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CASE REPORT

Endovascular Repair for Ascending Aortic Graft Side Branch Pseudoaneurysm: A Report of Two Cases

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Introduction: A pseudoaneurysm arising from the side branch of the prosthesis, following ascending aortic replacement, is extremely rare. Re-intervention usually involves open surgery, replacement of the ascending aorta, or ligation of the side branch. Redo surgery with an additional sternotomy carries the risk of cardiac and vascular injuries, and endovascular treatment can reduce such adverse events.
Report: This study describes the successful thoracic endovascular aortic repair (TEVAR) of two cases of pseudoaneurysms arising from the side branch after ascending aortic replacement. Case 1 involved a 79 year old man who underwent ascending aortic replacement and omentopexy for a ruptured tuberculous aortic aneurysm 13 years ago. The pseudoaneurysm was mushroom shaped with a 30 mm protrusion. Case 2 involved an 83 year old man who underwent ascending aortic replacement for Stanford type A acute aortic dissection 11 years ago. The pseudoaneurysm was rod shaped with a 27 mm protrusion. In both cases, the pseudoaneurysm arising from the side branch was not noted on computed tomography (CT) until one year earlier and was first identified at a routine follow up examination. The pseudoaneurysms required surgical repair because of the risk of rupture; however, TEVAR was selected considering the risks of redo surgery and the patients' ages. It was performed via a femoral artery approach without adverse events using a commercially available thoracic aortic device. Post-operative CT scan showed complete exclusion of the pseudoaneurysm.
Discussion: Although TEVAR is usually not indicated for ascending aortic pathologies, if there is an anatomical indication and a compatible stent graft, TEVAR for the ascending aorta should be the first choice in patients who are inoperable, at high risk and undergoing redo surgery.
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INTRODUCTION

Open surgery remains the gold standard of treatment for ascending aortic pathologies. In general, stent grafts are not indicated for ascending aortic pathologies because of the presence of the proximal aortic valve and coronary artery, distal brachiocephalic artery, changes in aortic diameter during the cardiac cycle, and the curve and length of the aorta.[1,2] Another issue is that commercially available stent graft devices for the thoracic aorta are not designed to treat the ascending aorta.[3] In 2000, TEVAR of the dissected ascending aorta was first reported, and thereafter, it has been performed for aortic dissection and pseudoaneurysm cases, among others.[1] This study reports successful endovascular repair in two cases of pseudoaneurysm arising from the side branch following replacement of the ascending aorta with prosthesis.

CASE REPORT

Case 1

A 79 year old man had a history of ascending aortic replacement and omentopexy for tuberculous ascending aortic aneurysm rupture when he was 66 years old (Fig. 1A). He was treated for tuberculosis after surgery and had no recurrence. Thirteen years later, a pseudoaneurysm was identified on a computed tomography (CT) scan performed on routine follow up examination. Enhanced CT revealed a pseudoaneurysm arising from the side branch stump of the prosthesis (Fig. 1C and D). The pseudoaneurysm was mushroom shaped, measured 30 mm in protrusion, and had a lateral diameter of 26 mm. A thrombus was found at the tip of the pseudoaneurysm. Plain CT performed one year earlier showed no pseudoaneurysm formation (Fig. 1B).

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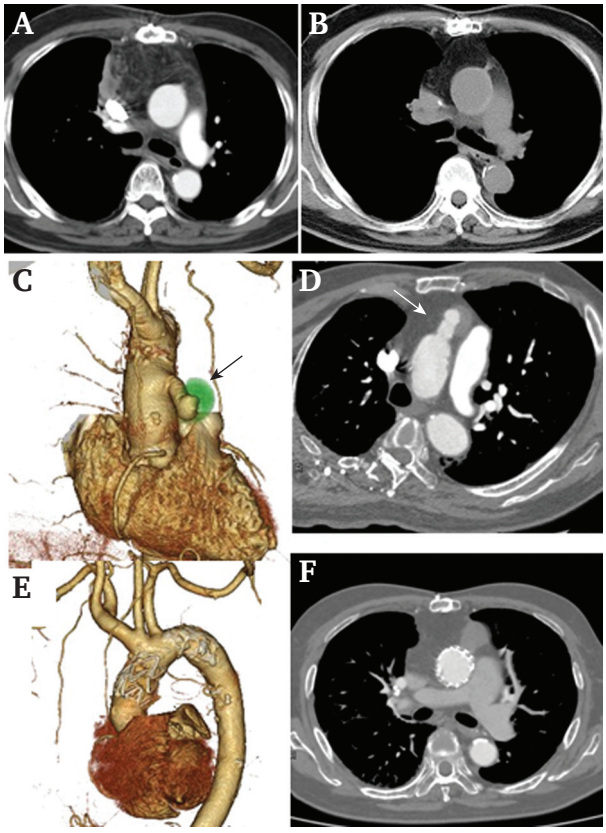

Figure 1. (A) Computed tomography after initial ascending aortic replacement and omentopexy. No contrast enhancement in the side branch. (B) There was no pseudoaneurysm formation in the side branch one year previously. (C) Pre-operative three dimensional computed tomography image showing the pseudoaneurysm arising from the side branch (black arrow). (D) Axial image of the pseudoaneurysm (white arrow). (E) Post-operative computed tomography image. (F) There was no endoleak on axial imaging.

