ELSEVIER

Case Report

Transapical Endovascular Aortic Aneurysm Repair in a Patient with Shaggy Aorta Syndrome

Takashi Murakami,[1] Yohei Kawatani,[2] Yoshitsugu Nakamura,[2] and Takaki Hori,[2] Osaka and Chiba, Japan

We report a case of a 68-year-old man with a large saccular aneurysm (70 mm) of the aortic arch. Although abundant atherosclerotic plaques or mural thrombi are generally considered to be a contraindication for endovascular repair, the patient's multiple comorbidities and anatomic limitations with a patent internal thoracic artery graft adjacent to the aneurysm made him unfit for open repair. Transapical deployment of the endograft through the less-diseased ascending aorta, with a concomitant chimney graft and carotid–carotid bypass, was performed, without evident stroke or embolism.

Transapical access for antegrade insertion of endografts for various thoracic aortic pathologies has been reported by several authors since it was first described by MacDonald et al.[1] Indications for the use of this approach include avoiding access through a calcified, tortuous, or narrowed iliac artery or aorta; limited length of the available devices for an ascending aortic lesion; and direct access to complex aortic pathologies such as type A aortic dissection and other ascending aortic aneurysms.[1–5] Abundant atherosclerotic plaques or mural thrombi in the aorta, or a shaggy aorta, are usually considered to be a contraindication for thoracic endovascular aortic repair (TEVAR). We describe our experience of using the transapical approach to treat an aortic arch aneurysm to avoid retrograde access through the shaggy aorta.

CASE REPORT

A 68-year-old man with a history of coronary artery bypass grafting, abdominal aortic aneurysm open repair, and chronic kidney disease (stage 3) had been repeatedly admitted for the treatment of chronic pancreatitis with a tumor. He was known to have a 70-mm saccular aneurysm of the aortic arch (Fig. 1B), but had been deemed unfit for open surgery because of the left internal thoracic artery graft adjacent to the aneurysm (Fig. 1A) and multiple comorbidities. In addition, abundant atherosclerotic plaques and mural thrombi in the descending thoracic aorta (Fig. 1C) contraindicated ordinary retrograde stent-graft implantation through a transfemoral approach. Therapeutic options were discussed with the patient, who consented to a transapical endovascular repair of the aortic aneurysm, followed by a distal pancreatectomy.

Surgery was performed in a hybrid operating room. The patient was induced under general anesthesia and intubated with a single-lumen endotracheal tube. Before the endovascular procedure, carotid–carotid left axillary bypass was constructed as a debranching of the supra-aortic vessels. Partial cardiopulmonary bypass was established with an arterial inflow to the previously mentioned bypass graft and a venous drainage tube inserted from the

[1]*Department of Cardiovascular Surgery, Osaka City University Graduate School of Medicine, Osaka, Japan.*

[2]*Department of Cardiovascular Surgery, Chibanishi General Hospital, Chiba, Japan.*

Correspondence to: Takashi Murakami, PhD, Department of Cardiovascular Surgery, Osaka City University, 1-4-3 Asahimachi, Abenoku, Osaka 545-8585, Japan; E-mail: takashimurakami24@hotmail.com

Ann Vasc Surg 2015; ■: 1–3
http://dx.doi.org/10.1016/j.avsg.2014.11.017

Manuscript received: August 1, 2014; manuscript accepted: November 6, 2014; published online: ■ ■ ■.

