

CASE REPORT

Symptomatic Distal Anastomotic Pseudo-aneurysm After the Bentall Procedure Successfully Treated by Supra-aortic Trunk Debranching and Zone 0 Thoracic Endovascular Aneurysm Repair

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Introduction: Post-operative anastomotic pseudo-aneurysms are rare but potentially lethal complications after the Bentall procedure. When symptomatic or ruptured, expedited repair is warranted, and open surgery may carry significant bleeding risk, particularly when these lesions project anteriorly. As totally endovascular techniques are frequently limited owing to hostile anatomies, complex hybrid interventions are an alternative option in such scenarios.

Report: A 53 year old man with a previous Bentall procedure performed 10 years previously for DeBakey type 1 dissection was admitted with chest pain. Computed tomography angiography revealed a distal anastomotic pseudo-aneurysm. Percutaneous pseudo-aneurysm occlusion with a septal occluder plug was performed initially, with significant clinical improvement but without total sac thrombosis. The patient was discharged under strict surveillance, but six months later was re-admitted owing to hoarseness and new onset of chest pain. As the patient developed acute pain and compressive symptoms, urgent treatment was required. As the pseudo-aneurysm projected anteriorly into the posterior aspect of sternum, significantly bleeding risk was anticipated with redo sternotomy. A hybrid repair was then planned, with a full supra-aortic trunk debranching (carotid–carotid and left carotid–subclavian bypass) and zone 0 TEVAR with a single parallel graft to the brachiocephalic trunk. The patient was discharged 10 days later. Total aneurysm exclusion was achieved, with no complications reported after six months follow up.

Discussion: Hybrid procedures may represent a safe and feasible alternative to open surgery in symptomatic ascending aortic pseudo-aneurysms. However, long term follow up studies are required to confirm the durability of these procedures.

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INTRODUCTION

Post-operative symptomatic pseudo-aneurysms are rare, but severe, complications after composite graft surgery for combined aortic valve and ascending aortic disease. The diagnosis is frequently cumbersome, as these lesions present with variable clinical features depending on the location of the pseudo-aneurysm and surrounding structures. Surgical repair is equally challenging, particularly when the

lesion is close to the thoracic wall and prone to rupture on chest exploration.¹

A case of a distal anastomotic pseudo-aneurysm after the Bentall procedure for DeBakey type 1 dissection is presented. The pseudo-aneurysm was projecting anteriorly and deemed unsuitable for open repair but was successfully treated by supra-aortic trunk debranching and Ishimaru zone 0 thoracic endovascular aneurysm repair (TEVAR) with a single chimney to the brachiocephalic trunk.

CASE PRESENTATION

A 53 year old man had been treated by the Bentall procedure for a DeBakey type 1 ruptured aortic dissection ten years previously. The operation was performed successfully at a different hospital and the patient was subsequently lost to follow up.

Ten years later, the patient was admitted with acute chest pain. Computed tomography angiography (CTA)

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revealed a voluminous pseudo-aneurysm of the distal anastomosis (largest diameter 60 mm) which projected anteriorly into the posterior aspect of the sternum (Fig. 1A). Chronic aortic dissection was also present, extending from the left subclavian artery, to the aortic bifurcation. Significant compression of the true lumen was visible (maximum diameter of 8.4 mm in zone 7), although both lumens were patent throughout (Fig. 1B). The superior mesenteric and right renal artery originated from the true lumen, while the left renal artery originated from the false lumen. The coeliac trunk origin was not visible, with retrograde perfusion through the gastroduodenal artery.

Considering the location of the lesion, and the significant risks associated with open repair, selective pseudo-aneurysm occlusion with an Amplatzer Septal Occluder (15 mm; Abbot, Chicago, IL, USA) was performed initially. CTA confirmed proper positioning of the plug, with partial thrombosis of the pseudo-aneurysm, although residual sac perfusion was still visible (Fig. 2). Symptoms significantly improved after the intervention, and the patient was discharged under strict imaging follow up, with the expectation of total sac thrombosis.

Six months later, the patient developed acute hoarseness and chest pain. As CTA confirmed no variation in the false lumen diameter, this new onset of compressive symptoms was thought secondary to pseudo-aneurysm expansion, and intervention was required.

