» **Case Report** «

A Single Stage Hybrid Repair of a Complicated Acute Type B Dissection with Aortic Arch Involvement

Rihito Higashi, MD, Yu Matsumura, MD, and Fumitaka Yamaki, MD

We present a case in which a single stage hybrid repair was successfully for a complicated acute type B dissection of the aortic arch involvement in a 63-year-old male patient. We performed a combination of different techniques; left subclavian artery debranching, elephant trunk insertion without aortic arch replacement, and thoracic endovascular aortic repair (TEVAR) from antegrade approach. The postoperative course was successful, and the patient was discharged on day 11 after surgery. A-half-year's follow up computed tomography (CT) scan showed shrinkage of thrombus lumen, vascular reverse remodeling.

Keywords: complicated acute type B dissection, hybrid operation, thoracic endovascular aortic repair

Introduction

The operative results and early clinical outcomes for aortic arch repair have improved for several years, but still represent a high-risk operation with increased mortality and morbidity, especially for high-risk patients. Extensive diseases involving the aortic arch are challenging to repair. As progression of thoracic endovascular aortic repair (TEVAR), instead of conventional total or partial aortic repair, an arch debranching, frozen elephant trunk, stented elephant trunk with endovascular repair of thoracoabdominal aorta, techniques have evolved into a hybrid repair.¹⁾ However, a hybrid repair of acute aortic dissection remains a clinical challenge. We succeed in performing a single stage hybrid operation, which consisted of partial debranching, elephant trunk procedure and TEVAR on a symptomatic acute type B dissection of the aortic arch.

Department of Cardiovascular Surgery, Nagano Chuo Hospital, Nagano, Nagano, Japan

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Corresponding author: Rihito Higashi, MD, Department of Cardiovascular Surgery, Nagano Chuo Hospital, 1570 Nishitsuruga-cho, Tsuruga, Nagano, Nagano 380-0814, Japan
Tel: +81-26-231-3211, Fax: +81-26-233-1493
E-mail: licht0905@gmail.com

Case Report

A 63-year-old man admitted to another facility with severe chest and back pain. He had both chronic hypertension and chronic kidney disease. Upon physical examination the patient exhibited no signs of visceral ischemia. Electrocardiography was normal and chest roentgenogram indicated a projection of aortic arch. Peripheral arterial pulses were well palpable in the upper and lower extremities. Laboratory data revealed an elevation of creatinine. Computed tomography (CT) scans showed aortic dissection extending from the distal aortic arch to upper portion of the celiac artery. The initial tear was located within the aorta just distal to the origin of the subclavian artery confirming the diagnosis as a Stanford type B aortic dissection. (Fig. 1A and 1B) Despite, low blood pressure control, the patient's back pain was not alleviated. As a result of blood pressure control, oliguria occurred and the patient had to temporarily undergo continuous hemodiafiltration. 11 days after admission, the CT scan displayed dilatation of aortic arch (60→64 mm). Due to the increased urgency of his condition, he was transferred to our facility. On admission he had shown only minor symptoms. We performed the operation 15 days after initial admission.

Standard total cardiopulmonary bypass and moderate systemic hypothermia (30°C) were established

Fig. 1 Computed tomography scans showed aortic dissection extending from the distal aortic arch to upper portion of the celiac artery. The Initial tear was located within the aorta just distal to the origin of the subclavian artery which confirmed the diagnosis as a Stanford type B dissection.

with right atrium drainage and ascending aortic cannulation. A venting tube was inserted into the right upper pulmonary vein. After cross clamping, cardiac arrest was obtained by antegrade cardioplegia. After circulatory arrest, we incised the front of the aortic arch longitudinally and started selective cerebral perfusion in brachiocephalic and left carotid artery. The left subclavian artery was simply occluded. The left subclavian artery was anastomosed in an end-to-end fashion using a 9 mm Dacron graft. This Dacron graft was sutured to another 9 mm graft opposite end in advance suture. We inserted a balloon catheter from common femoral artery into the aortic arch incision. We dilated the balloon catheter inside the 28 mm Dacron graft and moved them into position in the descending aorta. We sutured 3-0 polypropylene graft proximal to the aorta using the inclusion technique (elephant trunk insertion without aortic arch graft replacement). The aorta was closed over with two strips of Teflon felt. After recirculation and returning from systemic hypothermia, we punched a 9 mm hole at the superior site of ascending aorta and inserted a guide wire into it. We sutured 9 mm graft to the small hole and finished left subclavian artery debranching. An additional guide wire was introduced through another 9 mm graft before we sutured (Fig. 2). The cardiopulmonary bypass was terminated without difficulty. We inserted a sheath from another 9 mm graft. We concurrently placed a 34 mm × 20 cm and 37 mm × 20 cm TAG (WL Gore & Associates, Flagstaff, Arizona, USA) graft into the elephant trunk to the descending aorta just above the celiac artery. The hybrid procedure was completed successfully

Fig. 2 Elephant trunk insertion was made using inclusion technique without aortic arch replacement. For antegrade stent-graft insertion, two 9 mm Dacron grafts were sutured (Aortic cannulation is abbreviated).

without any complications. We discharged the patient uneventfully after 11 operative days. 5 postoperative days later the CT scan revealed an almost closed false lumen. (Fig. 3A) A half-year's follow up CT scan showed shrinkage of thrombus lumen, so called, vascular reverse remodeling (Fig. 3B and 3C).

