

CASE REPORT

Total Percutaneous Access for Deployment of a Custom Made Fenestrated Stent Graft in a 90 Year Old with a Large Symptomatic Thoracic Aortic Aneurysm

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Introduction: Open surgical cut down has been the standard for gaining carotid access in most thoracic endovascular repairs of aortic aneurysm (TEVAR) cases; however, when suitable, total percutaneous repair can be beneficial.

Report: A relatively fit 90 year old man with few medical comorbidities presented with six months of worsening upper back pain and an Ishimaru zone 2 fusiform thoracic aortic aneurysm of 7.2 cm diagnosed on CT aortography. A total percutaneously inserted custom made device (CMD) with innominate artery (IA) scallop, left common carotid artery (LCCA) fenestration combined with left subclavian artery (LSA) occlusion provided an effective repair. Haemostasis was obtained with Abbott Perclose ProGlide suture-mediated devices. The patient was discharged on post-operative day two. Follow up CT at one month was unremarkable without any endoleak, and an improvement in symptoms.

Discussion: There are risks of cerebral ischaemia and other complications with open carotid cut down, hence it is worth considering avoiding if possible, especially for select patients. Retrograde carotid access and subsequent closure device deployment is not new, but in conjunction with CMD, TEVAR allowing for carotid stenting is feasible and less often described in the literature.

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INTRODUCTION

Surgical cut down has been the recognised standard way of gaining access to the supra-aortic vessels in thoracic endovascular repair of aortic aneurysms (TEVAR). However, with growing experience and increased familiarity with percutaneous closure devices, a total percutaneous approach is possible in patients with the right aortic anatomy and may even prove beneficial.

This is a case of a fit, 90 year old patient with a symptomatic thoracic aortic aneurysm treated with a custom made device with proximal landing in Ishimaru zone 2.

CASE REPORT

A 90 year old man was referred with a 7 cm thoracic aneurysm seen on MRI spine performed for increasing upper back pain over six months. Apart from hypertension and

dyslipidaemia, he had no smoking history or any known major coronary or cerebrovascular disease. He also had no neurological signs or symptoms and was able to carry out his activities of daily living independently.

Computed tomography (CT) angiography confirmed the 7.2 cm fusiform aneurysm of the distal aortic arch, with an ectatic ascending aortic segment measuring up to 3.7 cm in diameter and a descending thoracic aneurysm measuring 4.2 cm (Fig. 1). Arch branches had atheromatous changes but were patent without significant stenosis. The abdominal aorta was also aneurysmal at 4.3 cm but the patient did not have any abdominal symptoms or lower back pain.

Based on symptomatology, age, rupture risk, and CT imaging, a plan was proposed for a percutaneously inserted 226 mm by 38–44 mm (diameter) custom made device (CMD) with an 8 mm diameter left common carotid artery (LCCA) fenestration and an innominate artery (IA) scallop (Fig. 2), along with occlusion of the left subclavian artery (LSA).

During the procedure, access was obtained using ultrasound (US) guided puncture of the right and left common femoral arteries (CFA) for insertion of 6 and 8 F sheaths, respectively. LCCA puncture, sited above the left clavicle, was performed in a retrograde fashion with US using a 4 F micropuncture set before insertion of a 6 F sheath. Intra-

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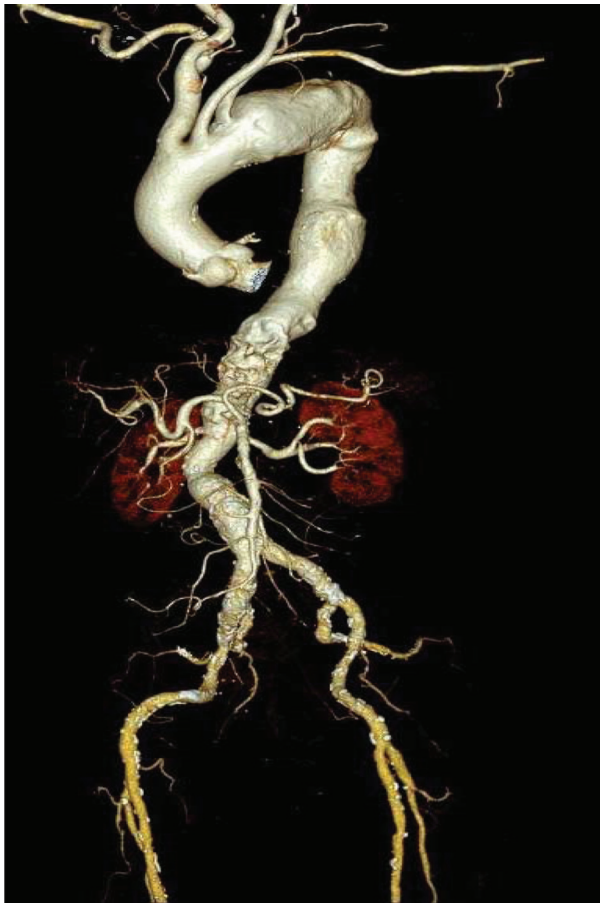


