



Antegrade thoracic endovascular aortic repair via the left axillary artery in a patient with aortoiliac occlusive disease (Leriche syndrome)

Takeshi Kamada¹ · Ryoichi Tanaka² · Hajime Kin¹ · Akihiko Abiko³ · Tomoyuki Iwase¹

Received: 18 March 2018 / Accepted: 6 June 2018 / Published online: 19 June 2018
© The Japanese Association for Thoracic Surgery 2018

Abstract

We present the case of a 77-year-old man with a saccular descending thoracic aortic aneurysm who underwent successful antegrade thoracic endovascular aortic repair (TEVAR) via the left axillary artery. The patient had a history of axillo-bifemoral bypass grafting due to aortoiliac occlusive disease (Leriche syndrome), which precluded normal retrograde TEVAR. Upon successful procedure completion, no endoleak was noted on postoperative computed tomography. The patient was discharged from the hospital without any complications. The left axillary artery is useful as an alternative access site in cases wherein conventional retrograde TEVAR is not feasible.

Keywords Left axillary artery · Antegrade TEVAR

Introduction

Thoracic endovascular aortic repair (TEVAR) is a safe, effective, and far less invasive treatment than open repair for thoracic aortic aneurysms (TAAs). In TEVAR, securing an appropriate landing zone and having an appropriate access site to deliver the large sheath are important requirements [1]. Cases having unsuitable femoral or iliac artery anatomies hinder conventional retrograde TEVAR, making the assessment of other access sites for introducing the large sheath important. Several successful, modified antegrade TEVAR approaches have been reported [2–9]. Herein, we present a successful case involving antegrade TEVAR via the left axillary artery.

Case

A 77-year-old male, with a history of axillo-bifemoral bypass grafting due to aortoiliac occlusive disease (Leriche syndrome), hypertension, dyslipidemia, and chronic obstructive pulmonary disease (COPD), was admitted to a local hospital with hemoptysis. Computed tomography (CT) revealed a TAA in the descending aorta. The patient was transferred to our hospital for surgical repair of the aneurysm. Enhanced CT angiography at our hospital revealed a saccular aneurysm (maximum diameter, 5.5 cm) in the descending thoracic aorta (Fig. 1a). He also showed normal proximal and distal descending aorta anatomies, with diameters and lengths that were favorable for a TEVAR landing zone. CT angiography also revealed that the infrarenal abdominal aorta and the bilateral common iliac arteries were completely occluded (Fig. 1b), preventing the introduction of a large sheath through a femoral artery during TEVAR. The axillo-bifemoral bypass graft, which was donated from the left axillary artery, was patent (Fig. 1b). The diameters of the left axillary and left subclavian arteries were at least 7.5 mm, indicating that they were adequately sized for the introduction of a large sheath during TEVAR. Preoperative coronary angiography revealed a stenotic lesion in both the left and the right coronary arteries. Percutaneous coronary intervention was performed for the right coronary artery, prior to repair of the descending thoracic aortic aneurysm. Conventional open surgical repair of the TAA, under

✉ Takeshi Kamada
tkamada@iwate-med.ac.jp

¹ Department of Cardiovascular Surgery, Iwate Medical University Memorial Heart Center, 19-1 Uchimaru, Morioka, Iwate 020-8505, Japan

² Department of Radiology, Iwate Medical University Memorial Heart Center, Morioka, Japan

³ Division of Cardiovascular Medicine, Nephrology and Endocrinology, Department of Internal Medicine, Iwate Medical University, Morioka, Japan

