Unique Technique for Open Surgical Repair after Failed Endovascular Aneurysm Repair with Proximal Anastomoses

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Endovascular aortic aneurysm repair (EVAR) has revolutionized the management of abdominal aortic aneurysms (AAAs), with lower perioperative morbidity and mortality compared to conventional surgical repair. However, late secondary re-interventions after EVAR are still needed before aneurysm rupture in many cases. A patient with impending rupture of an AAA associated with a type I endoleak 7 years after EVAR who was successfully treated with a unique technique of fixation of the proximal aortic neck taking into account the structure of the stent graft is reported. This technique offers a safe solution to late open conversion after failed EVAR.

Keywords: endovascular surgery, abdominal aortic aneurysm, operative strategy in late conversion

Introduction

Endovascular aortic aneurysm repair (EVAR) has been widely performed for the treatment of abdominal aortic aneurysms (AAAs), with lower perioperative mortality and morbidity compared to conventional surgical repair. However, concerns over late secondary re-interventions remain. Open conversion is still required in many cases, often resulting in higher operative morbidity and mortality than with primary open repair due to the presence of the endograft complicating surgical exposure.1,2 A successful case of open surgical repair with a unique technique for impending rupture of an AAA that had undergone EVAR 7 years previously is reported; this procedure for preserving a functional endograft is advocated in similar cases.

Case Report

In January 2015, a 79-year-old man was admitted to our hospital from a local hospital with a 1-week history of persistent abdominal pain. There was abdominal tenderness at the site of the AAA. The patient had had an infrarenal 50-mm AAA and had undergone implantation of a Zenith (Cook Inc, Bloomington, IN, USA) bifurcated endograft in another hospital in November 2007. After the EVAR, he had not been followed by the hospital. He had started hemodialysis (HD) due to chronic nephritis in September 2011 and was receiving three times a week maintenance HD at the local hospital. He had a gait disorder due to lumbar spondylosis since 2013. Computed tomography (CT) performed in the hospital revealed an expanding, tender, 75-mm, infrarenal AAA that had increased in size by 20 mm during the last 3 months and an apparent type I endoleak at the proximal attachment site (Fig. 1). Since impending rupture of the AAA was diagnosed, and a secondary EVAR would not be feasible, urgent open conversion was selected.

Under general anesthesia, in the supine position, a median laparotomy was performed to expose the entire aneurysmal body. The proximal infrarenal aortic neck and bilateral renal arteries were exposed and encircled. The terminal aorta or the distal end of aneurysm was exposed, but bilateral iliac arteries were not exposed. After 5000 units of heparin were administered systemically, and infrarenal aortic cross-clamping at the level of the barbed stents was performed, the aneurysmal sac was opened longitudinally. Iliac cross-clamping was not required at that time. Inflow bleeding from a few lumbar arteries on the posterior wall of the aneurysm was identified after removal of mural thrombus, and then the lumbar arteries were over sewn with 2-0 polyester suture. The endovascular devices in the sac were intact. After confirmation of complete hemostasis

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and cross-clamping of bilateral iliac stent grafts, the endograft was transected to divide the body, and the arteriotomy was extended cranially up to the first covered stents. After cutting the sutures that fixed the first segment of covered stents on the endograft, the stents were resected carefully, not to break the proximal structure of the endograft, including the bared top stents and fabric. Then, both the aortic wall and the proximal endograft were transected at the level of the fabric between the first and second covered stents. The trimmed proximal neck of the endograft was anastomosed to a woven shield J-graft (Japan Lifeline Co., Ltd., Tokyo, Japan) with 3-0 polypropylene in end-to-end fashion, passing the stitches into the aortic wall with a Teflon felt to prevent a future pseudoaneurysm or late dilatation of the residual aortic wall. Preserving the bifurcated tube endograft, the distal stump of the Dacron graft was anastomosed to the residual distal body of the endograft with 4-0 polypropylene (Fig. 2). The aneurysm sac was closed tightly over the aortic graft. The operative time was 307 minutes, and the estimated blood loss was 610 mL.

Postoperative CT scan demonstrated no endoleak and no pseudoaneurysm (Fig. 3). The patient underwent gait rehabilitation and was transferred to the local hospital on the 26th postoperative day. A CT scan performed 1 year after secondary open conversion detected no endoleak and no enlargement of the abdominal aorta.