Discussion

The management of acute complicated type B aortic dissection remains a clinical challenge. Especially with the aortic arch involvement, cause a dramatic and

Fig. 3 (A) Post operative day 7 computed tomography (CT) showed complete thrombosis of the false lumen of the proximal and descending thoracic aorta. (B) A half-year's follow up CT scan showed shrinkage of thrombus lumen, so called, vascular reverse remodeling. (C) A half-year's follow up three-dimensional-CT scan. Blue portion shows the Dacron graft (Left subclavian artery debranching and elephant trunk insertion).

life-threatening condition. Therefore, initial management of acute complicated type B dissection with aortic arch involvement is not specifically addressed in the current Stanford classification.²⁾ Endovascular repair of acute complicated type B dissection with a stent-graft is proven to be technically feasible and effective.³⁾

The important point of an emergency or urgent operative strategy decision is if staged or not. It is difficult to repair either only through median sternotomy or left lateral thoracotomy protecting the myocardium and cerebrum. In addition, both median sternotomy and thoracotomy or bilateral anterior thoracotomy (clamshell incision) is highly invasive. For type B dissection with aortic arch involvement, a staged procedure using elephant trunk may be normally used.⁴⁾ However, several studies have been reported rupture in interval patients awaiting second staged operations.⁵⁾ As in this case, high-risk cases of aortic rupture, of course, can't be afforded in order to perform a staged operation. Therefore, we created a combination of various newly available techniques to perform a single stage procedure for high-risk cases.

On the other hand, single stage operation may cause another severe complication, spinal cord ischemia. In a EUROSTAR registry, spinal cord ischemia was observed for four factor, left subclavian artery covering without revascularization, renal failure, concomitant open abdominal aorta surgery, and three or more stent grafts used. This paper indicated that left

subclavian artery revascularization was most important factor in spinal protection.⁶⁾ In our institution, if in case of left subclavian artery stent-graft covering, we reconstruct left subclavian artery in every case. Although spinal drainage is not routinely used because of dangerous of bleeding, we have scarcely experienced spinal cord ischemia in case of left subclavian artery reconstruction.

In case of aortic arch involvement, the next important issue is the management of the neck vessel. The surgical strategy of the neck vessel depends on the distance of the proximal landing zone. For the purpose of complete exclusion of the primary tear site, we have to obtain a proximal landing distance of over 20 mm. In addition, Bavaria and colleague proposed that if landing zone diameter is greater than 3.7 cm, they created a Dacron proximal landing fixation because of a decrease of the risk of retrograde type A dissection in the deployment of proximal stent grafts.⁷⁾ In this case, the patient had just a 20 mm proximal landing distance if the left subclavian artery was debranched, and the proximal landing diameter was 40 mm, thus we had a combined safety strategy; left subclavian artery debranching and elephant trunk insertion. The brachiocephalic artery and carotid artery were not debranched in order to reduce circulatory arrest time. For the same reasons, elephant trunk insertion was made without aortic arch replacement. Considering the risk of residual aortic arch aneurysms in the future, total aortic arch

Table 1 Hybrid aortic arch repair

Single stage
I Debranching + TEVAR
II Debranching + creating a Dacron proximal landing zone + TEVAR
Second stage
Arch replacement with a delayed TEVAR

replacement with an elephant trunk, combined with a delayed TEVAR repair may ensure for long-term mortality. However, in addition to dangerous of rupture, we thought concomitant antegrade TEVAR was more safety than retrograde approach because descending aorta was extended for dissected aneurysm.⁸⁾ It is additional factor that strategy of staged or not is decided to antegrade or retrograde TEVAR. Bavaria and colleague classified the variations of hybrid repair as three types.⁷⁾ We propose hybrid aortic arch repair modified their classification including staged or not. (Table 1) In the single stage operation, it is important strategical factor if available native aortic proximal landing zone.

In conclusion, we succeed in performing a single stage hybrid operation, which consisted of (1) left subclavian artery debranching, (2) elephant trunk insertion without aortic arch replacement and (3) antegrade TEVAR on a symptomatic acute type B dissection of the aortic arch involved.

Disclosure Statement

The authors have declared no conflicts of interest.

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