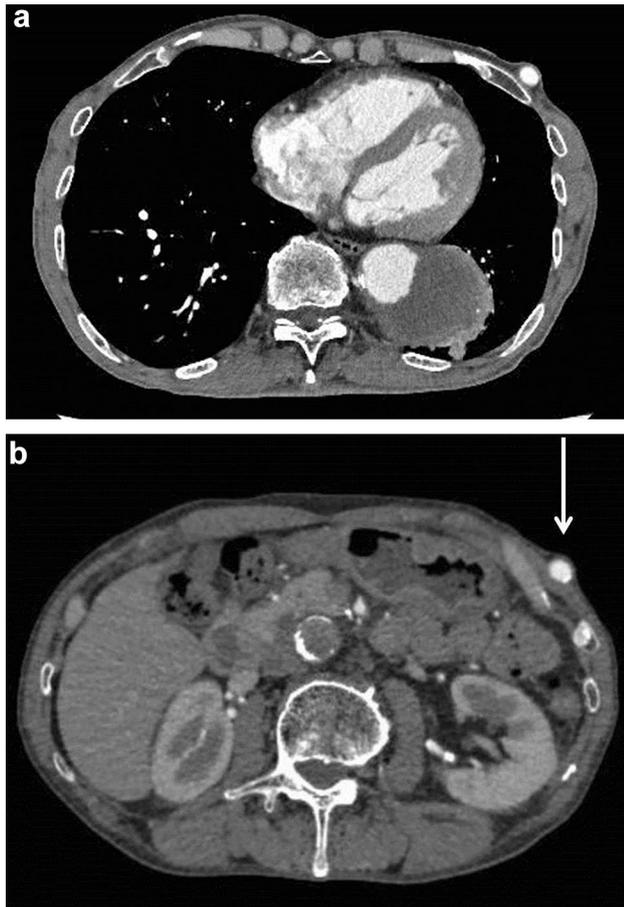


Fig. 1 **a** Preoperative computed tomography shows a saccular aneurysm (maximum diameter, 5.5 cm) in the descending thoracic aorta. **b** Preoperative computed tomography shows a completely occluded infrarenal abdominal aorta and a patent axillobifemoral artery bypass graft (arrow)

cardiopulmonary bypass, was considered to be of high risk due to the patient's advanced age, coronary artery disease, and COPD. Therefore, TEVAR was planned for this patient.

Procedural details and postoperative course

TEVAR was performed in a hybrid operating room under general anesthesia. A small skin incision was made at the left infraclavicular site, exposing the proximal axillo-bifemoral bypass graft site. After heparinization, the proximal axillo-bifemoral bypass graft site was clamped, and a 10-mm Dacron graft was anastomosed in an end-to-side manner to the axillo-bifemoral graft. Under fluoroscopic guidance, a 20-Fr DrySeal sheath (W.L. Gore and Associates, Flagstaff, AZ, USA) was carefully inserted into the descending aorta through the axillo-bifemoral bypass graft, the left axillary artery, and the left subclavian artery over a Lunderquist wire (Cook Medical, Bloomington, IN, USA) (Fig. 2a). On the basis of preoperative CT angiography and intraoperative

angiographic imaging, a C-TAG (TGU2610, W.L. Gore and Associates) was chosen for implantation. The stent graft was carefully passed through this large sheath and advanced to the descending thoracic aorta (Fig. 2b). After intraoperative angiography accurately confirmed the aneurysm's position, the C-TAG was deployed into the descending aorta. Following C-TAG deployment, angiography showed good positioning of the device and complete aneurysm exclusion, without endoleak (Fig. 2c). After removing the 20-Fr DrySeal sheath, angiography was performed to confirm the absence of left subclavian and axillary artery injuries. The operative time was 130 min, and the patient was later discharged without any complications; postoperative CT failed to reveal any type of endoleak (Fig. 3).

