A Staged Total Aortic Replacement with Combined Endovascular and Open Surgery: Report of a Case

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For a 75 year-old man with extensive aortic aneurysm, who had undergone a previous infra-renal abdominal Y-graft, a staged replacement of remaining segments was performed. A hybrid procedure of open-laparotomy debranching of visceral branches and endovascular stentgraft insertion in the thoracoabdominal aorta was performed first, followed by subsequent direct replacement between the proximal ascending and distal arch using cardiopulmonary bypass. Three months thereafter dissection of enlarged proximal descending aorta occurred, for which we performed an emergent endovascular stentgraft deployment which bridged “elephant trunk” of the arch graft and the previous stentgraft. Consequently total aortic replacement was successfully accomplished without any neurological sequela.

Keywords: endovascular surgery, hybrid therapy, dissection

INTRODUCTION

We experience a successful total aortic replacement with staged, combined thoracic endovascular aneurysm repair (TEVAR) and open-surgery strategy for a 75 year-old male patient without adverse neurological events, which we think deserves presentation.

CASE REPORT

A 75 year-old male who had undergone graft replacement using Vascutek Gelweave Y-graft for rupture-impending infrarenal abdominal aorta four years previously: He showed no characteristic body composition suggestive of Marfan syndrome. Also in the histopathological specimen of the resected aneurysm wall there was no detectable cystic medial necrosis. During postoperative follow-up, enlargement of the ascending aorta as well as definite aneurysmal dilatation of arch and thoracoabdominal segments (55 mm and 60 mm in diameter, respectively) progressively developed (Fig. 1), which necessitated surgical re-intervention. Considering relatively high frequency of postoperative paraplegia/paraparesis in direct open replacement,1) we chose to perform TEVAR in this area in the first stage, and then to carry out open direct total arch replacement. 1) Under laparotomy, ligation of proximal celiac, superior mesenteric, and both renal arteries were performed (debranching procedure), with concurrent bypass grafting to these vessels with cross-shaped composite vascular graft (Gelsoft 10 mm (Vascutek Terumo Ltd., Inchinnan, Scotland) and Gore-Tex 6 mm graft (W.L.Gore & Associates, Flagstaff, Ariz)) and saphenous vein graft, which was used for the reconstruction of the celiac axis, inflow portion of which was anastomosed into right common iliac segment of previous Y graft (Fig. 1). Weeks later, subsequent TEVAR for the aneurysm between the mid-portion of descending thoracic aorta and just above the previous Y-graft, using three stentgrafts (two Gore TAG endografts (W.L.Gore & Associates, Flagstaff, Ariz)(37 mm × 15 cm and TAG 34 mm × 15 cm), and home-made stentgraft (using a noncoated polyester fabric graft(WST graft; Ube, Japan)

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Received: July 19, 2011; Accepted: September 12, 2011
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Ann Vasc Dis Vol.4, No.4; 2011; pp 340-343
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with Gianturco stent (William Cook Europe A/S, Bjaeverskov, Denmark)) was performed (Fig. 1). We used a homemade stentgraft because the treatment length of this case was so long that we couldn’t treat with two endografts, and the third commercial endograft could not be covered by insurance in Japan. The TEVAR procedure, combined with debranching of visceral branches under laparotomy, can be described as “hybrid” TEVAR. As protective measures of the spinal cord, perioperative intravenous infusion of naloxone (1 µg/kg/h) and continuous drainage of cerebrospinal fluid (CSF) to maintain intrathecal pressure not exceeding 10 cm H₂O, were carried out. Postoperative recovery was smooth without any neurological deficit. 2) Six months after hybrid TEVAR, open direct graft replacement of the segment between proximal ascending to distal arch aorta, using Triplex branched graft (Vascutek Terumo Ltd., Inchinnan, Scotland), was performed under a mid-sternal incision, with the use of cardiopulmonary bypass. Deep hypothermic circulatory arrest (23°C) with selective antegrade cerebral infusion was used to protect both cerebrum and spinal cord. An “elephant trunk” was hung down into somewhat enlarged proximal descending aorta. Postoperative recovery was uneventful. 3) Three months later, he transferred to our hospital by ambulance with severe back pain. A CT-scan image showed acute dissection of proximal descending aorta associated with circumferential pleural effusion, leading to the diagnosis of impending rupture (Fig. 2). An emergent TEVAR procedure of this aortic segment, bridging the elephant trunk of the arch graft and previous thoracoabdominal stent-graft with two Gore TAG endografts (28-mm × 15 cm and 34 mm × 20 cm), was performed (Fig. 3). Through all these phases, as a result, total aortic replacement was accomplished with combined open and TEVAR procedures successfully, without any neurological adverse events.

