The Heart Surgery Forum 2020-3345
24 (1), 2021 [Epub February 2021]
doi: 10.1532/hsf.3345

Online address: http://journal.hsforum.com

Reoperation a ter Implanting a Triple-Branched Stent Gra t: Case Report

Yu Song, MD*, Huadong Li, MD*, Xiaofan Huang, MD, Xiaobin Liu, MD, Long Wu, MD

Department of Cardiovascular Surgery, Union Hospital, Tongji Medical College, Huazhong University of Science and Technology, Wuhan, China

ABSTRACT

Acute type A aortic dissection (ATAAD) is an aortic catastrophe with high mortality, requiring immediate surgical intervention. Recently, placement of a triple-branch stent graft has emerged as an effective technique for total arch reconstruction. Indications for this approach, however, are limited by various complications, such as endoleak, stent graft migration or kinking, and spontaneous thrombosis. Here, we report a case of Marfan syndrome in which the patient underwent a reoperation owing to frame fractures (or degradation of graft material) in a triple-branched stent graft implanted 5 years earlier.

INTRODUCTION

Acute type A aortic dissection (ATAAD) that involves the aortic arch is a life-threatening vascular disorder, requiring immediate surgical treatment. Placement of an endovascular stent graft has been commonly accepted as an effective aortic repair technique for ATAAD [Shimamura 2008; Liu 2006]. Chen et al [2010] described an open triple-branched stent graft placement technique for repairing the proximal descending aorta, the arch, and 3 arch vessels instead of direct surgical repair. The proposed triple-branched stent graft comprises a main graft (consisting of a self-expandable nitinol stent and polyester vascular graft fabric) and 3 sidearm grafts, which are individually mounted on 4 catheters and restrained by 4 silk strings. This approach has some complications, however, such as an endoleak, stent graft shifting, and malperfusion syndrome [Shen 2012; Qiu 2020]. This report describes a case of Marfan syndrome that required reoperation 5 years after placement of a triple-branched stent graft.

Received Septembrer 23, 2020; received in revised form November 9, 2020; accepted November 9, 2020.

Yu Song and Huadong Li equally contributed to the study.

Correspondence: Long Wu, MD, Department of Cardiovascular Surgery, Union Hospital, Tongji Medical College, Huazhong University of Science and Technology, Wuhan 430022, China (e-mail: wulong@hust.edu.cn.

CASE REPORT

A 22-year-old female patient with Marfan syndrome underwent scoliosis orthopedic surgery and occlusion of the patent ductus arteriosus (PDA) in 2010. In 2012, Bentall surgery combined with triple-branched stent graft placement was performed because of an aortic dissection, ranging from the aortic root to the iliac artery. In the early morning of November 12, 2017, the patient suffered from persistent pain in the chest and back, sudden dizziness, and inability to move her lower limbs. Computed tomography angiography (CTA) examination at the local hospital indicated a recurrence of the aortic dissection, involving the innominate artery and the distal end of the intraluminal stent. The patient was transferred to our department the same day.

After the patient was admitted, a level III/VI murmur could be heard in the precardiac area, and no obvious abnormality was found in pulmonary auscultation. The opening and closing sound of the mechanical valve was clear. The patient's phalangeal joints were overextended, physiological curvature of the spine was diminished, and the dorsalis pedis artery pulse in both lower extremities was weak. Echocardiography showed a gap of ~0.3 cm with relative activity between the proximal end of the triple-branched stent graft and the wall of the autologous aorta. The proximal end of the innominate artery dilated to 2.3 cm, and the torn inner membrane divided it into true and false cavities. Valve function and cardiac function were normal, however, with no perivalvular leakage or coronary anastomotic leakage. An emergency CTA indicated that the stent graft was partially kinked, and the true and the false cavities were found to be connected in many places (Figures 1A and 1B), and the innominate artery had a fusiform dilatation.