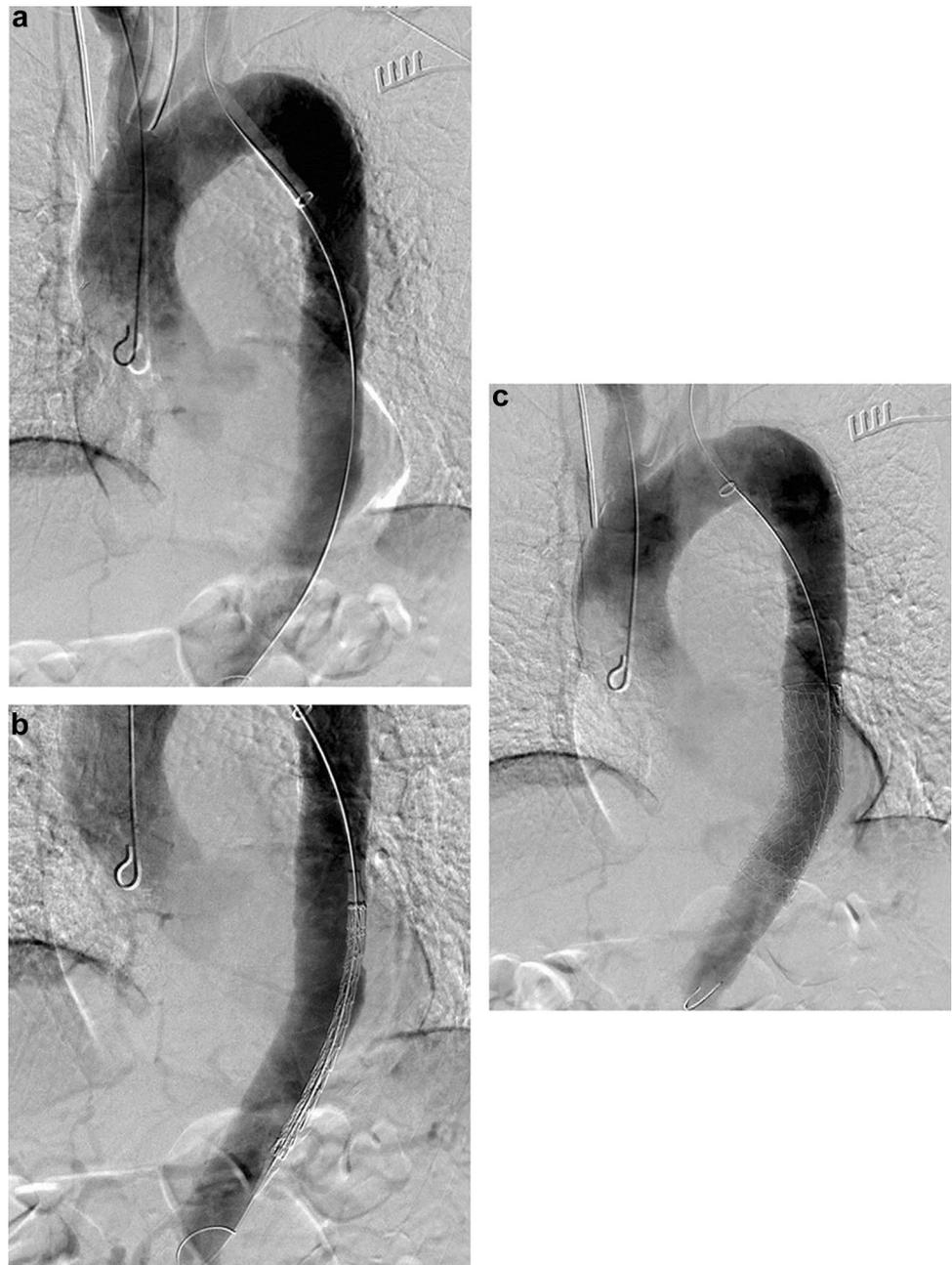
Discussion

TEVAR is a useful approach for treating TAAs because of its low level of invasiveness and its low post-interventional morbidity and mortality. However, successful TEVAR requires serious preprocedural consideration regarding the access site [1]. Preoperative CT is required to accurately evaluate the diameter, tortuosity, and degree of calcification of the access artery. When the patient's iliac anatomy is unsuitable for TEVAR, the retrograde approach to a TAA via a femoral artery becomes difficult or impossible. Thus, an alternative access site needs to be considered, prior to the procedure.

Several reports have described alternative TEVAR access sites for patients with unfavorable iliac anatomies. These alternative sites have included the right axillary artery [2–4], left common carotid artery [5, 6], ascending aorta [7, 8], and left ventricular (LV) apex [9]. The right axillary artery and the left common carotid artery are also easily exposed and may be suitable for antegrade TEVAR. These approaches have technical advantages because the angles from these arteries to the descending thoracic aorta are obtuse and favorable for the procedure. In particular, the left common carotid artery travels linearly to the descending thoracic aorta, making the insertion of a large sheath reasonably easy. On the other hand, when approaching from the right axillary artery or the left common carotid artery, impairment of cerebral perfusion is a concern. Especially in a case with a bovine-type aortic arch, approach from these arteries should be avoided. If a problem occurs in the brachiocephalic trunk during TEVAR, blood flow in both common carotid arteries can be impaired.

