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Redo surgery for extensive chronic type A dissecting aneurysm following a Bentall operation

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ABSTRACT

INTRODUCTION: Despite the technical improvements, redo surgery on the aortic root and arch is still associated with high morbidity and mortality due to the trauma of repeat open-heart surgery and technical complexity. We present the case of extended chronic type A dissecting aneurysm that developed after a Bentall operation, which was successfully treated by applying a modified long elephant trunk technique and surgical aortic fenestration.

CASE PRESENTATION: A 77-year-old man, who had previously undergone a Bentall procedure and an abdominal surgery, developed a type A aortic dissection. At presentation, the aortic dissection extended from the proximal arch to the terminal aorta, which were treated with an axillobifemoral bypass. After 8 months follow-up, the dissecting aneurysm had extended and the visceral arteries were perfused from the false lumen, without re-entry. We successfully repaired a complicated and extended chronic type A dissecting aneurysm by applying a modified long elephant trunk technique and surgical aortic fenestration. Postoperatively, the thoracic aorta false lumen was thromboexcluded, and the visceral perfusion was preserved through the fenestration.

CONCLUSION: In the treatment of complicated aortic arch diseases especially in redo cases, appropriate strategies are mandatory to achieve optimal outcomes. In the extended aortic dissection without the reentry for visceral perfusion, a primary entry closure may lead to visceral ischemia. Modified long elephant trunk technique combined with fenestration technique may be one of the useful techniques to treat the complicated aortic dissection extending to the terminal aorta.

1. Introduction

In the aging population, the incidence of aortic disease is increasing. Concomitantly, chronic aortic dissection after ascending aorta graft replacement has become more common, leading to more repeat surgeries of the thoracic aorta [1]. Unfortunately, redo surgery on the aortic arch is associated with a high mortality rate, despite the technical improvements [1]. Complications and death are owing to many factors, including the trauma of repeat open-heart surgery, extensive involvement of the aorta, and the structural complexity caused by the dissection. Here, we report a case of an extended chronic type A dissecting aneurysm extending from the proximal arch to the terminal aorta, with perfusion of the visceral arteries from the false lumen without re-entry, which we repaired using a modified long elephant trunk (LET) technique and surgical aortic fenestration. This work has been reported in line with the SCARE criteria [2].

2. Case report

A 77-year-old man who had previously undergone the Bentall procedure and abdominal surgery for Mirizzi syndrome, developed a type A aortic dissection, showing ischemic symptoms of lower limbs. Enhanced computed tomography (CT) revealed dissection from the distal anastomosis site of the previous graft in the ascending aorta and extending to the terminal aorta, with the primary entry site in the aortic arch and total occlusion of the infrarenal abdominal aorta. Because of the high operative risk posed by the previous Bentall procedure, we performed only an axillobifemoral bypass. Follow-up CT findings (8 months) revealed an extended arch aneurysm (diameter 60 mm), with perfusion of the celiac trunk and superior mesenteric arteries from the false lumen, and perfusion of the bilateral renal arteries from the true lumen. The abdominal aortic diameter was 30 mm (Fig. 1). Aortic angiography did not show a re-entry site, and therefore closing the primary entry site could cause visceral ischemia.

To correct these problems, two surgical techniques were applied: a modified LET technique for total arch replacement (TAR) [3], and surgical aortic fenestration. For the TAR, we transected the previous graft and inserted a custom-made trifurcate graft into the transection. Surgical fenestration of the abdominal aorta

