Total arch replacement for aortic arch aneurysm with coexisting middle aortic syndrome

Zaiqiang Yu, Masahito Minakawa*, Norihiro Kondo, Kazuyuki Daitoku, Ikuo Fukuda

Department of Thoracic and Cardiovascular Surgery, Hirosaki University Graduate School of Medicine, Aomori, Japan

ARTICLE INFO

Article history:
Received 20 September 2018
Received in revised form
15 November 2018
Accepted 19 November 2018
Available online 24 November 2018

Keywords:
Aortic arch aneurysm
Middle aortic syndrome
Axillary-femoral artery bypass
Case report

ABSTRACT

Introduction: Middle aortic syndrome (MAS) combined with thoracic aortic aneurysm (TAA) is a rare vascular disease. One stage open surgery to treat this condition, becomes a challenge for our cardiovascular surgery.

Presentation of case: A 69-year-old man presented with a saccular type aortic arch aneurysm, shaggy aorta and severe atherosclerotic stenosis of the thoracoabdominal aorta with middle aortic syndrome and aberrant right subclavian artery, renovascular hypertension, renal dysfunction, and intermittent claudication of both legs. Total arch replacement procedure was performed under a cardiopulmonary bypass using aortic inflow from the right axillary artery and a femoro-femoral crossover bypass graft to avoid malperfusion of the lower body. Before weaning from the cardiopulmonary bypass, we established an extra-anatomical bypass from the ascending aortic graft to the femoro-femoral crossover bypass graft. 3D-CT showed patency of bypass graft without any sign of stenosis postoperatively. The patient’s postoperative course was uneventful and he was discharged from hospital with improvements in intermittent claudication, hypertension, and renal dysfunction.

Discussion: Although open surgery including graft bypass for MAS is more invasive than endovascular treatment, it could be performed successfully to preventing from intraoperative complications postoperatively.

Conclusion: Combined operation of total arch replacement and a bypass from the ascending aorta to the bifemoral arteries is alternative for MAS combined with TAA.

© 2018 The Authors. Published by Elsevier Ltd on behalf of IJS Publishing Group Ltd. This is an open access article under the CC BY license (http://creativecommons.org/licenses/by/4.0/).

1. Introduction

Middle aortic syndrome (MAS) is a rare vascular disease that presents as severe stenosis of the middle of the thoracoabdominal aorta. The incidence ranges from 0.5% to 2% of the population [1]. Catheter intervention and endovascular surgery are minimally invasive approaches to treating MAS. Open aortic surgery using a cardiopulmonary bypass is an alternative to endovascular procedures, but it can result in malperfusion of the abdominal organs and legs. We describe total aortic arch replacement to treat coexisting MAS under a cardiopulmonary bypass with dual aortic inflow through the axillary artery and a femoro-femoral bypass graft. Our work has been reported in line with the SCARE criteria [2].

2. Presentation of case

A 69-year-old man presented with severe intermittent claudication, and chronic kidney disease (Serum Creatinine 1.7 mg/dL, eGFR 32.2 mL/min/1.73 m²), was introduced to our department. Renovascular hypertension induced by renal arteries stenosis had become exacerbated despite an increased dose of oral anti-hypertensive drugs (Telmisartan 40 mg, Doxazosin mesylate 4 mg, Amiodipine besilate 7.5 mg). He also had a history of autoimmune pancreatitis and diabetes mellitus. Electrocardiogram was normal without any arrhythmia. Contrast-enhanced computerized tomography (CT) revealed a saccular aortic aneurysm with a diameter of 68 mm on the middle aortic arch (Fig. 1A) without any relevant complications. An aberrant right subclavian artery (ARSCA) originated from the distal aortic arch, and a thick atheroma irregularly protruded from the intima of the aortic arch and descending thoracic aorta. Severe diffuse aortic stenosis (Fig. 1C, D, E) was confirmed in the thoracoabdominal and infra-renal abdominal aortae.
with severe calcification and shaggy aorta (Fig. 1B). The orifice of the bilateral renal arteries was also stenosed and calcified (Fig. 1C). Chest X-ray showed enlargement of aortic arch (Fig. 1G). Pulses were not palpable on the bilateral common femoral arteries. Therefore, surgical intervention was indicated for both the aortic arch aneurysm with ARSCA and MAS. The patient underwent total aortic arch replacement and a concomitant extra-anatomical bypass of the bilateral femoral arteries.