As with transcatheter aortic valve implantation, approaches from the ascending aorta or from the LV apex are options for cases in which retrograde TEVAR is difficult [9]. However, a report describing life-threatening bleeding when approaching from the LV apex suggests

Fig. 2 **a** Intraoperative angiography shows a large sheath inserted into the descending thoracic aorta via the left subclavian artery. **b** Intraoperative angiography shows a stent graft being passed through the large sheath. **c** Intraoperative angiography shows the stent graft deployed into the descending thoracic aorta



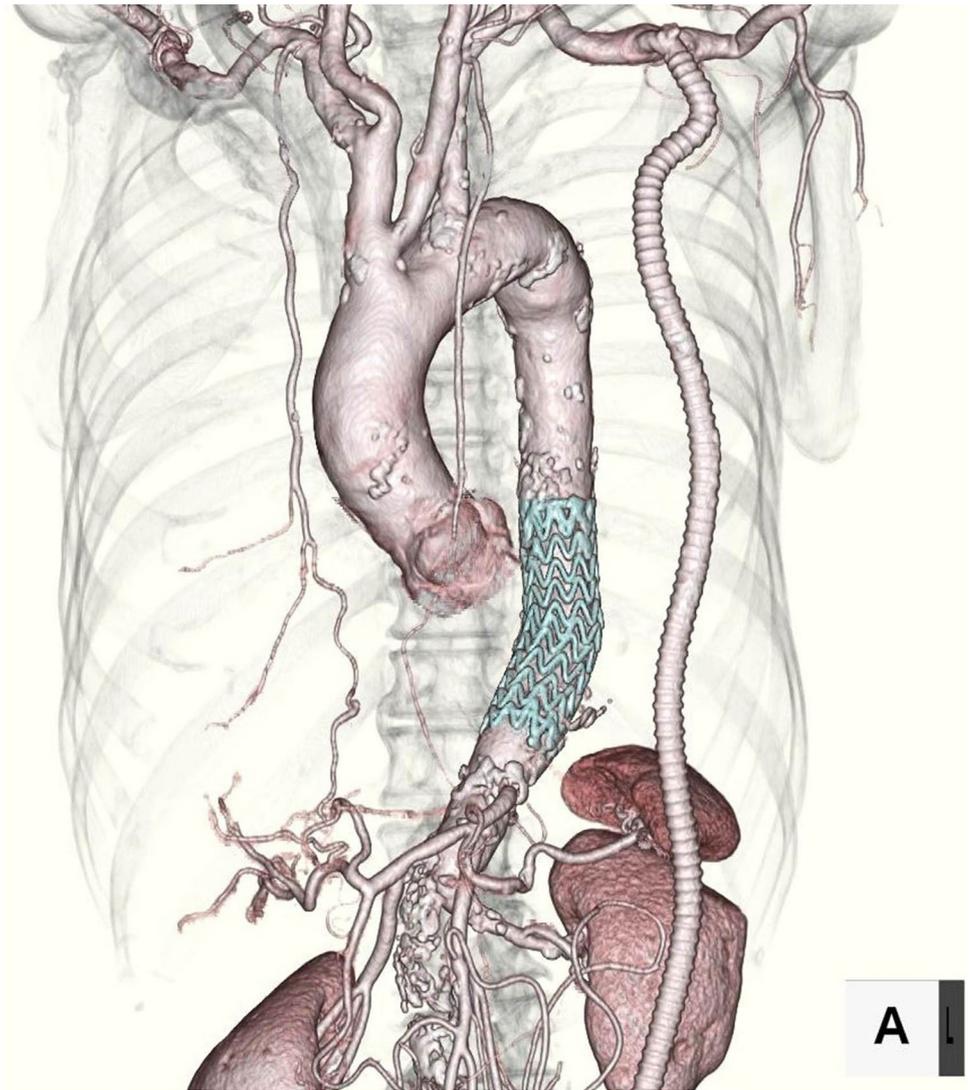
that this access site may not be a suitable first choice as an alternative access site during antegrade TEVAR.