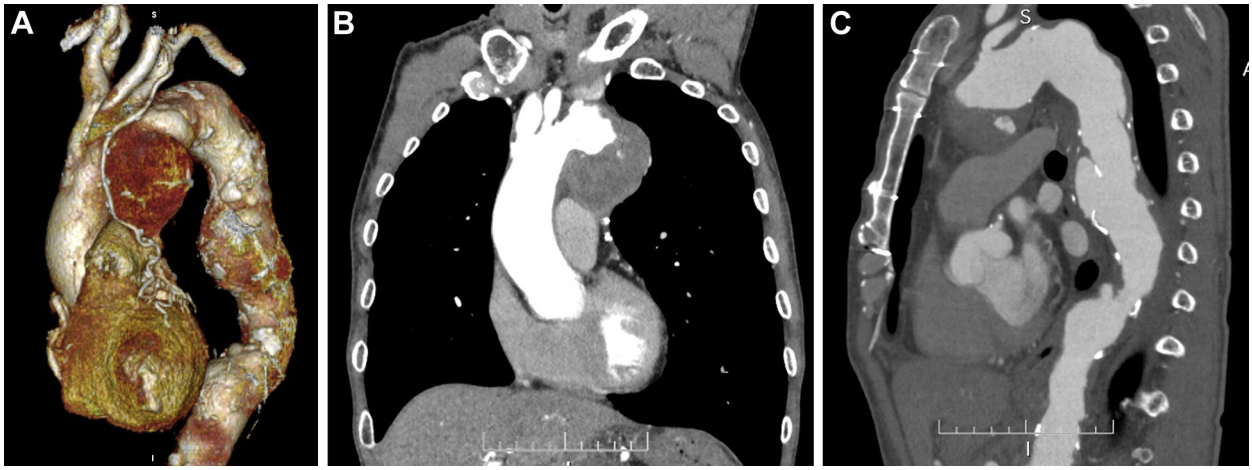

Fig. 1. Preoperative computed tomographic angiography. **(A)** Three-dimensional reconstruction showing the saccular aneurysm of the aortic arch and internal thoracic artery graft adjacent to the aneurysm. **(B)** Multiplanar reconstruction depicting mural thrombi all along the descending aorta. **(C)** Ascending aorta relatively free of atherosclerotic change.

femoral vein into the right atrium. This was performed to maintain the brain circulation throughout the endovascular procedure. This also established an isolated circulation to the brain to prevent embolic stroke by excluding the forward flow from the aorta to the brain, which might contain debris developed from the endovascular procedure. A left minithoracotomy incision was made in the fifth intercostal space at the midclavicular line. After exposure of the left ventricular apex, 3 paired pledgeted sutures were placed. The left ventricular apex was accessed with a 4-Fr sheath, and under fluoroscopic guidance, a 300 cm long curved hydropholic Radifocus Guide wire (Terumo Corporation, Tokyo) was advanced across the aortic valve and down into the abdominal aorta, where fewer atheromatous plaques compared with the descending thoracic aorta were present. A snare was introduced from the right common femoral artery, and the Radifocus guidewire was captured and pulled through to the right femoral sheath. The 4-Fr sheath was removed and exchanged with a 24-Fr Gore DrySeal Sheath (WL Gore & Associates, Flagstaff, AZ). A 40 $\times$ 200 mm^2 Conformable Gore TAG endoprosthesis (WL Gore & Associates) was advanced to the aortic arch with a tug at the pull-through wire. A 12-Fr sheath was retrogradely inserted from the right common carotid artery just proximal to the graft anastomosis. As a chimney graft, a 14.5 $\times$ 100 mm^2 leg endoprosthesis of Gore Excluder (WL Gore & Associates) was advanced into the ascending aorta, and the proximal ends of both stent grafts were precisely adjusted and deployed under rapid ventricular pacing. The patient was weaned from cardiopulmonary bypass. The origin of the left subclavian artery, as well as the origin of the left common carotid artery, was extensively coil embolized. Completion aortic angiogram using digital subtraction angiography demonstrated a successful implantation without endoleaks. Transesophageal echo did not show any deterioration of aortic regurgitation during and after the procedure. The patient was extubated in the operating room without any evident neurologic deficit. There was no clinically evident embolism. The postoperative period was uneventful, and the patient was fully ambulatory at the time of discharge on the 12th postoperative day. The patient tolerated distal pancreatectomy 2 months after the aortic repair, and chest computed tomography 5 months after the endovascular repair demonstrated an excellent result (Fig. 2).