Figure 1. Computed tomography angiography reconstruction showing thoracic aneurysm.

arterial heparin 5000 units was administered and an arch aortogram was performed with a pigtail catheter in the ascending aorta.

The LSA was next occluded by deployment of a 14 × 10 mm Amplatzer Vascular Plug II, proximal to the vertebral artery origin. Next, the Cook CMD was introduced via the right groin and positioned proximal to the origin of the IA. Its preloaded wire was snared from the LCCA access to obtain through and through passage before continued deployment to expose the LCCA fenestration fully. A 10 × 27 mm BeGraft was deployed via the LCCA across the CMD fenestration and flared. The final check angiogram showed a patent IA and LCCA along with an occluded LSA origin without obvious leak. The left VA and distal SCA could be seen to be perfused via collateral flow (Fig. 3).

Haemostasis of both groin accesses was obtained with suture tightening of prior inserted Abbott Perclose ProGlide suture mediated devices in preclose fashion. For the LCCA access, the patient’s head was first rotated to the right and a single Perclose ProGlide device was inserted under fluoroscopy with standard manufacturer technique over a short Terumo 0035 wire positioned above the aortic cusps. Intra-

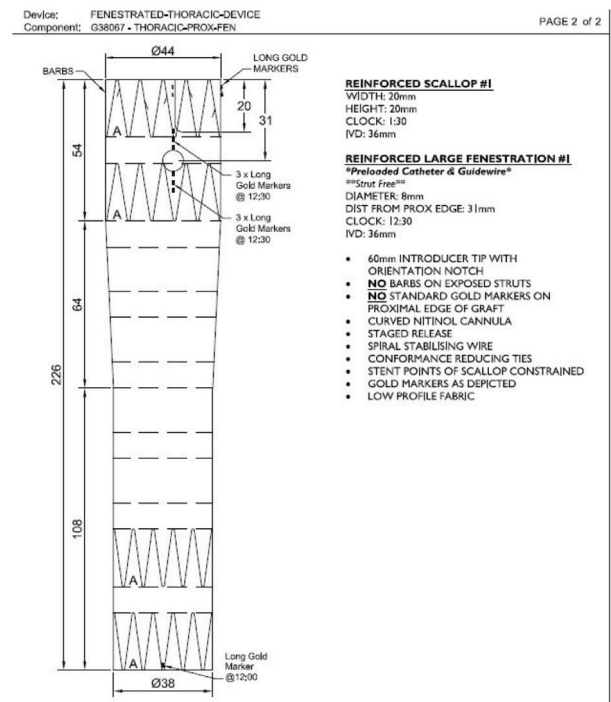
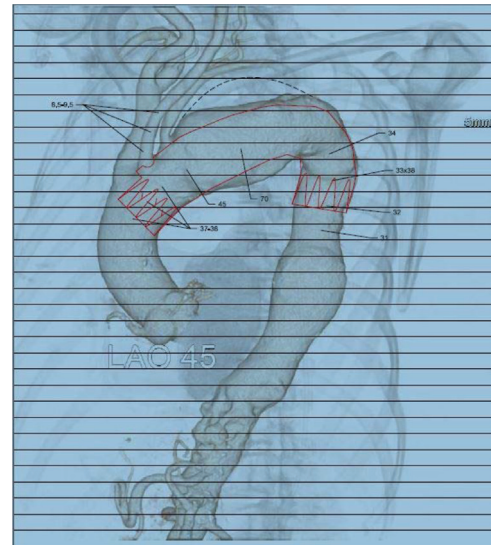


Figure 2. Pre-operative plan of custom made device.

venous protamine was given for reversal and manual compression further applied. Haemostasis was confirmed visually and using sonography. Operative time was two hours and ten minutes.