After preparing a median sternotomy and before establishing a cardiopulmonary bypass (CPB), we created a femoro-femoral crossover bypass using a T-shaped, 8-mm ringed, extended polytetrafluoroethylene (ePTFE) graft. A 9-mm Dacron graft was anastomosed to the right axillary artery and CPB perfusion proceeded via a femora-femoral crossover bypass graft for the lower extremities and a right axillary artery graft for the upper extremities. Under deep hypothermic circulatory arrest at a bladder temperature of 25°C, the aortic arch was transected at the distal portion of the orifice of the aberrant right subclavian artery (Fig. 2A, B). Selective cerebral perfusion (SCP) was established including right and left common carotid artery and left subclavian artery.
Right subclavian artery was perfused from inflow graft after the stump of ARSCA was sutured and closed at proximal site from aortic arch. A 26-mm SHIELD NEO™ graft (Japan Lifeline Co. Ltd., Tokyo, Japan) was used for total aortic replacement to treat the aortic aneurysm. Thereafter, the arch vessels were reconstructed. Graft bypass was performed from aortic graft branch for reconstructing right subclavian artery in the anatomic position. During systemic rewarming, inflow anastomoses of extra-anatomic bypass graft from the ascending aortic graft to the femoro-femoral crossover bypass graft was established to maintain circulation blood perfusion to the lower body for MAS (Fig. 2C). The total durations of CPB, cardiac arrest, and circulatory arrest were 252, 137 and 69 min, respectively.

The postoperative course was uneventful and the patient was discharged without complications. The serum creatinine level was postoperatively improved (Cre 1.1 mg/dL). Blood pressure was normalized with lower doses of anti-hypertensive drugs (Amlodipine besilate 5 mg), the ankle brachial pressure index was almost normal (right: 0.92, Left: 0.86), and the intermittent claudication disappeared. Three-dimensional CT showed that all grafts were patent without stenosis (Fig. 3). Pathological diagnosis showed that atheroma change was found mainly. Edoxaban tosilate hydrate 30 mg/day was prescribed for keep graft patency. There was no any complications induced by graft stenosis or occlusion two years postoperative, the bypass graft to femoral arteries is patency (Fig. 4).

Fig. 3. Intra-operative picture. A: aorta. B: aberrant right subclavian artery. C: Total image of total procedure finished.

Fig. 4. Computed tomography findings showed that graft was patency (white arrow).
3. Discussion

Middle aortic stenosis (MAS) is a rare aortic disease that can be congenital or adult-onset. The typical etiology of MAS is congenital coarctation, aortitis, and atherosclerosis of the aorta. The renal artery is involved in 50–90% of patients with MAS [3,4]. Many symptoms and comorbidities are associated with MAS due to reduced blood circulation to the visceral organs and lower extremities; they include abdominal angina, renovascular hypertension, chronic kidney disease, and intermittent claudication [3,5]. Comorbid MAS and a thoracic aortic aneurysm is rare [6]. Middle aortic syndrome in adults was originally described as a variant of Takayasu aortitis secondary to localized aortitis [7]. However, our patient did not have a history of fever or an elevated inflammatory response. Atherosclerosis might have been the most probable cause, because intimal thickening, severe calcification, and shaggy atherosclerotic changes were found on the thoracoabdominal aortic segment.

An extra-anatomical bypass is an effective surgical strategy for managing MAS. The ascending aorta or the descending thoracic aorta can serve as an inflow site for a bypass to the lower abdominal aorta or iliac artery [8]. Hetzer found that an extra-anatomic bypass resulted in good outcomes and provided long-term graft patency in children with MAS [9]. Resection and interposition grafts at stenotic sites represent another option [10].

Percutaneous intervention is also an effective alternative to bypass surgery, but it is associated with a high incidence of restenosis and reintervention [11]. Our patient had diffuse stenosis of the thoracoabdominal aorta with severe calcification over the orifice of the renal artery. Regarding endovascular repair for this case, it is difficult to get enough landing zone, and with high risk of aortic rupture or restenosis. Although endovascular repair is as the first line in management for these patients as well for MAS, but in the presence of peripheral vascular disease, this would not be easily feasible. We decided to implement a bypass from the ascending aorta to the bilateral-femoral arteries using inflow from the graft for the total arch replacement as CT images. This simple procedure allows secure perfusion of the lower extremities during CPB. Renovascular hypertension was also improved after the surgery without the need for secondary intervention to the renal arteries.