The surgery was performed on November 29, 2017, with the patient's consent. After median sternotomy along the original incision, 3 branches of the aortic arch with tumor-like dilatation were freed. There was a thrill on palpation at the anastomosis of the ascending aorta and the stent graft. Cardiopulmonary bypass (CPB) was instituted through the right axillary artery, the femoral artery, and the right atrium. After cross-clamping of the proximal artificial blood vessel in the ascending aorta, cardioplegia was delivered to arrest the heart. Once the patient was cooled to 26°C, 3 branches of the aortic arch were cross-clamped, and the artificial vessels of the ascending aorta were cut up to the aortic arch under moderate hypothermic circulatory arrest and antegrade cerebral

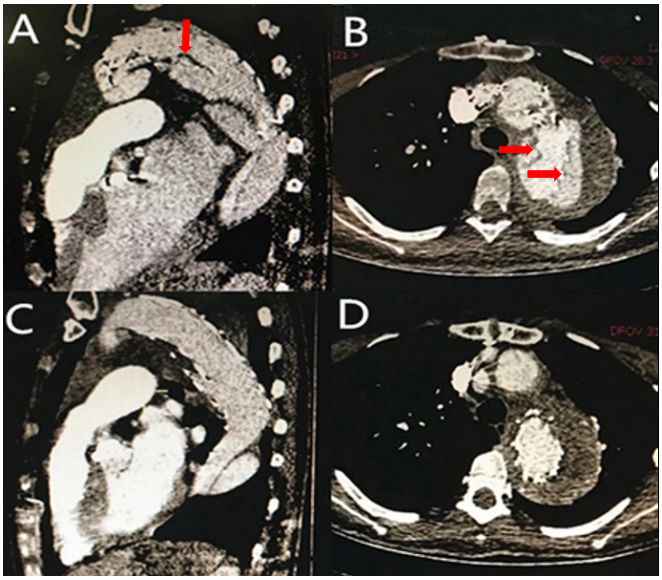

Figure 1. Preoperative and postoperative aortic CTA results. A and B, Preoperative CTA shows the false cavity (as indicated by the red arrows) caused by an endoleak. C and D, Postoperative aortic CTA indicates that the aortic arch has normal shapes, and the lumen of the descending aortic stent is unobstructed.

perfusion. At the anastomosis of the Dacron artificial blood vessel and the polytetrafluoroethylene (PTFE) material of the stent graft, a large rupture was observed involving a half-circle of the suture joint (Figure 2A). There was internal leakage in the decayed triple-branched stent graft connecting with the false lumen of the aortic arch. After the decayed stent graft was cut off (Figure 2B), a 26-mm CRONUS stent (MicroPort Endovascular Co., Shanghai, China) was implanted into the descending thoracic aorta, and the 26-mm 4-branched vascular graft was anastomosed with the proximal end of the CRONUS stent to close the false lumen. The sutureable artificial blood vessel of the cross-clamped 4-branched graft was pulled down to anastomose with the ascending aorta's artificial blood vessel. The 3 branches of the arch were reconstructed one by one (Figure 2C) during rewarming. The patient was mechanically ventilated for 48 hours after surgery and stayed in the intensive care unit for 10 days. She was discharged on day 15 after the surgery. Seven months later, the patient's total aortic CTA showed that the aortic arch and the 3 branches had normal shapes, and the lumen of the descending aortic stent was unobstructed (Figures 1C and 1D).

RESULTS

In traditional total arch replacement, the elaborate anastomosis of the Dacron prosthesis with the descending aorta and the 3 arch vessels is a time-consuming procedure, which could potentially cause damage to the phrenic and recurrent laryngeal nerves. Furthermore, anastomosis and hemostasis at the descending aorta and the left subclavian artery are usually very difficult to perform because of the deep surgical field.

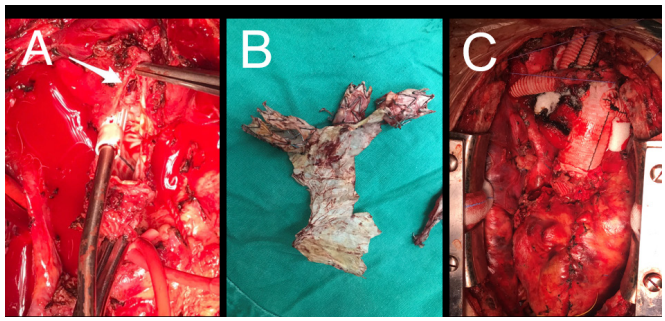

Figure 2. A decayed triple-branched stent graft was replaced by a 26-mm CRONUS stent and the 4-branched vascular graft. A, A large rupture was observed in the half-circle of the suture joint between the Dacron artificial blood vessel and PTFE material. B, The triple-branched stent graft after cutting. C, The anastomosis between the 26-mm CRONUS stent and the 4-branched vascular graft.