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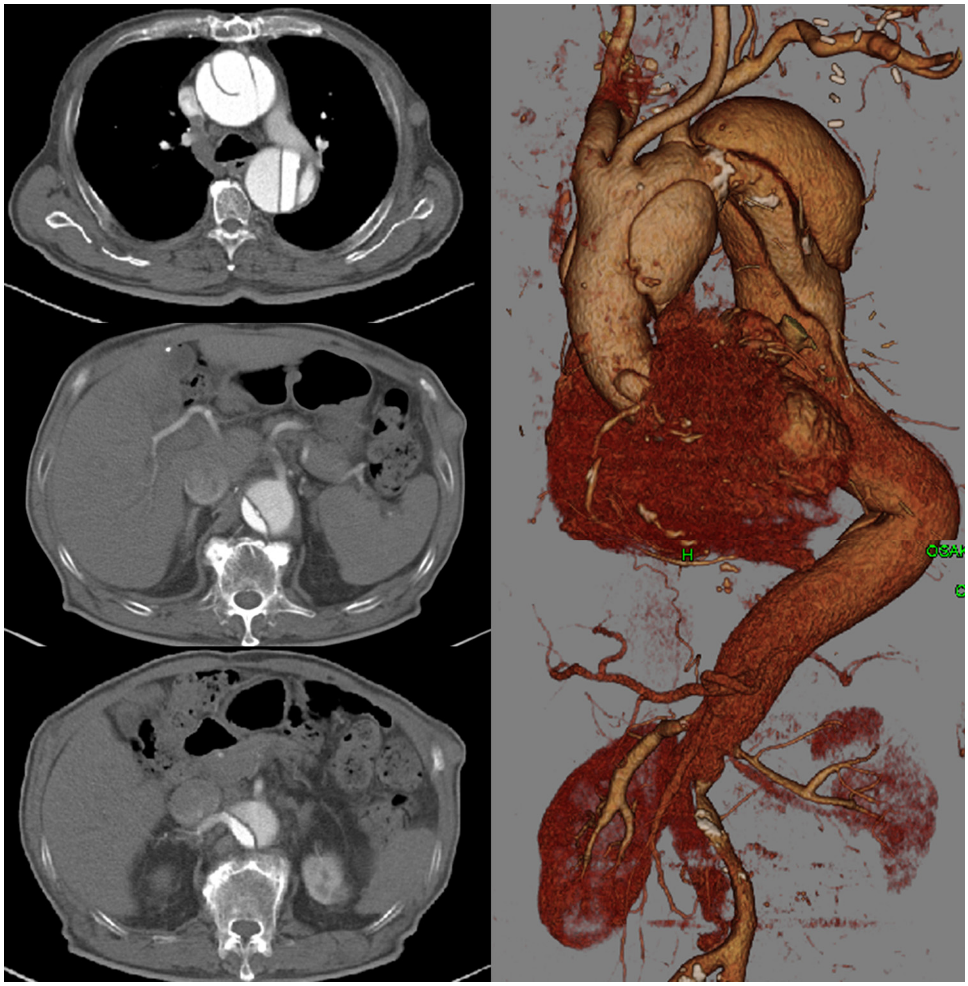

Fig. 1. Preoperative CT. The proximal aortic arch was the primary entry site of the false lumen, which extended to the celiac trunk and the origin of the superior mesenteric arteries.

Table 1
Summary of operation.

1. Grafts anastomosis with bilateral axillary arteries.
2. CPB induction (arterial return to right axillary graft)
3. Cooling and clamp of the previous replaced graft of ascending aorta.
4. Induction of cardiac arrest and the previous aorta graft transection.
5. Insertion of trifurcated graft to transected site.
6. Proximal anastomosis of the trifurcated graft.
7. SCP via bilateral axillary grafts and left carotid artery. Circulatory arrest.
8. LET insertion via transected graft to descending aorta.
9. Distal anastomosis of the trifurcated graft with LET and the surrounding previous graft.
10. CPB restart, arterial return from the side branch of trifurcated graft.
11. Arch branches reconstruction: Anastomosis of branches of trifurcated grafts with axillary grafts and left carotid artery.
12. Surgical fenestration on abdominal aorta.

CPB, cardiopulmonary bypass; SCP, selective cerebral perfusion; LET, long elephant trunk.

was performed via the retroperitoneal pathway. The previous aortic root graft and arch vessels were minimally dissected using a median sternotomy. Concomitantly, the abdominal aorta was dissected from the inferior mesenteric artery (IMA) to the bilateral common iliac arteries (CIAs) via the retroperitoneal pathway with a pararectal incision.

