

Case Report

A Case of Using “PETTICOAT” Technique for DeBakey Type I Aortic Dissection after Aortic Arch Replacement to Promote Distal Aortic Remodeling

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Abstract: A 41-year-old man with acute type A aortic dissection was referred. Computed tomography (CT) revealed dissection with patent false lumen from the ascending to abdominal aorta and the narrowed true lumen of the abdominal aorta. Although emergency partial aortic arch replacement was performed, no entry tear was found. Postoperative CT revealed the residual entry tear in the descending aorta and the descending aorta was dilated to 46 mm. On postoperative day 68, thoracic endovascular aortic repair and interclavicular bypass were performed. The postoperative course was favorable. CT confirmed closure of the entry tear and dilatation of the true lumen.

Keywords: TEVAR, Aortic Dissection, PETTICOAT Technique

1. Introduction

Most of patients present with DeBakey type I aortic dissection are often focused on proximal aortic reconstruction because of the emergency and the catastrophic condition. However, several studies have reported that a remnant dissected distal aorta after proximal aortic reconstruction for DeBakey type I aortic dissection leaves risks of aneurysmal degeneration and reintervention in the future [1].

Provisional Extension To Induce Complete Attachment (PETTICOAT) technique, that is entry tear exclusion with a covered stent graft while providing intimal support to the remaining aorta with the use of an uncovered bare metal dissection stent without obstruction of vital side branches, was first reported by Mossop et al. [2]. It has been reported favorable clinical and anatomic result in complicated type B aortic dissection (cTBAD) [3]. And it could also avoid this

negative remodeling in DeBakey type I aortic dissection.

2. Case

A 41-year-old man had sudden onset of chest and back pain. At another clinic, he was diagnosed with acute type A aortic dissection and referred to our department for surgery. While the preoperative blood test showed no major abnormalities, computed tomography (CT) revealed dissection with patent false lumen extending from the ascending to abdominal aorta, and the narrowed true lumen of the abdominal aorta. Emergency partial aortic arch replacement (reconstruction of the brachiocephalic and left common carotid arteries and insertion of an elephant truck [ET]) was performed. No entry tear was intraoperatively found in the segment from the ascending aorta to the aortic arch.

After surgery, the patient temporarily became oliguric, and dialysis was initiated. Two weeks after surgery, renal function

recovered, and he was weaned from dialysis. Although paraparesis and muscle weakness in both lower limbs were observed after surgery, he underwent rehabilitation and gradually regained the ability to walk without assistance.

Postoperative contrast-enhanced CT revealed the residual entry tear in the descending aorta and the narrowed true lumen of the descending to abdominal aorta (Figure 1). Moreover, the descending aorta was dilated to 46 mm (true lumen diameter: 10 mm, false lumen diameter: 36 mm).

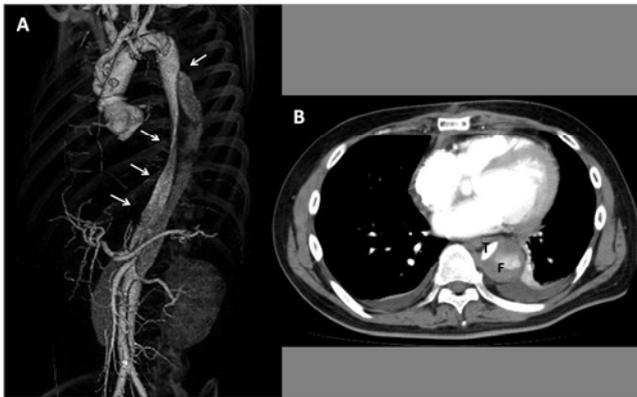


Figure 1. After partial arch replacement and insertion of an elephant trunk, computed tomography reveals the narrowed true lumen of the descending to abdominal aorta (→) and entry tear in the descending aorta (←). The descending aorta is dilated to 46 mm. T=true lumen F=false lumen.

On postoperative hospital day 68, thoracic endovascular aortic repair (TEVAR, with a proximal stent graft and a distal bare metal stent) and interclavicular bypass were performed to close the entry tear and dilate the narrowed true lumen.

Interclavicular bypass was performed by the presternal subcutaneous route after the right and left axillary arteries were exposed. Zenith TX2 Thoracic Aortic Aneurysm (TAA) Endovascular Graft with Pro-Form (ZTEG-2P-28-140-PF-D), used as a proximal stent graft, was inserted from the left femoral artery. Although the central landing zone was in a blood vessel prosthesis, the peripheral landing zone was the narrowed true lumen of the descending aorta. To prevent overdilatation of the peripheral end during deployment of the main device, an extension stent-graft (Zenith TX2 TAA Endovascular Graft with Pro-Form, ESBE-22-80-T-PF-D) was inserted to the peripheral landing zone and expanded. The main device was inserted. When systolic blood pressure was lowered to the 60s by rapid pacing, the main device was deployed just beyond the left common carotid artery branch of the blood vessel prosthesis. To dilate the true lumen of the descending to abdominal aorta, a bare metal stent (Zenith Dissection Endovascular Stent, GZSD-36-164-2) was inserted up to the peripheral level of the superior mesenteric artery and expanded. Finally, an AMPLATZER™ Vascular Plug 2 (AVP 12 mm, 9-AVP2-012) was inserted at the origin of the left subclavian artery.

According to postoperative CT, although the reentry tear in the abdominal aorta remained patent, the entry tear in the descending aorta was closed. The true lumen of the

descending to abdominal aorta was confirmed to be larger after surgery than before (Figure 2). The postoperative course was favorable, and the patient was discharged to home after rehabilitation. CT performed 3 months after surgery revealed that the diameter of the descending and abdominal aorta had markedly decreased to 36 mm (true lumen diameter: 25 mm, false lumen diameter: 11 mm) (Figure 3).