The open triple-branched stent graft placement technique, developed by Chen et al [2010], circumvents such difficulties. The technique offers the least invasiveness and a significant shortening of the operation time. Therefore, the open triple-branched stent graft placement technique was used in this case to repair the aortic arch at the local hospital.

Endovascular stent graft placement has widely proved to be an effective technique for type B aortic dissection [Hughes 2015]. However, stent implantation in the aortic arch could lead to some complications. An endoleak, as an inevitable complication in stent implantation, is more likely to occur at the aortic arch than at the descending aorta, owing to the radial force, the violent curve of the vessels, and the continuous friction between the stent and the Dacron vascular tube. In most cases, the triple-branched stent graft cannot be perfectly matched with the various aortic arches and the 3 branches, increasing the incidence of stent displacement or endoleak. In addition, the anastomosis between the stent graft and the artificial vessel breaks the integrity of the stent graft to some degree, and this may accelerate the process of endoleak occurrence in the stent graft.

Although placement of the triple-branched stent graft in patients with Marfan syndrome has demonstrated satisfactory results [Chen 2014], its indication is typically limited by the pathological and clinical characteristics of Marfan syndrome, such as aortic wall fragility and progressive degeneration of a residual aorta or neighboring arterial segments after surgery or intravascular treatment of the affected primary aortic segment [Dong 2009]. In addition, because of the small diameter of the aorta and the neck of the aortic arch in young children, stent implantation should be considered, especially in young patients. The young patient reported in this case underwent reoperation owing to an endoleak and stent graft kinking.

Triple-branched stent graft placement represents a beneficial technique for the surgical treatment of ATAAD involving the aortic arch. However, there is still a lack of multicenter-based randomized controlled trials on the long-term surgical effects of this technique and its indications. Therefore, the triple-branched stent graft placement approach requires

further improvements that should result from careful consideration of anatomic factors, technical feasibility, surgical indications, long-term surgical effects, and advancements in material technology.

REFERENCES

Chen LW, Dai XF, Lu L, Zhang GC, Cao H. Extensive primary repair of the thoracic aorta in acute type A aortic dissection by means of ascending aorta replacement combined with open placement of triple-branched stent graft: Early results. Circulation 2010;122:1373-1378.

Chen LW, Lu L, Dai XF, et al. Total arch repair with open triple-branched stent graft placement for acute type A aortic dissection: Experience with 122 patients. J Thorac Cardiovasc Surg 2014;148:521-528.

Dong ZH, Fu WG, Wang YQ, et al. Retrograde type A aortic dissection after endovascular stent graft placement for treatment of type B dissection. Circulation 2009;10;119:735-741.

Hughes GC. Management of acute type B aortic dissection; ADSORB trial. J Thorac Cardiovasc Surg 2015;149(2 suppl):S158-S162.

Liu ZG, Sun LZ, Chang Q, et al. Should the "elephant trunk" be skeletonized? Total arch replacement combined with stented elephant trunk implantation for Stanford type A aortic dissection. J Thorac Cardiovasc Surg 2006;131:107-113.

Qiu ZH, Chen LW, Liao LM, et al. Efficiency of modified triple-branched stent graft in type i aortic dissection: Two-year follow-up. Ann Thorac Surg 2020;110:925-932.

Shen K, Tang H, Jing R, Liu F, Zhou X. Application of triple-branched stent graft for Stanford type A aortic dissection: Potential risks. Eur J Cardiothorac Surg 2012;41:e12-e17.

Shimamura K, Kuratani T, Matsumiya G, et al. Long-term results of the open stent-grafting technique for extended aortic arch disease. J Thorac Cardiovasc Surg 2008;135:1261-1269.