Dacron grafts (8 mm; Gelweave, Vascutek, Germany) were anastomosed to the right and left axillary arteries below the clavicle. A cardiopulmonary bypass was started with arterial return to the right axillary graft and venous drainage from the bicaval cannula. The patient was then cooled to 25 °C. During cooling, the previous graft was clamped near the previous distal anastomosis site, and the heart was arrested by antegrade and retrograde cold blood cardioplegia. We transected the previous graft in the middle, inserted the custom-made trifurcated graft, and performed a proximal anastomosis. After cooling was complete, systemic perfusion was stopped and selective cerebral perfusion (SCP) was started, using the axillary arteries and an additional 3-mm cannula in the left carotid artery. A 20-mm tube graft, the LET (Hemashield Platinum, MAQUET Cardiovascular LLC, Wayne, NJ), was placed into the aortic arch and drawn into the descending aorta by pulling from the femoral artery with a catching catheter (Amplatz Goose-Neck Snare, Microvena, MN).

The proximal end of the LET was anastomosed between the distal end of the transected graft and the inserted trifurcated graft. Antegrade systemic perfusion was resumed from the lowest branch of the trifurcated graft, and the patient was rewarmed. The brachiocephalic and left common carotid arteries were divided and anastomosed to the graft branches, and the lowest branch was anastomosed to the left axillary artery graft, which was introduced into the pericardial space through a retro-clavicle tunnel.

After the arch branch reconstruction, abdominal aortic fenestration was performed via a longitudinal aortotomy between the bilateral CIAs and the IMA. After the true and false lumens were identified via the aortotomy, the intimal membrane was widely excised and the aortotomy sutured. Systemic circulatory arrest, SCP, and aortic cross-clamp durations were 29, 71, and 72 min,