The patient recovered well and was discharged on post-operative day two. Follow up CT a month later showed that the stent graft, LCCA fenestration and IA were patent, and that the proximal LSA had been occluded as planned with collateral perfusion of the left VA and LSA distal to the vascular plug (Fig. 4). No endoleak was shown and the patient reported an improvement in his symptoms.

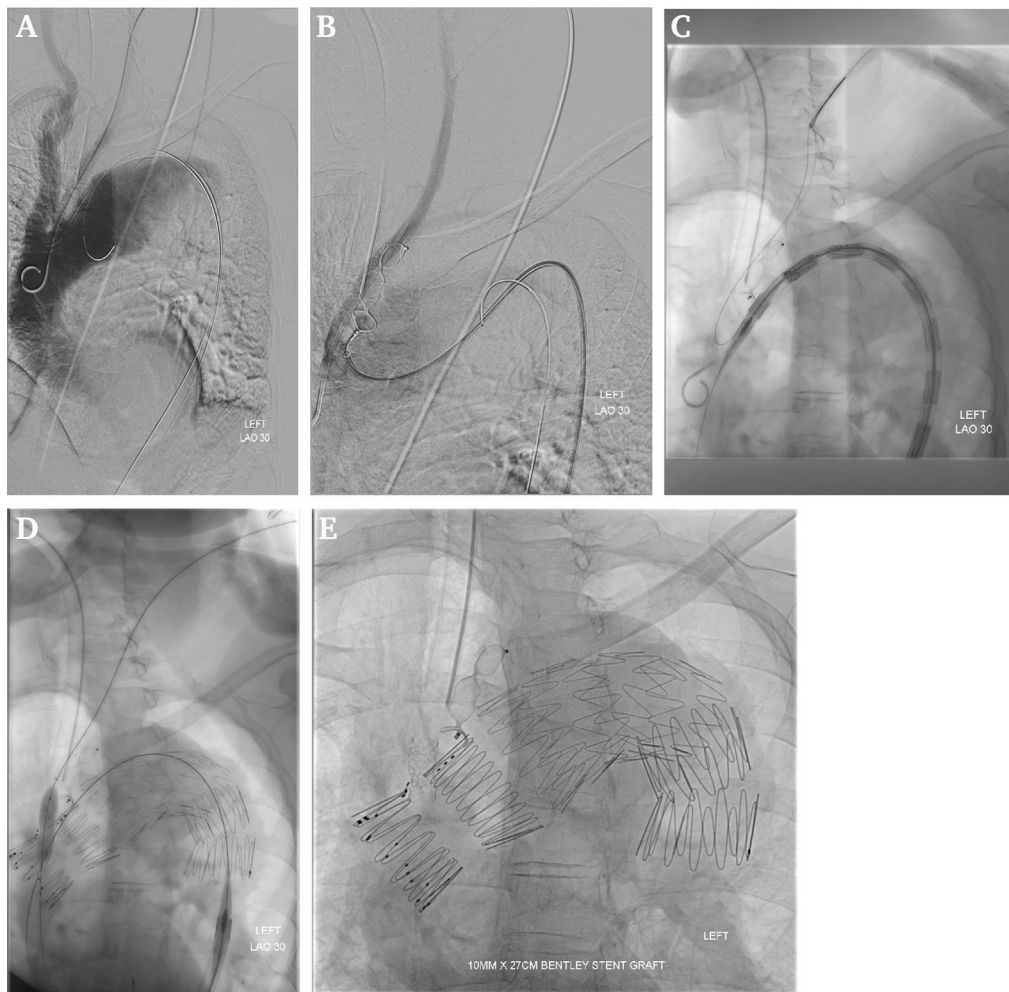


Figure 3. (A) Angiogram demonstrating aneurysm and origins of innominate artery (IA) and left common carotid artery (LCCA) retrograde puncture access. (B) Left subclavian artery (LSA) cannulation and occlusion. (C) Snaring of custom made device (CMD) preload wire into the LCCA. (D) LCCA BeGraft deployment and flaring. (E) Final placement of device.

