Case Report

Staged Hybrid Debranching and Thoracic Endovascular Aneurysm Repair for Multiple Aortic Aneurysms after Conventional Open Repair of the Descending Aorta: A Case Report

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Endovascular repairs of thoracic and thoracoabdominal aortic aneurysm have recently been proposed as a less invasive alternative to conventional open surgical repair. In selective cases, adjunctive bypass surgery may be required to provide an adequate landing zone. We describe a case of staged hybrid debranching and thoracic endovascular aneurysm repair for distal aortic arch and thoracoabdominal aortic aneurysms after conventional open repair of the descending aorta.

Keywords: thoracic endovascular aneurysm repair, debranching, multiple aortic aneurysm

INTRODUCTION

Since the first successful endovascular thoracic aortic aneurysm repair, performed by Dake and colleagues in 1994,1) endovascular repair has evolved into a valuable treatment for thoracic and aortic aneurysm. This technique is less invasive with low morbidity and mortality for high-risk patients, especially those who have undergone prior open aortic surgery.2) In cases of aortic arch or thoracoabdominal pathologies, which often involve the origin of the supra-aortic or visceral-renal branches, it may be necessary to cover those branches using an endovascular stent graft to extend the proximal or distal landing zone. To reduce the risk of neurologic and vascular complications, adjunctive open surgical bypass surgery may be required to provide an adequate landing zone.3) This is a case report of staged hybrid debranching and thoracic endovascular aneurysm repair for multiple aortic aneurysms after conventional open surgical repair of the descending aorta.

CASE REPORT

A 71 year-old man was referred to our hospital with the diagnosis of multiple aneurysms in the distal aortic arch and thoracoabdominal aorta. He had undergone conventional open repair of the proximal descending aorta through a left lateral thoracotomy eight years ago. A computed tomography (CT) scan showed a distal aortic arch aneurysm just below the left subclavian artery (LSCA) with a maximum diameter of 51 mm and a thoracoabdominal aortic aneurysm just below the previous distal anastomotic level of the prosthetic graft, involving the celiac artery (CA) and the superior mesenteric artery (SMA) with a maximum diameter of 61 mm (Fig. 1). Because the patient was insistent in avoiding a redo thoracotomy and declined a conventional, open surgical treatment and strongly requested a less invasive treatment, we chose the thoracic endovascular aneurysm repair (TEVAR). As those aneurysms were closed to the left common carotid artery (LCCA) and involved the CA, adjunctive surgical bypass grafting was needed to provide adequate landing zone.
zones for TEVAR. As a result, we decided to perform staged hybrid debranching and TEVAR.

Under general anesthesia, bilateral axillary arteries were exposed through an infraclavicular incision parallel to the clavicle and the left common carotid artery was exposed through a longitudinal incision along the medial aspect of the left sternocleidomastoid. An extra-anatomic right-to-left axillary artery bypass was performed in an end-to-side fashion using a ringed Gore-Tex 8 mm graft (W.L. Gore and Associates, Inc., Flagstaff, AZ). Then the LCCA-to-the prosthetic graft bypass was performed using another Gore-Tex 8 mm graft and the root of the LCCA was ligated to prevent retrograde perfusion into the aneurysm. There was no change of regional cerebral oxygen saturation during carotid artery clamping according to cerebral oxymetry monitoring. Following those procedures, a 37 mm × 20 cm Gore TAG thoracic endoprosthesis (W.L. Gore and Associates, Inc., Flagstaff, AZ) was deployed from just distal to the origin of the innominate artery to the proximal part of the previous prosthetic graft through a right common iliac artery. A completion angiogram demonstrated no evidence of retrograde type II endoleak. Therefore, proximal ligation or coil embolization of the LSCA was not performed. There were neither neurologic nor vascular complications. Postoperative CT scan revealed complete exclusion of the aneurysm without any evidence of leakage and good patency of the bypass grafts (Fig. 2). He was discharged on postoperative day 11th.