**Discussion**

EVAR has caused a revolutionary change in the management of AAAs and has been proven to be safe and effective over two decades. Studies have consistently demonstrated that EVAR leads to significantly lower perioperative mortality and morbidity than conventional open surgical repair. However, it is also associated with increased rates of late secondary re-interventions. Surgical re-interventions after failed EVAR have been considered to be more demanding and challenging compared to primary open repair because the presence of the endograft could increase perioperative mortality and morbidity. The explantation of endografts is technically challenging in secondary open repair with device incorporation into the aortic wall, periaortic inflammation, and the presence of barbs and hooks.

Recently, some reports have suggested that secondary surgical repair after EVAR is not associated with increased mortality and morbidity compared with primary open repair. Secondary procedures can be performed safely considering the cause and aspects of failed EVAR. Some studies demonstrated the successful removal of barbed endografts using wire cutters, collapsing the proximal stent into a syringe, pouring iced saline in the case of nitinol stents in the endograft, and performing partial resection with hybrid reconstruction.
In the present case, the patient had enlargement of the abdominal aortic sac due to a type Ia endoleak. The cause of that endoleak was presumably due to use outside the instructions for use. The proximal neck was significantly enlarged, and the endograft was unsealed at the neck. Moreover, the patient complained of abdominal pain, and impending rupture of the AAA was assumed. It was therefore decided to perform urgent open conversion to repair the proximal neck. In the secondary repair, proximal infrarenal aortic cross-clamping was placed at the level of the bared stents. After cross-clamping and opening of the abdominal sac, the first covered stent that would be a hindrance to a certain proximal anastomosis was removed, but the fabric was preserved to use for the proximal anastomosis. The bared top stents were probably well incorporated into the aortic wall, and removal of the barbed stents would lead to laceration of the aorta; hence, the proximal part of the endograft was retained. The “neo-neck” technique has been reported recently. Our strategy is similar to that “neo-neck” procedure, which makes a new proximal anastomosis site composed of the first covered stent and the infrarenal aortic wall. Since it was assumed that it would be better to anastomose a new graft to the residual aortic wall and just the fabric than to the fabric with stent, the first stent was removed, but the bared top stents were preserved to keep a functional part of the endograft. This simple surgical strategy appears to minimize the risk of serious aortic wall injury and reduce operative time. However, this simple procedure could not be applied in cases having an aneurysmal proximal neck or migration of the first stent into the sac.

Some studies suggested that secondary open surgical repair of failed EVAR could be accomplished without explanting all or part of the endograft in most cases. The preoperative CT scan demonstrated that there was no endoleak at the iliac arteries; therefore, the distal portion of the endograft was preserved in the secondary repair. To simplify the secondary repair, reduce operative time, and lower the risk of arterial injury, direct distal anastomosis was performed between the new graft and the residual...
endograft without the aortic wall, since the distal portion of the endograft was well sealed in the iliac arteries. However, concerns over a future type Ib endoleak leading to rupture remain. Therefore, the aneurysm sac was tightly closed over the aortic endografts in the late open conversion. One year after the secondary open conversion, the CT scan showed no endoleak and no recurrence of aneurysm in this patient. He has had no remarkable events since the secondary open conversion. Recently, one case of late aneurysm rupture 29 months after secondary open conversion was reported.10) In several similar reports, a layer of aortic or iliac wall was included in the distal anastomoses to avoid further rupture or endoleak. It is essential that we continue periodic careful follow-up of this patient in the same way as in usual EVAR follow-up in order to identify complications and treat them as early as possible.

**Conclusion**

Impending AAA rupture due to a type Ia endoleak after failed EVAR was successfully surgically treated, retaining the bared top stent of the endograft, which was well incorporated into the aortic wall, and the partial endograft to complete the proximal anastomosis. Open surgical conversion after EVAR, especially complete explantation of the endograft, the presence of which complicates a secondary surgical procedure, is frequently more demanding than primary open repair, with a high mortality and morbidity rate. Feasible surgical strategies need to be established depending on individual cases that can minimize operative risk and be effective in late open conversion after failed EVAR.

**Disclosure Statement**

The authors have no conflict of interest directly relevant to the content of this article.

**Author Contributions**

Study conception: SM
Data collection: ST, KM, HA
Analysis: ST
Investigation: ST, KM, JH
Writing: ST
Critical review and revision: all authors
Final approval of the article: all authors
Accountability for all aspects of the work: all authors.

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