DISCUSSION

This case demonstrates the feasibility of avoiding open carotid cut down during CMD deployment for endovascular repair of Ishimaru zone 2 and 3 thoracic aneurysms. An open cut down requires neck dissection and carotid clamping risking plaque disruption, cerebral ischaemia as well as nerve injury, wound infection, and scarring. While percutaneous access to supra-aortic arteries has been in place for many years, and more recently Chan et al. described the use of retrograde percutaneous carotid access with chimney repairs in a case series,¹ to the present authors' knowledge, the use of retrograde carotid access in combination with fenestrated TEVAR is less common in this area of the literature.

Use of a closure device in the carotid artery is not new. It is most often described in inadvertent carotid punctures during central venous catheter insertion and other neurovascular interventions.² While manual compression is cheap and reliable, prolonged carotid compression can be time consuming with systemic heparinisation and can cause cerebral ischaemia

in patients with reduced collateral flow.³ The use of the Abbott Perclose ProGlide device stems from the present authors' familiarity with its use in lower limb and aortic intervention, and also because it lacks an intraluminal component, reducing the likelihood of vessel stenosis.

During delivery, the device shaft is advanced and retrieved under fluoroscopic monitoring. This reduces the risk of dislodgement of the BeGraft during advancement while the guidewire is parked above the aortic root. The routine use of ultrasound for carotid puncture above the clavicle is recommended, as puncture below can be difficult for bailout manual compression should there be device closure failure.

While open surgery may be the gold standard in younger or in genetic aortic syndromes, technologies have evolved over the last decade such that endovascular surgery renders comparable peri-operative mortality and stroke rates in elderly patients with degenerative arterial disease and higher cardiopulmonary comorbid profiles.⁴ A complete endovascular solution avoids cardiopulmonary bypass, deep hypothermic circulatory arrest, and antegrade or retrograde cerebral



Figure 4. Computed tomography volume reconstruction of surveillance scan performed one month after repair.

perfusion.⁵ Surgery duration and the length of stay are significantly shorter compared with open repair.⁶

Complications associated with endovascular repair of the aortic arch include dysrhythmias and myocardial ischaemia resulting from the close proximity of the wire or sheath to the coronary ostia and left ventricles.⁶ Cardiac perforation by the stiff wire is a recognised complication and must be avoided by careful wire manipulation.⁵ Access site complications are not uncommon and occasionally require intervention for arterial repair. Temporary renal impairment is common, and care should be taken with judicious use of contrast withholding any nephrogenic medications for 48 hours after the procedure if possible. Overall, treatment must be individualised based on a patient's physiology, anatomical features, and the experience of the surgical team.

CMDs have combinations of fenestrations and (or) scallops created on a standard stent graft platform. These extend the proximal landing zone without compromising the great vessels. Apart from the manufacturing waiting time, they may be subjected to manufacturing constraints related to strut positioning. As a general rule, fenestrations can exist with centres 10–14 mm apart. However this is influenced by graft diameter, relative clock positions, and the distance from the distal edge of a proximal scallop. According to the manufacturer in the present case, while the LCCA and LSA origin were about 17 mm apart measured along the outer curve, the distal edge of the IA scallop and middle of the LCC were reasonably close, requiring that an LSA fenestration be at least 20 mm from the LCC one to withstand the stress forces on the stent wires. Fortunately, in terms of the activity level of the patient under consideration here, it felt reasonable to occlude the left

subclavian origin and rely on collaterals. In doing so, the need for brachial access and its associated complications such as bleeding and arm ischaemia were also avoided.

The deployment of a fenestrated or scallop endograft can be relatively simple and the Cook fenestrated endograft is reported to be safe and technically feasible with a mortality of up to 9%, stroke risk of 9%, temporary spinal cord ischaemia rate of 7%, and early re-intervention rate of 7%.⁷ O'Callaghan retrospectively compared custom made fenestrated endografts ($n = 15$) against non-custom made chimney stents ($n = 18$). In hospital mortality appeared higher in the non-custom group (7% vs. 18%) and a trend was noted favouring better durability of fenestrated grafts for sealing and re-intervention rates, but these were not statistically significant.⁸

To conclude, the case demonstrates that total percutaneous placement of a CMD during TEVAR is feasible with US guided retrograde LCCA puncture and snaring of a preload CMD wire. The avoidance of a cut down is worth considering, especially for selected patients.

CONFLICT OF INTEREST

None.

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