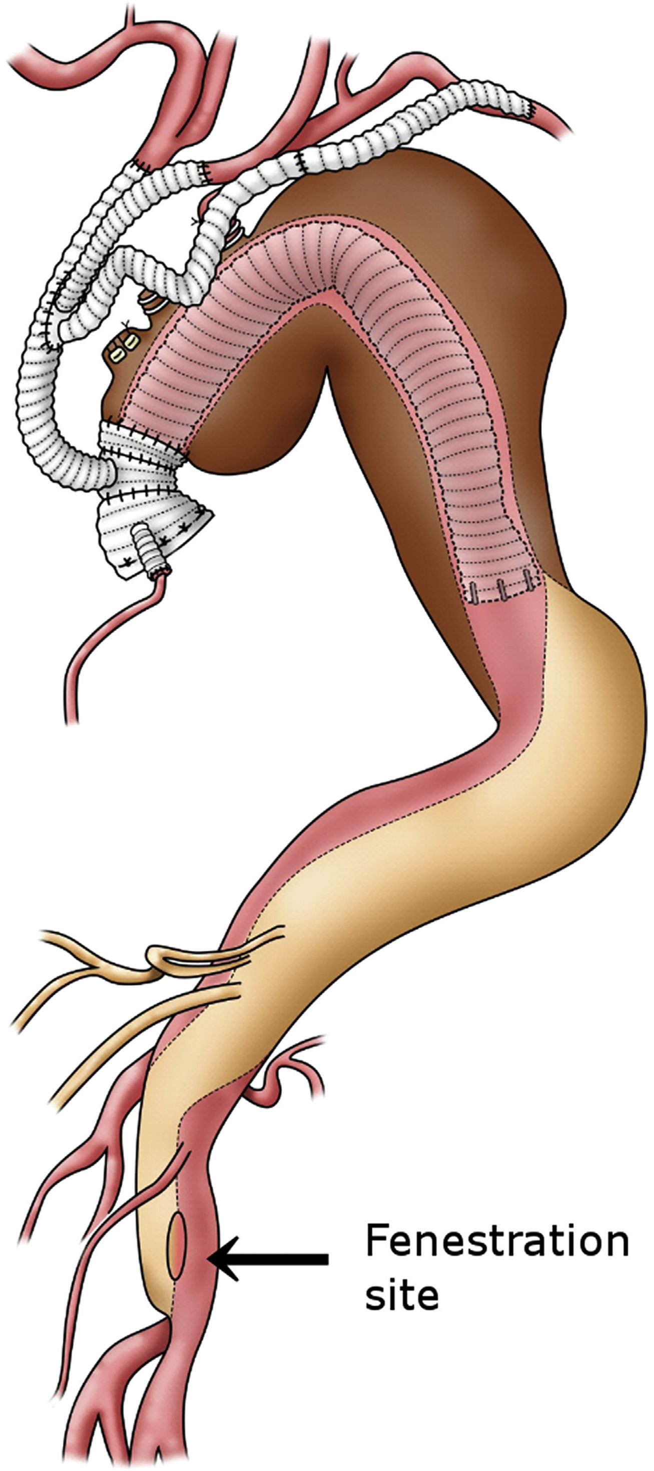

Fig. 2. Schematic illustration of the technique used in this case for total arch replacement with LET and aortic fenestration.

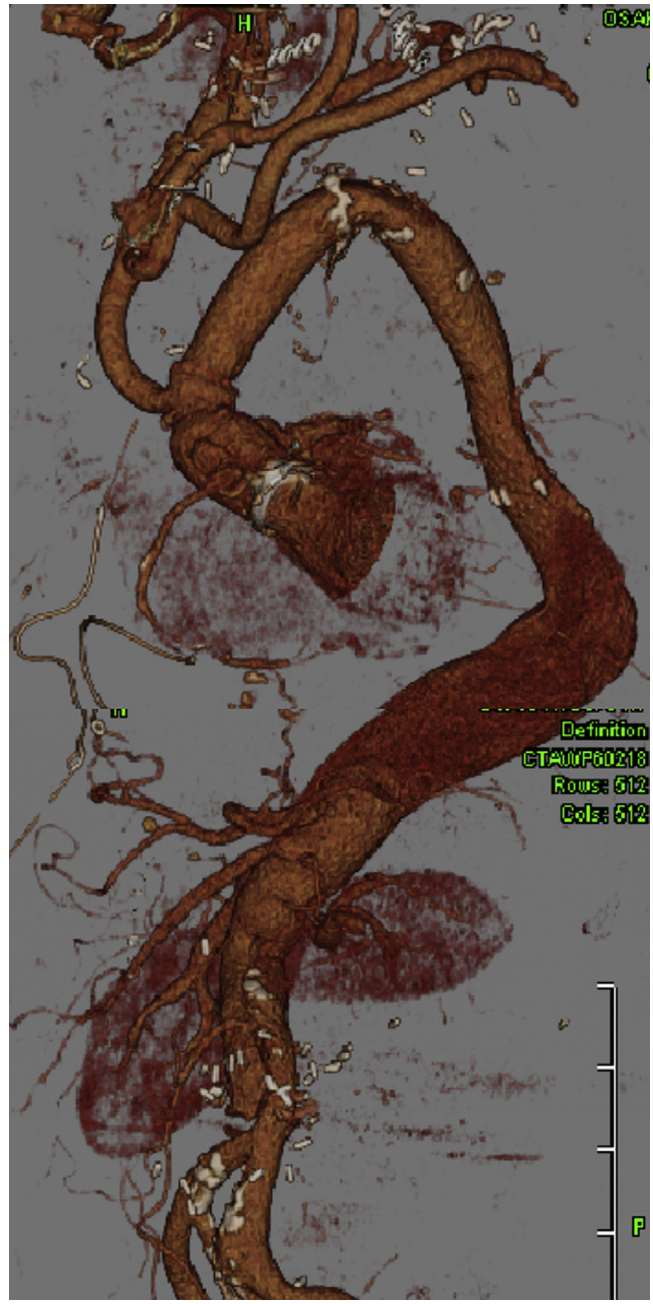

Fig. 3. Postoperative 3D CT. The false lumen in the thoracic aorta was thromboexcluded, with abdominal visceral perfusion from the false lumen preserved through the fenestrated site.

respectively. The distal end of the LET was located at the 8th thoracic vertebral level. The operative procedure is summarized in Table 1 and Fig. 2 shows the schematic illustration.