There were no findings suggestive of infection, such as fever or an increased inflammatory response. Considering his medical history, it was discerned that it would be difficult to perform repeat sternotomy, and deployment of a stent graft was considered. The ascending aortic prosthesis had a diameter of 30 mm, and the length from the proximal anastomosis to the orifice of the brachiocephalic artery was 52.6 mm on the greater curvature and 50.9 mm on the lesser curvature. The distance from the coronary artery ostia to the pseudoaneurysm was 40.6 mm. It was feasible to use the shortest thoracic endograft, although the lesser curvature was slightly shorter. The operation was performed under general anaesthesia. Following systemic heparinisation, the right inguinal region was incised, and an 8 Fr sheath was inserted via the right femoral artery (FA). Under fluoroscopy, the aortic valve was crossed with a 0.035 inch guide wire with the support of a pigtail catheter, which was subsequently exchanged for a pre-shaped Safari 2 guidewire with an extra small curve (Boston Scientific, Natick, MA, USA). A 5 Fr sheath was inserted via the right femoral vein (FV) and the left FA percutaneously. A temporary pacing catheter was inserted into the right ventricle from the right FV. A pigtail catheter was placed in the non-coronary cusp from left FA for injection of contrast. A stent graft with a diameter of 34 mm and a length of 52 mm (Valiant Navion CoveredSeal stent graft system, Medtronic, Minneapolis, MN, USA) was implanted into the ascending aorta under 180 beats/min of rapid ventricular pacing. Touch up balloon dilatation was not performed, and final angiography showed that the endograft was well positioned with no endoleaks. The rapid pacing time was 40 seconds, and the operation time was 65 minutes. A post-operative CT scan confirmed complete exclusion of the pseudoaneurysm (Fig. 1E and F).

Case 2

An 83 year old man underwent ascending aortic replacement for Stanford type A acute aortic dissection 11 years ago (Fig. 2A). A pseudoaneurysm was recognised on CT scan during routine follow up examination. As in Case 1, enhanced CT findings showed a pseudoaneurysm arising from the side branch stump of the prosthesis (Fig. 2C and D). The pseudoaneurysm was rod shaped, with a 27 mm

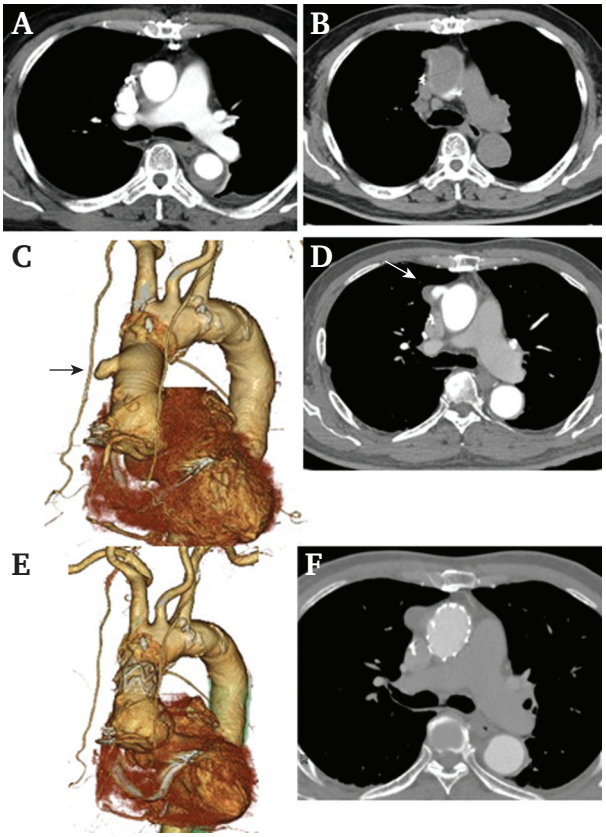

Figure 2. (A) No contrast into the side branch after initial surgery. (B) There was no enlargement of the side branch or pseudoaneurysm formation one year previously. (C) Pre-operative computed tomography image showing the pseudoaneurysm (arrow). (D) Presence of contrast into the pseudoaneurysm (white arrow). (E) Post-operative computed tomography image showing stent graft inserted into the ascending aorta. (F) No endoleak seen on axial imaging.