The patient was readmitted to our hospital for surgical treatment of the thoracoabdominal aortic aneurysm 3 months after the first operation. Prior to the second operation, the celiac artery balloon occlusion test was performed, and intact collateral foregut circulation between the celiac and superior mesenteric arteries was confirmed. Operation was performed thorough a median
laparotomy under general anesthesia. Spinal cord protective measures, including cerebral spinal fluid drainage, motor-evoked potential, and prevention of intraoperative and perioperative hypotension were used during this staged procedure. The CA, the SMA and the left common iliac artery (LCIA) were exposed in preparation for the bypass grafting. The LCIA was used as the donor vessel of inflow for the retrograde SMA bypass graft. The SMA was anastomosed end-to-side fashion using a ringed Knitted Dacron 8 mm graft (Gelsoft®, Vascutek). Following those procedures, a 31 mm × 15 cm Gore TAG thoracic endoprosthesis was deployed from the distal part of the previous prosthetic graft to just above the bilateral renal arteries through a terminal abdominal aorta. Then, the root of the CA and SMA was ligated to prevent retrograde perfusion into the aneurysm. Postoperative CT scan showed complete exclusion of the aneurysm without any evidence of leakage and good patency of the bypass grafts (Fig. 3). His postoperative course was uneventful without any complications, and he was discharged 20 days after the surgery.

DISCUSSION

The long-term results of most thoracic or thoracoabdominal aortic aneurysm repairs are satisfactory. However, some patients require a reoperation for a separate aneurysm after the original aortic repair. Thus, in cases of thoracic or abdominal aortic aneurysms there is quite a high risk of development of multiple aortic aneurysms. Carrel et al. reported that new or recurrent aortic aneurysms accounted for 36 (27.7%) of the 130 thoracic aortic reoperations performed in their series of 120 patients were due to new or recurrent aortic aneurysms. Crawford’s complete TAAA experience reported by Svensson and colleagues, 181 patients (12%) had previously undergone a proximal aortic operation; this group of patients was characterized by a lower 30-day mortality rate than in the group of patients who had not previously undergone thoracic aortic aneurysm repair.

Endovascular repair of thoracic pathology is emerging as the preferred treatment strategy in a majority of patients, as increasing data suggest that endovascular repair may be performed with lower perioperative morbidity and mortality rates, with similar midterm survival, when compared with conventional open surgical repair. However, because of anatomic constraints related to required endograft seal zones, a significant number of patients, many of whom are not ideal candidates for open surgery, are excluded from standard endovascular repair. Consequently, in an attempt
to expand the pool of patients suitable for endovascular repair, “hybrid” techniques, including open aortic arch and thoracoabdominal debranching procedures, have been described to allow creation of proximal and/or distal landing zones for stent graft seal. Current data suggest that these techniques of hybrid debranching and TEVAR (H-TEVAR) could be performed with lower rates of morbidity and mortality than could conventional, open surgical repair.2,3,8)

By avoiding thoracotomy, H-TEVAR may be hypothesized to be particularly advantageous in the case of previous descending thoracic aortic repair in which a redo left-sided thoracotomy may be associated with major bleeding, increased rate of postoperative respiratory and organ failure, longer distal aortic perfusion time, longer total aortic clamping time, longer operation time, and reduced long-term survival.2,9) It is interesting to hypothesize that existing thoracic or abdominal tube grafts in H-TEVAR may offer optimal in-graft landing zones for endografts and ideal inflow sites for visceral bypasses. When the distal landing zone proximal to celiac artery is inadequate, either a thoracoabdominal approach or debranching of visceral vessels is required, followed by TEVAR. Another alternative includes extending the distal landing zone by covering the celiac artery origin. In our present case, the celiac artery balloon occlusion test was performed, and intact collateral foregut circulation was confirmed. Preoperative collateral angiography is recommended to assess the collateral circulation between the celiac and superior mesenteric arteries before coverage of the celiac artery.10)

The staged operation has several advantages, one of which was less invasive for the patient, including shorter operation times and potentially decreases the risk of renal failure from contrast load during the operation. Moreover, it is likely that the staged procedure contributes to the preservation of spinal cord perfusion through collateral arterial flow, which may result in lower paraplegia rates.

In conclusion, hybrid debranching and TEVAR expand the available surgical options for patients with multiple thoracic aortic aneurysms, and they appear to be a safe alternative to open repair for thoracoabdominal and aortic arch aneurysms in properly selected patients with significant comorbidity or prior open aortic surgery.

**Disclosure Statement**

The authors declare that they have no competing interests.

**References**