the thrombus (Fig. 2A). 5. After making sure of complete hemostasis (Fig. 2B), residual aneurysmal wall was resected as much as possible to reduce the dead space between the endograft and the aneurysmal sac, followed by continuous running suture to tightly close the aneurysmal sac (Fig. 2C). 6. Finally, a Teflon-backed glutaraldehyde-preserved equine pericardium (Xenomedica; Baxter Health Corp., Horw, Switzerland) was wrapped and sutured to the aneurysmal sac to reinforce it against further pressurization (Fig. 2D). 7. The retroperitoneum was closed to prevent aorto-enteral fistulae.

Results

The mean age of patients at the time of initial EVAR was 81.0 ± 3.6 (range 74.4–85.7) years, and two cases (25%) were female. The mean interval between EVAR and late open conversion was 41.3 ± 8.8 (range 24–52) months. The mean change in sac diameter was 9.4 ± 3.2 (range 5–13) mm. EVAR grafts included 6 Excluder (W.L. Gore, Flagstaff, Arizona, USA) and 2 Zenith (Cook Inc., Bloomington, Indiana, USA). Primary cause of aneurysmal sac enlargement included 7 persistent type 2 endoleak (PT2EL) and 1 endotension classified as type 5 endoleak. The mean

observation period after late open conversion was 6.6 (3 weeks–23 months). There have been no instances of sac re-enlargement to date. This information is summarized in Table 1, and there were no cases of operative or in-hospital death in Cases patients.

Discussion

Operative strategies in terms of late open conversion for aneurysmal sac enlargement after EVAR are still controversial, and include some more technical challenges which are quite different from those with initial OS. One of the most important therapeutic decisions in considering open repair after EVAR depends on whether the endograft should be completely removed or left in-situ. In case of performing complete removal of the endoprosthesis, one of the technically demanding issues is the existence of the suprarenal bare metal stent which is the part of the most commonly used stent grafts such as Zenith (Cook Inc., USA). As this bare metal stent is usually placed in a transrenal position, the site of proximal clamp replacement is often suprarenal or occasionally supra celiac. Therefore, direct clamping of these relatively stiff endoprostheses can lead to the risk of insufficient aortic control and damage to the aortic tissues if the supra-renal bare metal stent or fixation barbs tear the aorta.⁵⁾ Although “the clamp and pull” complete endograft extraction approach was suggested by several surgeons,^{6,7)} this is considered to be a very hazardous approach because of the existence of transrenal fixated endografts as the bare metal stent becomes incorporated into the juxtarenal aortic lining with a layer of neointima.⁸⁾ Therefore, endograft extraction using

Fig. 2 (A) After longitudinal opening of the aneurysmal sac, relatively fresh clots (white arrow-heads) identified at the bottom, which indicated PT2EL due to patent lumbar arteries. (B) All the bleeding spots were carefully inspected. Complete hemostasis was confirmed. (C) Residual aneurysmal sac was resected as much as possible followed by tightly closing the aneurysmal sac. (D) Equine pericardium was wrapped and sutured to the aneurysmal sac for reinforcement to prevent aneurysmal sac re-enlargement.

Table 1 Patient characteristics

Age (gender)	Endograft	Interval	Change in sac diameter	Type of endoleaks
79 (M)	Zenith	47 months	51→60 (+9 mm)	Type V
74 (M)	Excluder	43 months	51→56 (+5 mm)	Type II
79 (F)	Excluder	45 months	44→51 (+7 mm)	Type II
82 (M)	Excluder	24 months	70→83 (+13 mm)	Type II
85 (F)	Zenith	46 months	52→60 (+8 mm)	Type II
81 (M)	Excluder	40 months	49→62 (+13 mm)	Type II and III
84 (M)	Excluder	52 months	53→60 (+7 mm)	Type II
84 (M)	Excluder	34 months	43→56 (+13 mm)	Type II

this technique can lead to clinically serious tears in the pararenal aorta with hemorrhage and renal artery injury requiring revascularization.⁹⁾ On the other hand, there have been several reports with regard to the usefulness of partial endograft preservation. This method includes separation of the endoprosthesis from its proximal attachment system with wire cutters, which facilitates less traumatic retrieval without the need for a suprarenal clamp followed by proximal residual endograft anastomosed to aortobiiliac prosthesis.^{10,11)} In 2003, Lipsitz demonstrated follow-up results from 7 patients who underwent partial resection with a hybrid reconstruction. At an average of 22 months from time of operation, no patients had anastomotic complications such as pseudoaneurysm formation.¹¹⁾ Also, Kelso, et al. advocated that portions of stents that are often challenging to remove, including the transrenal fixated bare metal stent, barbs, and small distal limbs with external stents, may be left in-situ on condition that they are not the culprits of endograft failure, such as endoleaks and graft

infection. However, they emphasized these patients should receive close and frequent surveillance because future complications of remaining EVAR elements remain a possibility, and strongly suggested complete removal of the endograft should be the goal of procedure.⁶⁾ Considering technical difficulties in complete removal of the endoprosthesis and uncertainties in terms of the long term durability of incomplete preservation of the stent graft, we reported in 2012 modified open repair for aneurysmal sac enlargement after EVAR as one of the possible methods of completely preserving the endograft.⁴⁾ One of the most beneficial points of this procedure is the avoidance of aortic cross clamping, which prevents the need for systemic heparinization and therefore decreases the amount of surgical site bleeding. Moreover, even in case of identifying type 1 endoleak by accident at the time of opening the aneurysmal sac, this can be surgically managed by performing the banding procedure to the proximal aortic neck and iliac arteries, corresponding to the distal landing zones following prompt

closure of the aneurysmal sac. Furthermore, type 3 endoleak, if identified, can be fixed by wrapping the diseased portions with a prosthetic graft. Although we have never experienced type 4 endoleak in this series, this type of endograft failure can also be surgically managed by rubbing the commercially available fibrin glues on the leaking spots. We prefer to use an equine pericardium as a wrapping material to reinforce the aneurysmal sac. Compared to other wrapping material like the prosthetic grafts, we consider an equine pericardium can fit the aneurysmal wall very well without any gap, and this additional procedure is expected to obtain the satisfactory sealing effect around the entire aneurysmal body so as to reinforce it against further pressurization which can lead to aneurysmal sac re-growth.

Conclusions

Clinical results of open reintervention technique in this series have been satisfactory to date. This type of surgical procedure is expected to be one of the feasible treatments of option for aneurysmal sac enlargement after EVAR. However, it is important to note that further close and regular surveillance is necessary to establish if the long-term results of this technique are superior to that of other reported surgical options.⁵⁻¹¹⁾

Disclosure Statement

None.

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