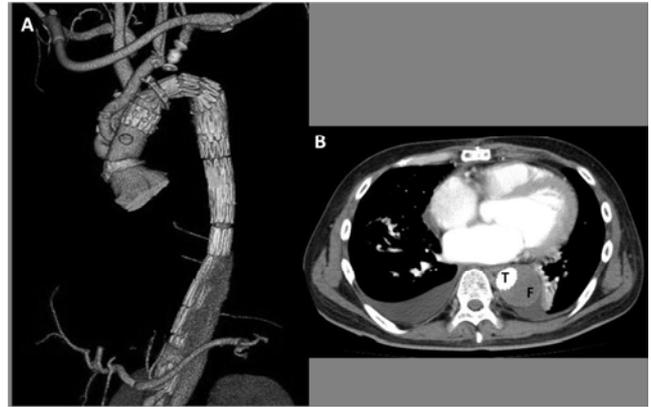


Figure 2. After thoracic endovascular aortic repair and interclavicular bypass, computed tomography reveals the dilated true lumen of the descending to abdominal aorta and the closed entry tear in the descending aorta. T=true lumen F=false lumen.

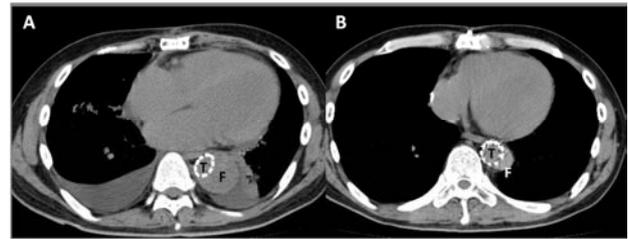


Figure 3. In comparison of computed tomographic images taken one week (A) and 3 months (B) after thoracic endovascular aortic repair and interclavicular bypass, the false lumen is markedly reduced, and the true lumen is dilated. T=true lumen F=false lumen.

3. Discussion

Surgical outcomes of proximal aortic reconstruction have improved for DeBakey type I dissection during the past few decades [4]. However, there is the most important issue of the remnant dissected distal aortic repair.

The PETTICOAT technique could achieve more extended positive remodeling. We used the Zenith dissection endovascular system (cook medical, bloomington, ind) that is a dual-construct device that provides proximal covered stent graft for sealing the primary entry tear and distal bare metal stents for support of the dissected true lumen [5]. Lombardi *et al.* [6] reported the 30-day mortality rate and freedom from dissection-related mortality after TEVAR with the device for cTBAD was 4.7% and 89.3% at 2 years, and a majority of patients had either a stable or shrinking transaortic diameter in the thoracic and abdominal aorta.

In the present case, no entry tear was found in the segment from the ascending aorta to the aortic arch during emergency surgery performed for acute type A aortic dissection. Because

the entry tear was expected to remain in the descending aorta, partial aortic arch replacement (reconstruction of the brachiocephalic and left common carotid arteries and insertion of an ET) was performed in consideration of possible later additional procedures. Postoperative CT revealed a residual major entry tear in the descending aorta and the narrowed true lumen of the descending to abdominal aorta. It has been reported that subsequent additional treatment is highly likely to be required in cases with maximal dissected aortic diameter of 40 mm or larger [7]. In the present case, the descending aorta was dilated to 46 mm; the patient was relatively young, and the descending aorta and downstream segments were expected to undergo subsequent dilation. Thus, the PETTICOAT technique was performed. Hung-Lung et al. [8] reported that the technique in the management of acute DeBakey type I dissection is a feasible and promising method to promote distal aortic remodeling.

In addition, because our patient presented with paraparesis due to acute aortic dissection, the left subclavian artery needed to be preserved to protect the spinal cord. Thus, interclavicular bypass was simultaneously performed. Extensive stent graft coverage of the thoracic aorta has been shown to increase the risk of spinal cord ischemia [9]. However, the incidence of paraparesis caused by using the PETTICOAT technique in cTBAD is reportedly low at 2.5% [6]. This low incidence may be attributable to the following aspects of this procedure: a covered stent graft is placed in the smallest area possible to close the entry tear, and insertion of a bare metal stent up to the abdominal aorta contributes to enhanced remodeling of the descending to abdominal aorta without occluding the intercostal artery and arteries branching to abdominal organs.

In the present case, postoperative CT confirmed closure of the entry tear in the descending aorta but revealed a residual reentry tear in the abdominal aorta. However, CT performed 3 months after surgery revealed marked reduction in the false lumen extending from the descending to abdominal aorta, and the diameter of the descending aorta had decreased to 36 mm. It was suggested that aortic remodeling might have been enhanced by insertion of a bare metal stent into the true lumen of the descending to abdominal aorta.

There are few reports of cases in which the PETTICOAT technique is performed for patients who develop paraparesis after partial aortic arch replacement for acute type A aortic dissection, as in the present case. Our case suggested that the PETTICOAT technique is an effective treatment strategy for aortic remodeling and spinal cord protection.

However endovascular treatment of aortic dissection with stent grafts has been reported several unfavorable consequences such as retrograde dissection, device-induced new-entry tear or dissection, stent graft infolding, or collapse [10]. Careful studies are needed to investigate the indications and timing of TEVAR.

4. Conclusion

In conclusion, in the present case in which paraparesis occurred after partial aortic arch replacement performed for

acute type A aortic dissection, we performed the "PETTICOAT" technique to close the residual entry tear in the descending aorta and promote distal aortic remodeling. Favorable outcomes were achieved. Moreover, because the long-term outcomes of this procedure have not been clarified, further follow-up studies are necessary.

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