Hirosaki Med. J. **70** : 62—66, 2019

CASE STUDY

Thoracic endovascular aortic repair for giant thoracic and abdominal aneurysms combined with Y-graft replacement in one stage: Report of a case

Zaiqiang Yu, Norihiro Kondo, Xu Liu, and Ikuo Fukuda

Abstract An 80-year-old man with multilevel aortic aneurysms was referred to our hospital. Enhanced computed tomography showed a 90-mm descending aortic aneurysm and a 50-mm abdominal aortic aneurysm with severe stenosis of bilateral external iliac arteries. Thoracotomy was considered a high-risk procedure because he had a long history of chronic obstructive pulmonary disease. We performed combined operation; Y-graft replacement for making access routes, followed by thoracic endovascular aortic repair for the thoracic aortic aneurysm with one debranching bypass from the left common carotid artery to the left subclavian artery. Neither paraplegia nor infectious complications occurred postoperatively.

Hirosaki Med. J. **70** : 62—66, 2019

Key words: Multilevel aortic aneurysm; combined operation; One-stage repair.

Introduction

Multilevel aortic aneurysms are increasing in aging societies, but there is no sufficient evidence to determine the treatment strategy, including open surgery and hybrid procedures simultaneously or subsequently. Multiple segmental aortic pathologies in the chest and abdomen provide an opportunity for staged management, but with subsequent repair, rupture might occur at the residual lesion while waiting for the next operation[1]. Simultaneous treatment for these patients is to avoid residual aneurysm rupture and thoracotomy, but it is high risk with complications such as spinal cord injury and embolism. To determine the best strategy for such cases, accumulation of data about the aortic pathology is essential. We report a case with giant thoracic (> 80 mm) and abdominal aneurysms who was successfully treated by simultaneous surgery including Y-graft replacement and thoracic endovascular aortic repair.

Case Report

An 80-year-old man was referred to our hospital with a diagnosis of multilevel aortic aneurysms. Enhanced computed tomography (CT) showed multilevel aortic aneurysms as follows: a distal aortic arch aneurysm with a diameter of 75 mm; a descending thoracic aortic aneurysm 90 mm in diameter; and an infrarenal abdominal aortic aneurysm 50 mm in diameter (AAA). CT also showed severe stenosis of bilateral external iliac arteries with each having a diameter of 3 mm (Fig. 1). The patient had a long history of chronic obstructive pulmonary disease (COPD) over 10 years, but without any surgical history. Transthoracic echocardiography showed good cardiac function with a left ventricular ejection fraction of 61.8%. Blood examination showed normal renal function (serum creatinine 1.01 mg/dL) and slightly elevated fibrinogen degradation products of 14.6 mg/dL. Activities of daily living were very well

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

Correspondence: N. Kondo
Received for publication, January 17, 2019
Accepted for publication, April 4, 2019