DISCUSSION

Shaggy aorta syndrome is known to cause peripheral and visceral ischemia, attributed to multiple cholesterol emboli from the aorta. Invasive angiography is one of the predisposing factors.[6] Considering the higher profile, stiffness, and less trackability of the devices used for TEVAR, the risk of embolization during TEVAR would be higher than in simple angiography. Surgical repair of the aortic aneurysm, either by open or endovascular approaches, could be considered contraindicated because of the risk of this potentially catastrophic complication. Because of the patient's multiple morbidities and frailty, in addition to the anatomic difficulty of open repair, TEVAR was considered the only option available for our patient.

Among several types of reconstruction procedures for the supra-aortic vessels, total debranching through median sternotomy is the most reliable in terms of long-term patency. Frailty of this patient precluded this option, as a small left thoracotomy incision seemed less invasive than median sternotomy. The thoracic branch endoprosthesis is not

Fig. 2. Three-dimensional rendering of computed tomographic angiography showing a thoracic stent graft, chimney graft, and carotid–carotid axillary bypass graft, with some impeded visibility of the stent graft by artifacts generated by adjacent coils around the origin of the left common carotid and the left subclavian artery.

commercially available in our country; therefore, the chimney graft was used as the only source of blood for the whole brain. Close follow-up of the patency of the chimney graft is mandatory, although evaluation would be difficult in our patient because the use of contrast media is not preferable owing to impaired renal function. No sign of reduced perfusion to the brain and upper extremities was noted on physical examination 11 months after surgery.

Because the ascending aorta was less diseased, as in most of these cases, we opted to take a transapical approach to avoid the passage of high-profile devices through the descending aorta where abundant atherosclerotic plaques or thrombi were present. Although a wire and an angiographic catheter were passed through this diseased aorta, which could cause embolism, manipulation of the most highly diseased portion of the aorta was minimal. There was no clinically evident embolism noted postoperatively.

As atherosclerotic plaques are also considered a risk factor for embolic stroke,[7] we established isolated brain circulation using cardiopulmonary bypass to avoid the antegrade flow from the aortic arch to the brain during the procedure, as was proposed by Shiiya et al.[8] This also supported the circulation during the transapical approach where high-profile devices are deployed through the aortic valve, although many reports have demonstrated hemodynamic stability during the procedure without any need for mechanical circulatory support.

In conclusion, we describe the successful endovascular treatment of an aortic arch aneurysm with a shaggy aorta using a transapical approach. We believe that the transapical approach and the establishment of an isolated brain circulation significantly decreased the risk of stroke and embolism.

REFERENCES

1. MacDonald S, Cheung A, Sidhu R, et al. Endovascular aortic aneurysm repair via the left ventricular apex of a beating heart. J Vasc Surg 2009;49:759–62.
2. Kappert U, Ouda A, Ghazy T, et al. Transapical endovascular deployment of a stent-graft in the thoracic descending aorta. Ann Thorac Surg 2012;93:2063–5.
3. Kölbel T, Reiter B, Schirmer J, et al. Customized transapical thoracic endovascular repair for acute type A dissection. Ann Thorac Surg 2013;95:694–6.
4. Szeto WY, Moser WG, Desai ND, et al. Transapical deployment of endovascular thoracic aortic stent graft for an ascending aortic pseudoaneurysm. Ann Thorac Surg 2010;89:616–8.
5. Uthoff H, Garcia-Covarrubias L, Samuels S, et al. Transapical endovascular aortic repair to treat complex aortic pathologies. Ann Thorac Surg 2012;93:1735–7.
6. Kazmier FJ, Hollier LH. The Shaggy aorta. Heart Dis Stroke 1993;2:131–5.
7. Murphy EH, Stanley GA, Ilves M, et al. Thoracic endovascular repair (TEVAR) in the management of aortic arch pathology. Ann Vasc Surg 2012;26:55–66.
8. Shiiya N, Kunihara T, Kamikubo Y, Yasuda K. Isolation technique for stroke prevention in patients with a mobile atheroma. Ann Thorac Surg 2001;72:401–2.