protrusion, having a lateral diameter of 17 mm. As in Case 1, plain CT performed one year earlier showed no pseudoaneurysm formation (Fig. 2B). The ascending aortic prosthesis had a diameter of 30 mm. The length from the proximal anastomosis to the orifice of the brachiocephalic artery was 61 mm on the greater curv and 52 mm on lesser curve. The distance from the coronary artery ostia to the pseudoaneurysm was 47 mm. Unlike Case 1, the lengths of the lesser curvature and the stent graft did not present challenges, and it was determined that the prosthesis was amenable to endovascular intervention. The surgical procedure was the same as in Case 1, and a Valiant Navion CoveredSeal with a diameter of 34 mm and a length of 52 mm was implanted under rapid pacing. The rapid pacing time was 48 seconds, and the operation time was 92 minutes. A post-operative CT scan confirmed complete exclusion of the pseudoaneurysm (Fig. 2).

In both cases, two years have passed since the surgery without any complications such as endoleak or stroke.

DISCUSSION

Open surgery remains the gold standard of treatment for ascending aortic pathologies. However, TEVAR has recently been reported in the context of potential applications for managing ascending aortic pathologies.[2] The endovascular approach is less invasive than conventional surgery, especially in redo cases. In this case, the pseudoaneurysms were anatomically excluded, without complications.

TEVAR for ascending aortic lesions has been reported in more than 150 cases from 2000.[1—10] Aortic dissection is the most common pathology, followed by pseudoaneurysms. The anatomical issues encountered involved the length of the ascending aorta, aortic curvature, aortic valve and orifice of the coronary arteries on the proximal side, and orifice of the brachiocephalic artery on the distal side. The length of the ascending aorta from the sinotubular junction to the brachiocephalic artery has been reported to have mean values of 96 and 64 mm on the greater and lesser curves.[3—5] Valiant Navion previously had a device with a minimum length of 52 mm, but it is no longer available because of its association with a type III endoleak. Other commercial stent grafts are straight and designed for the descending aorta; they possess, a minimum length of 100 mm and are not suitable for ascending aortic anatomy. There have been reports of abdominal devices being used because of the length of the ascending aorta. However, these device systems are too short to be introduced from the femoral artery; thus, they require approaches from the axillary and carotid arteries, which are closer to the ascending aorta.[2,4,10] The operative mortality rates were reported to be 13%—15%, and that of stroke was 10%.[2,3,5] Additional risks include myocardial infarction caused by coronary artery occlusion and device induced aortic insufficiency.[2,3,5,7] The cooperation of cardiac and vascular surgeons, radiologists, anaesthetists, and cardiologists is necessary to manage these complications.[5] There are no clear anatomical indications, but the proximal and distal landing should be at least 10 mm.[6]

A similar case of a pseudoaneurysm arising from a prosthesis side branch stump has been reported previously.[10] This side branch was used for cardiopulmonary bypass re-perfusion after distal anastomosis during ascending aortic replacement. At the present authors' hospital, this side branch was doubly ligated using silk sutures after weaning from cardiopulmonary bypass. Because endovascular treatment was chosen, the cause of the pseudoaneurysm could not be determined. In Case 1, the primary disease was a mycotic thoracic aneurysm, although there were no obvious findings suggestive of infectious pathology during evolution of the pseudoaneurysm. Similarly, no cause has been mentioned in the prior report.[10] It is possible that the silk sutures ligating the side branch had become loose or deteriorated, allowing blood flow into the side branch disrupting the silk sutures. However, it is not possible to prove whether there was blood flow in the side branch because the follow up CT was without contrast. As the pseudoaneurysms appeared and expanded rapidly in the present cases, apart from their size, timely intervention was warranted. Because the side branch was ligated at approximately 10 mm during the initial operation, the tip of the pseudoaneurysm was probably ruptured. However, because of the presence of fibrous adhesions around the pseudoaneurysm, the possibility of major bleeding was low, although there was a risk of embolism through thrombus formation. However, if conventional open surgery had been performed, major bleeding may have occurred. TEVAR is useful because it avoids such fatal complications.

Conclusion

TEVAR for side branch pseudoaneurysm of the ascending aorta was performed safely and was effective. If there is an anatomical indication and a compatible stent graft, TEVAR for the ascending aorta should be the first choice for inoperable, high risk, and redo patients.

ADDITIONAL NOTE

This article was written based on sufficient informed consent and patient agreement. The study was reviewed and approved by the institutional review board (IRB number:R3-26).

CONFLICTS OF INTEREST

None.

FUNDING

None.

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