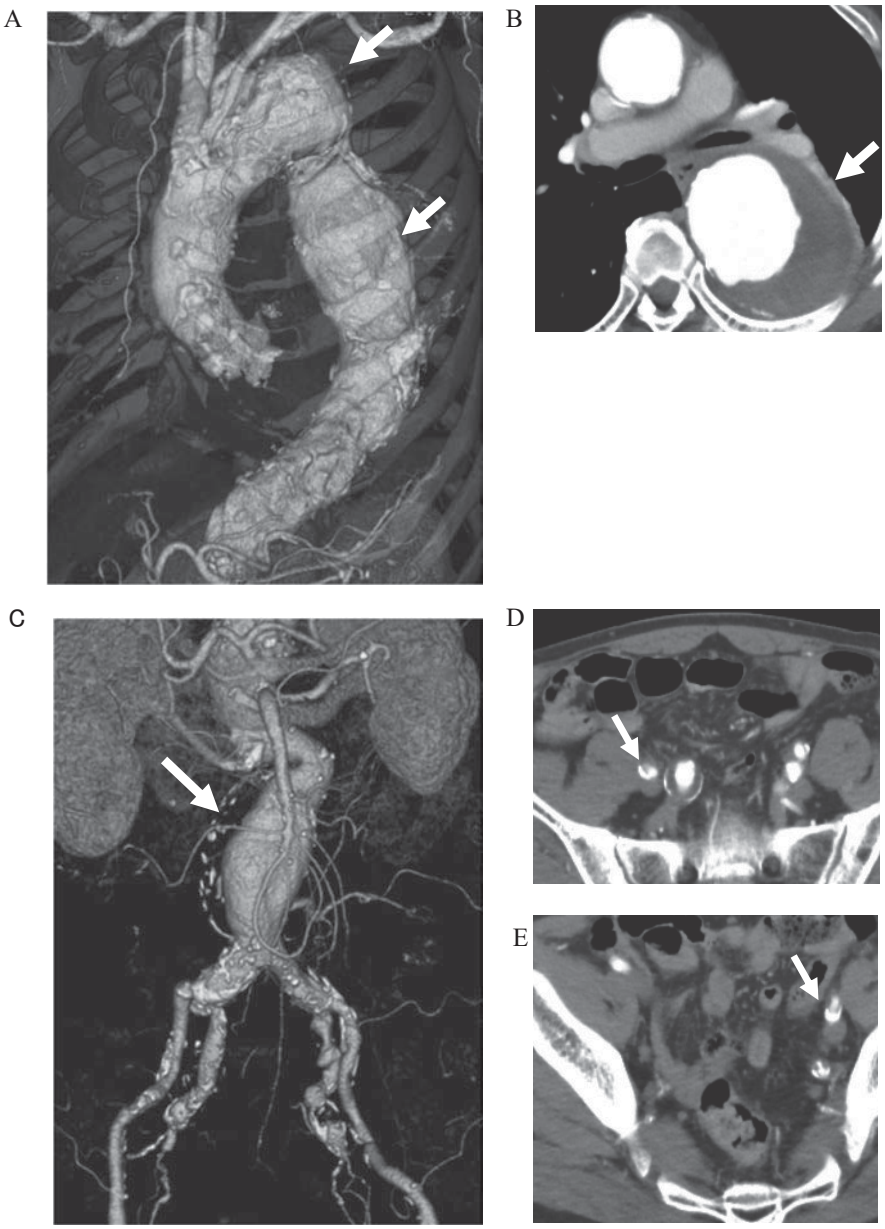

Fig. 1 Contrast CT findings
A: Distal aortic arch aneurysm (75 mm) (white arrow) and descending thoracic aortic aneurysm (90 mm) (white arrow) were found.
B: Shaggy aorta with massive mural thrombosis is confirmed (white arrow).
C: The abdominal aortic aneurysm (50 mm) (white arrow) is seen under the renal arteries. Severe tortuosity of the abdominal aorta is evident above the abdominal aortic aneurysm.
D: Severe stenosis of the right external iliac arteries (3 mm) is seen (white arrow).
E: Severe stenosis of the left external iliac arteries (3 mm) is seen (white arrow).

maintained, and his performance status was 1.

This patient's condition was assessed, and the 90-mm descending thoracic aortic aneurysm was considered the most life-threatening condition. Because arterial access was difficult to obtain, the patient underwent simultaneous repair of the abdominal aortic aneurysm with Y-graft replacement and endovascular treatment of the thoracic aorta (TEVAR). The operation was performed without cerebrospinal fluid (CSF) drainage, but with awareness of the potential for urgent drainage in the case of postoperative

paraplegia. To attain a sufficient landing zone for TEVAR, the left subclavian artery was covered. The left common carotid to left subclavian artery bypass grafting was performed using an expanded polytetrafluoroethylene and knitted polyester graft (Fusion vascular graft 7 mm MAQUET, Rastatt, Germany). With a median laparotomy, the abdominal aortic aneurysm was reconstructed using Y grafting from the infrarenal aorta to bilateral common femoral arteries with a trifurcated collagen coated knitted Dacron vascular graft (Intergard Treo® 20×10×10×9mm MAQUET). The common femoral arteries were used as distal anastomoses to preserve access routes for endovascular treatment, if needed in the future. The bilateral common iliac arteries were closed just above the iliac bifurcation to preserve internal iliac artery perfusion. One of the 10-mm limbs of the trifurcated graft was used as an access route for TEVAR. TEVAR was performed using two stent grafts (RELAY plus® 44×250 mm, 46×200 mm, Bolton Medical, Sunrise, FL) to cover from zone 2 to the lower level of the twelfth thoracic vertebra. The left subclavian artery was occluded at the ostium with a vascular plug (10-mm AMPLATZER vascular plug®, St. Jude Medical, St. Paul, MN). The final confirmatory angiography showed no endoleaks after completion (Fig. 2). Postoperative wound pain management was successful with rectus sheath block. The patient's postoperative course was uneventful. The thoracic aneurysm was shrinking one year after the operation.