**DISCUSSION**

Since Dake, et al. first reported about TEVAR for descending thoracic aortic aneurysm in 1994,2) growing demands as well as achievements of TEVAR have ever been expanding in these days. However, there still exists a controversy regarding application of this less invasive procedure for thoracoabdominal aneurysm. And while there are series of literature of direct total aortic replacement since the first successful report by Crawford et al.,3) there are a few reports of extensive graft replacement using the TEVAR technique. For TEVAR of the thoracoabdominal aneurysm, we adopted the “hybrid” procedure, in which open debranching of major visceral branches with bypass grafting is combined with TEVAR procedure. According to the meta-analytic report of this

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**Fig. 1** A computed tomography (CT) 1 showed three dimensional reconstruction of patient’s complex aortic pathology. A CT 2 showed patient’s aorta after visceral debranching surgery. A CT 3 showed patient’s aorta after endovascular surgery for thoraco-abdominal aortic aneurysm.
hybrid procedure in various institutes where more than ten cases were performed, the result was not excellent with the mortality of 15%, paraplegia/paraparesis of 7% and renal failure rate of 9.9%. However the result was still considerably better when compared with the average morality of 20% and paraplegia/paraparesis rate of 16% in direct open graft replacement of thoracoabdominal aneurysms in the United States, although we realize that in high-volume, well experienced institute with expert surgeon(s) the result of open surgery can be as excellent as with the mortality of 7.3% and paraplegia rate of 4.6%.

We utilized the hybrid procedure this time for a 75 year-old patient with extensive aneurysm (Crawford type 2 with additional arch aneurysm) who had previous abdominal aortic replacement, a clinical setting known as most vulnerable to postoperative paraplegia.

As regards the visceral bypass grafts, the patency ratio has been reported to be good with 98%. However as the bypass is non-anatomical, the long-term fate of it has to be thoroughly followed up. In this setting, experiences of the use of a fenestrated and branched stentgrafts in the TEVAR procedure have been reported, with considerably good results. Also this technique obviates the need of laparotomy, making all the procedure even less invasive. This time non-availability and lack of experience made us impossible to apply this technique, which
may seem promising and advantageous in the near future. As the protective measure of spinal cord from ischemia, we adopted the combined use of intravenous naloxone and continuous CSF drainage, which seemed effective in preventing the occurrence of paraplegia/paraparesis.

Direct total arch replacement has been a well-established surgical method with low mortality and low stroke rate, which in the present case seemed preferable to the “open” stentgraft procedure, the latter reportedly with unexpected occurrence of postoperative paraplegia. And we were not able to perform TEVAR with debranching because the size of ascending aorta was over 42 mm.

Occurrence of dissection relatively early after the TEVAR procedure in the proximal descending aorta deserves consideration. We think there may be a stress placed on the aortic intima in the area of the “flare” of the stentgraft, which could trigger the occurrence of wall damage and subsequent dissection. Although unreported, we have had a same experience of dissection after stentgraft deployment in the distal arch. In both cases emergency procedures successfully managed the situation (one in open surgery, one—present case—by additional TEVAR).

**CONCLUSION**

By using staged and combined open and TEVAR procedures, a successful total aortic replacement could be performed with no neurological adverse sequela nor any other complication. This less invasive method seems especially advantageous in old and compromised patients with extensive aneurysmal involvement.

**DISCLOSURE STATEMENT**

I declare that we have no ethnical problem or conflict of interest in connection with this paper.

**REFERENCES**