The postoperative course was uneventful. Follow-up CT findings after 3 days showed total thromboexclusion of the false lumen surrounding the thoracic aorta and patency of the visceral arteries perfused from the false lumen around the abdominal aorta (Fig. 3). The post-operative course followed-up at our out-patient clinic was uneventful.

3. Discussion

Performing an arch aneurysm repair with aortic dissection after an ascending or aortic root operation is challenging, both because of the trauma of repeated open-heart surgery and because of the structural complexity of the diseased aorta [1]. Therefore, appropriate surgical strategies are crucial. We encountered two major complexities here: an extended type A aortic dissection after a previous Bentall procedure and perfusion of the abdominal visceral arteries from the false lumen without re-entry.

The first challenge was the extended dissecting aortic arch aneurysm as a redo operation after the Bentall procedure. We used a modified LET technique, with the trunk placed through the transverse arch into the descending aorta by transecting the previous ascending aorta graft [3–5]. The modified LET technique enabled fast and secure anastomosis with nearly the same view as with ascending aorta replacement, and with no exposure of enlarged fragile hemorrhagic tissue, and injury to the laryngeal and phrenic nerves prevented [3]. This technique is well characterized by no touching of the unmanageable aortic arch and descending aorta, avoiding a bleeding problem [3–5]. Moreover, total thromboexclusion of the dissecting aneurysm false lumen is a reasonable expected outcome [5].

The second challenge was to secure perfusion of the visceral arteries from the false lumen after closing the primary entry, given the absence of a re-entry site. Several strategies for such repairs have been reported, including abdominal aortic graft replacement and endovascular or surgical fenestration [6–10]. Graft replacement was considered too invasive in this case, particularly because of the previous abdominal operations, and because the abdominal aorta was only 30 mm in diameter. Surgical fenestration is reliable way to secure the visceral perfusion, with the low frequency of subsequent dilatation of fenestrated aorta even in the long-term follow-up [6–8]. In contrast, endovascular fenestration requires both a suitable vascular anatomy and adequate surgeon experience, and the long-term outcomes are still uncertain [9,10]. However, endovascular fenestration would be better and less invasive alternative when surgeons get used to the procedure, because this technique would be performed through the same sheath, which was utilized for inserting the catching catheter in LET operation.

Use of these techniques in the present case was intended to obtain paradoxical results; simultaneous sealing of the aortic arch entry site to repair the extended arch aneurysm and opening of the abdominal aortic false lumen to maintain visceral perfusion. Postoperative CT showed a totally thromboexcluded false lumen surrounding the thoracic aorta and a patent false lumen in the abdominal aorta without dilatation of the fenestrated site. Although long-term follow-up is required to monitor possible changes of the entire aortic lesion, the present technique proved to be a safe and effective treatment in this complicated case.

4. Conclusion

In redo surgery for extended dissecting arch aneurysm following ascending aortic surgery, modified LET technique combined with aortic fenestration was easy and reliable technique, which enabled us to avoid dissecting the fragile tissue and bleeding problem and to secure the visceral perfusion. More cases and longer follow-up may be required to show the superiority of this technique.

Conflicts of interest

All of authors have no conflict of interest.

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Ethical approval

In our institute, ethical approval is exempted due to the retrospective nature and previously acquired patient consent.

Consent

Written consent was obtained from the patient.

Author contribution

All authors contributed to manuscript preparation, manuscript editing, manuscript review.

Guarantor

The first author, Keisuke Miyake.

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