Consequently, we adopted the left axillary artery as an alternative access site in our case. The reasons are as follows: (a) this patient has a bovine-type aortic arch, and this could result in a risk of cerebral perfusion impairment if the right axillary artery or the left common carotid artery is used as an access site during TEVAR; (b) exposing the proximal site of the axillo-bifemoral bypass graft that passed through subcutaneously is easy; and (c) the left axillary artery had a sufficient diameter to introduce the large sheath.

The configuration and curvature of the aortic arch are also important considerations for antegrade TEVAR through the left axillary artery. In a patient with an aortic arch that is elongated in the anterior–posterior direction, the transition from the aortic arch to the descending thoracic aorta is far from the ostium of the left subclavian artery. This increases the risk of the large sheath bending at the aortic arch, making the delivery of a large sheath and stent graft into the descending aorta impossible.

A disadvantage of using the left axillary artery as an alternative access site is the risk of impaired flow through the left internal thoracic artery (ITA) during TEVAR.

Fig. 3 Postoperative three-dimensional computed tomography angiography shows the absence of endoleak and the complete exclusion of the aneurysm



Therefore, in patients who have undergone coronary artery bypass grafting involving the left ITA, there is an increased risk of myocardial ischemia during TEVAR. In such cases, an access site other than the left axillary artery should be considered.

In antegrade TEVAR, an endoprosthesis is deployed in a reverse direction, in contrast to the original design. Originally, there are partially uncovered stents only at the proximal site of the C-TAG, which increases the conformability of the device and optimizes adhesion between the stent graft and aorta [10]. Upon deploying the C-TAG in the reverse direction in the aorta, occurrence of a type 1a endoleak in the long term is a possibility that is of concern. Therefore, close follow-up using CT is of great importance in the future.

Conclusion

We presented a novel approach for antegrade TEVAR in a patient with vascular anatomy that was unsuitable for the conventional retrograde approach. This case demonstrated that the left axillary artery is a safe and useful alternative access site for performing antegrade TEVAR.

Compliance with ethical standards

The authors have no conflicts of interest.

References

1. Fiorucci B, Tsilimparis N, Rohlfes F, Heidemann F, Debus SE, Kolbel T. Tips and tricks in vascular access for (T)EVAR. *J Cardiovasc Surg (Torino)*. 2017;58:194–203.
2. Wudel JH, Williams JB. Right axillary artery conduit for antegrade deployment of a thoracic aortic endoprosthesis. *J Thorac Cardiovasc Surg*. 2008;135:436–7.
3. Probst C, Esmailzadeh B, Schiller W, Wilhelm K. Emergent antegrade endovascular stent placement in a patient with perforated Stanford B dissection via right axillary artery. *Eur J Cardiothorac Surg*. 2008;33:1148–9.
4. Ahn SS, Feldtman RW, Hays FA. Thoracic aorta aneurysm repair using the right axillary approach. *J Vasc Surg*. 2011;54:1201–4.
5. Estes JM, Halin N, Kwoun M, Burch J, England M, Mackey WC. The carotid artery as alternative access for endoluminal aortic aneurysm repair. *J Vasc Surg*. 2001;33:650–3.
6. Heidenreich MJ, Neschis DG, Costanza MJ, Flinn WR. Endovascular repair of a penetrating thoracic aortic ulcer by way of the carotid artery. *J Vasc Surg*. 2003;38:1407–10.
7. Botta L, Bruschi G, Fratto P, Margari V, Solcia M, Borgia F, et al. Direct transaortic TEVAR: an alternative option for selected patients with unsuitable peripheral access. *Ann Thorac Surg*. 2016;102:e1117-9.
8. Morishita A, Hanzawa K, Katahira S, Hoshino T, Tomioka H. Antegrade thoracic endovascular aortic repair using an ascending aortofemoral through-and-through wire technique for a severely tortuous aorta associated with rickets. *Surg Case Rep*. 2017;3:48.
9. MacDonald S, Cheung A, Sidhu R, Rheaume P, Grenon SM, Clement J. Endovascular aortic aneurysm repair via the left ventricular apex of a beating heart. *J Vasc Surg*. 2009;49:759–62.
10. Jordan WD Jr, Rovin J, Moainie S, Bavaria J, Cambria R, Fillinger M, et al. Results of a prospective multicenter trial of CTAG thoracic endograft. *J Vasc Surg*. 2015;61:589–95.