This case highlights that thoracic aortic aneurysm with concomitant MAS can be treated by combined operation of total arch replacement and a bypass from the ascending aorta to the bifemoral arteries successfully. Visceral and legs malperfusion was prevented by femoral arteries perfusion, and MAS was treated by graft bypass rather than graft replacement of stenosis section which is easy to be performed. The clinical outcome was satisfactory.

Conflicts of interest

There are no any conflicts of interest to disclose.

Funding

There are no any sources of funding for this study to declare.

Ethical approval

This study had got ethical approval from the institutional review boards of the Hospital of Hirosaki University.

Consent

Written, informed consent was obtained from the patient for the publication of this case report and any accompanying images.

Author contribution

Zaiqiang Yu, Masahito Minakawa and Ikuo Fukuda performed the surgery.

All authors drafted the manuscript.

All authors read and approved the final manuscript.

Registration of research studies

Researchregistry4411.

Guaran
tor

Masahito Minakawa.

Department of Thoracic and Cardiovascular Surgery, Hirosaki University Graduate School of Medicine, 5 Zaifu-cho, Hirosaki, Aomori 036-8562, Japan.

Provenance and peer review

Not commissioned, externally peer reviewed.

References

[1] H. Zapata, J.F. Edwards, J.L. Titus, Aberrant right subclavian artery with aortic arch: associated anomalies, Pediatr. Cardiol. 14 (1993) 159–161.
[2] R.A. Agba, A.J. Fowler, A. Saetta, I. Barai, S. Rajmohan, D.P. Orgill, the SCARE Group, The SCARE statement: consensus-based surgical case report guidelines, Int. J. Surg. 34 (2016) 180–186.
[3] R.G. Fisher, C.J. Whigham, C. Trinh, Diverticula of Kommerell and aberrant subclavian arteries complicated by aeurysmns, Cardiovasc. Intervent. Radiol. 28 (2005) 553–560.
[4] J.C. Stanley, E. Criad, J.L. Elaison, et al., Abdominal aortic coarctation: surgical treatment of 53 patients with a thoracoabdominal bypass, patch aortoplasty, or interposition aorto-aortic graft, J. Vasc. Surg. 48 (2008) 1073–1082.
[5] Y. Atay, C. Engin, H. Posaçoglu, et al., Surgical approaches to the aberrant right subclavian artery, Tex. Heart Inst. J. 33 (2006) 477–481.
[6] K.T. Delis, P. Gloviczki, Middle aortic syndrome: from presentation to contemporary open surgical and endovascular treatment, Perspect. Vasc. Surg. Endovasc. Ther. 17 (2005) 187–203.
[7] S. Daimon, K. Kitamura, Coarctation of the abdominal aorta. Report of a case and review of the literature, Jpn. Heart J. 82 (1964) 562–573.
[8] Y.K. Okamoto, K.Z. Yamamoto, T.T. Sugimoto, et al., Descending aorta–exterior iliac artery bypass for middle aortic syndrome, Heart Vessels 29 (2014) 864–866.
[9] R. Hetzer, D. Abi, O. Miera, et al., Extraanatomic bypass technique for the treatment of midaortic syndrome in children, Ann. Thorac. Surg. 96 (2013) 183–189.
[10] A. Youssif, G. Kloppenburg, W.J. Morshuis, et al., Repair of adult aortic coarctation by resection and interposition grafting, Intercar. Cardiovasc. Thorac. Surg. 23 (2016) 526–530.
[11] E.S. Siwik, S.B. Perry, J.E. Lock, Endovascular stent implantation in patients with stenotic aortoarteriopathies: early and medium-term results, Catheter. Cardiovasc. Interv. 59 (2003) 380–386.

Open Access

This article is published Open Access at sciencedirect.com. It is distributed under the IJSCR Supplemental terms and conditions, which permits unrestricted non commercial use, distribution, and reproduction in any medium, provided the original authors and source are credited.