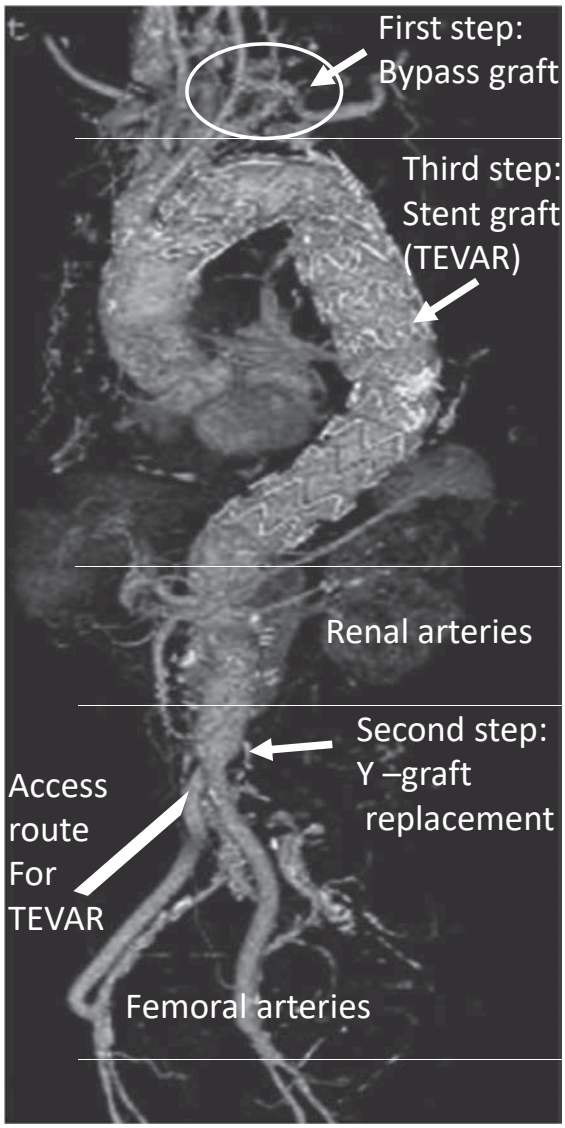

Fig. 2 Postoperative CT shows no endo-leak and complete obliteration of the aneurysmal sac. The bypass graft between the left carotid artery and the left subclavian artery is patent (white arrow). The white part showed the access route branching graft for TEVAR, which was taken out after procedure completed.

Discussion

Overall, 10 to 29% of patients with a thoracic aortic aneurysm have multilevel aneurysms, especially abdominal aortic aneurysms[2]. One-stage surgical treatment for multilevel aortic aneurysms remains challenging for cardiovascular surgeons, with a high risk of postoperative paraplegia[3]. If TEVAR were performed subsequently after Y-graft replacement as a staged repair, the possibility of residual aneurysm rupture while waiting for the second-stage procedure is not negligible[1].

In the present case, he had several problems: 1) Since he had a long history of COPD, surgery with thoracotomy under selective lung ventilation could not be performed. 2) Due to severe stenosis

of bilateral external iliac arteries, there was no satisfactory access routes for endovascular repair. 3) One-stage surgical treatment for multilevel aortic aneurysms had a high risk of postoperative paraplegia. Firstly, to avoid thoracotomy surgery and residual aneurysm rupture before second-stage operation, we performed one-stage repair including TEVAR and Y-graft replacement for creating access route for TEVAR.

Secondly, the risk of spinal cord injury may increase with simultaneous treatment for multilevel aortic aneurysms. Although a recent study showed that staged surgery reduced the risk of paraplegia[4], one-stage repair of multilevel aortic aneurysms could be performed safely with a low risk of paraplegia by reconstruction of the intercostal artery feeding the anterior spinal artery and postoperative CSF drainage if the patient shows signs of leg muscle weakness[5]. Low blood pressure and renal dysfunction are risk factors for postoperative paraplegia[6]. The most important point is sustaining the blood pressure >90 mmHg for spinal circulation when replacement or endovascular repair is performed for multilevel aortic aneurysms[7]. CSF drainage is an effective solution for preventing spinal cord ischemia, which decreases CSF pressure and increases perfusion pressure to sustain the flow of spinal cord arteries[8]. Postoperative CSF drainage was also effective to improve signs of spinal cord ischemia[9]. Based on the preoperative examinations, this patient's intercostal arteries from Th6 to Th12 were obstructed by mural thrombosis of the aneurysm, so CSF drainage was not performed preoperatively. Instead, flow reservation of the left subclavian artery and bilateral internal iliac arteries was completed as a collateral flow source.

Recently, hybrid endovascular treatment has become another effective solution for multilevel aortic aneurysms after Y-graft replacement or total visceral vessel bypass[10]. For elderly high-risk patients, some reports showed that hybrid endovascular treatment for multilevel aortic aneurysms was a more effective solution than open surgery. Since the present case had severe stenosis of bilateral external iliac arteries, endovascular repair of the external iliac arteries could not obtain sufficient diameter to pass the sheath through the stenotic segment. Therefore, endovascular treatment for the descending thoracic aortic aneurysm after open repair of the abdominal aortic aneurysm as one-stage surgery was selected to avoid residual aneurysmal rupture. However, the risks of postoperative paraplegia become higher in a combined operation because of abdominal aortic replacement. Because the patient was at high risk for respiratory complications due to longstanding COPD, rectus sheath block was performed by anesthesiologists to inhibit wound pain induced by respiratory depression.

Conclusion

Hybrid endovascular treatment for multilevel aortic aneurysms combined with Y-graft replacement is an effective solution for elderly high-risk patients. Perioperative pain management was useful to prevent postoperative respiratory complications.

Informed consent

Informed consent has been obtained from patient for publication of the case report and accompanying images.

Disclosure Statement

All authors have no conflict of interest.

Acknowledgements

This research received no specific grant from any funding agency in the public, commercial or

not-for-profit sectors.

Author Contributions

Study conception: all authors
Writing: YZ, NK
Critical review and revision: all authors
Final approval of the article: all authors
Accountability for all aspects of the work: all authors

References

1) Menard MT, Nguyen LL, Chan RK, Conte MS, Fahy L, Chew DK, Donaldson MC, et al. Thoracovisceral segment aneurysm repair after previous infrarenal abdominal aortic aneurysm surgery. J Vasc Surg. 2004;39:1163-70.

2) Meguid AA, Bove PG, Long GW, Kirsch MJ, Bendick PJ, Zelenock GB. Simultaneous stent-graft repair of thoracic and infrarenal abdominal aortic aneurysms. J Endovasc Ther. 2002;9:165-9.

3) Coselli JS, LeMaire SA, Miller CC, Schmittling ZC, Köksoy C, Pagan J, Curling PE. Mortality and paraplegia after thoracoabdominal aortic aneurysm repair: a risk factor analysis. Ann Thorac Surg. 2000;69:409-14.

4) Takagi H, Mori Y, Iwata H, Umeda Y, Fukumoto Y, Matsuno Y, Hirose H. Simultaneous operations for combined thoracic and abdominal aortic aneurysms. Surg Today. 2003;33:674-8.

5) Coselli JS, LeMaire SA, Schmittling ZC, Köksoy C. Cerebrospinal fluid drainage in thoracoabdominal aortic surgery. Semin Vasc Surg. 2000;13:308-14.

6) Wong DR, Coselli JS, Amerman K, Bozinovski J, Carter SA, Vaughn WK, LeMaire SA. Delayed spinal cord deficits after thoracoabdominal aortic aneurysm repair. Ann Thorac Surg. 2007;83:1345-55.

7) Iida H. Spinal cord protection for anesthesiologists. The journal of Japan Society for Clinical anesthesia. 2007;27:599-607.

8) Sugiura J, Oshima H, Abe T, Narita Y, Araki Y, Fujimoto K, Mutsuga M, et al. The efficacy and risk of cerebrospinal fluid drainage for thoracoabdominal aortic aneurysm repair: a retrospective observational comparison between drainage and non-drainage. Interact Cardiovasc Thorac Surg. 2017;24:609-14.

9) Katsargyris A, Oikonomou K, Kouvelos G, Renner H, Ritter W, Verhoeven EL. Spinal cord ischemia after endovascular repair of thoracoabdominal aortic aneurysms with fenestrated and branched stent grafts. J Vasc Surg. 2015;62:1450-6.

10) Wu IH, Chan CY, Liang PC, Huang SC, Chi NS, Wang SS. One-stage hybrid repair to thoracoabdominal aortic aneurysm. Ann Vasc Surg. 2014;28:201-8.