Open surgery was considered but disregarded in view of the high bleeding risk with redo sternotomy, and totally endovascular treatment strategies with custom made

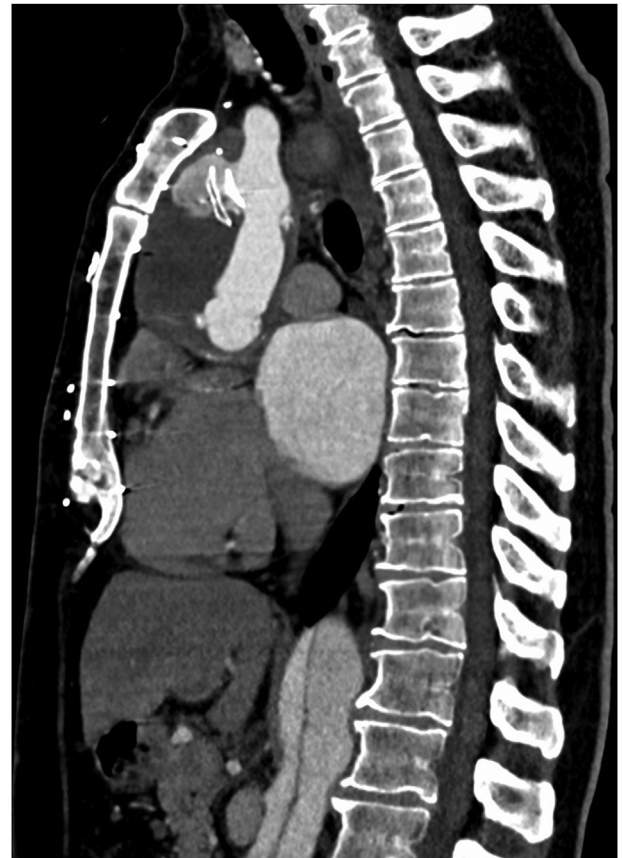


Figure 2. Post-operative occluder implantation computed tomography angiogram. Although significant sac thrombosis occurred, residual sac perfusion remains visible.



Figure 1. (A) Sagittal computed tomography angiogram (CTA), revealing a 6 cm distal anastomotic pseudo-aneurysm, projecting anteriorly into the posterior aspect of the sternum. (B) Sagittal view CTA revealing chronic aortic dissection, extending distally from the left subclavian artery.

devices were not an option given the urgency of the case. After multidisciplinary discussion, a hybrid procedure with supra-aortic trunk debranching and Ishimaru zone 0 TEVAR with a single chimney to the brachiocephalic trunk was planned.

Firstly, anterior carotid–carotid bypass and left carotid–subclavian bypass were performed, using a ringed expanded polytetrafluoroethylene graft (Fusion 8 mm; MAQUET, Solna, Sweden). The right axillary artery was also exposed.

The brachiocephalic trunk diameter was 14 mm, and with 10% oversizing, a 16 mm diameter stent graft was required for target vessel parallel grafting. In order to reduce the size of the stent graft crossing the proximal aortic landing zone, a previously described technique for parallel graft size reduction was followed.²

A thoracic endograft (Conformable GORE TAG 21–21-100; W.L. Gore and Associates, Flagstaff, AZ, USA) was initially navigated into the descending thoracic aorta and deployed in Ishimaru Zone 3 (Fig. 3A). A second thoracic endograft (Conformable GORE TAG 34–34-200; W.L. Gore and Associates) was then navigated into the ascending

aorta, distal to the coronary ostia. Through the axillary access, a 12 F sheath (DrySeal Flex Introducer Sheath; W.L. Gore and Associates) was advanced into the ascending aorta, parallel to the thoracic stent graft. A self expanding covered stent (Viabahn Endoprosthesis 9-100; W.L. Gore and Associates) was then positioned inside the sheath, anchored in the brachiocephalic trunk ostia (Fig. 3B). Under rapid pacing, TEVAR was deployed in zone 0, immediately after which the self expanding covered stent was opened (Fig. 3C). A balloon expandable covered stent (Viabahn VBX Balloon Expandable Endoprosthesis, 11–79; W.L. Gore and Associates) was then positioned distal to the previous self expanding covered stent graft, and inflated to an intended diameter of 16 mm, in order to prolong the parallel graft up to the brachiocephalic trunk bifurcation (Fig. 3D). Final stent relining was then performed using a proximal balloon expandable covered stent (Viabahn VBX Balloon Expandable Endoprosthesis, 9–59; W.L. Gore and Associates) and a distal self expanding uncovered stent (SMART Flex System Stent Vascular, 9–80; Cordis, Santa Clara, CA, USA).

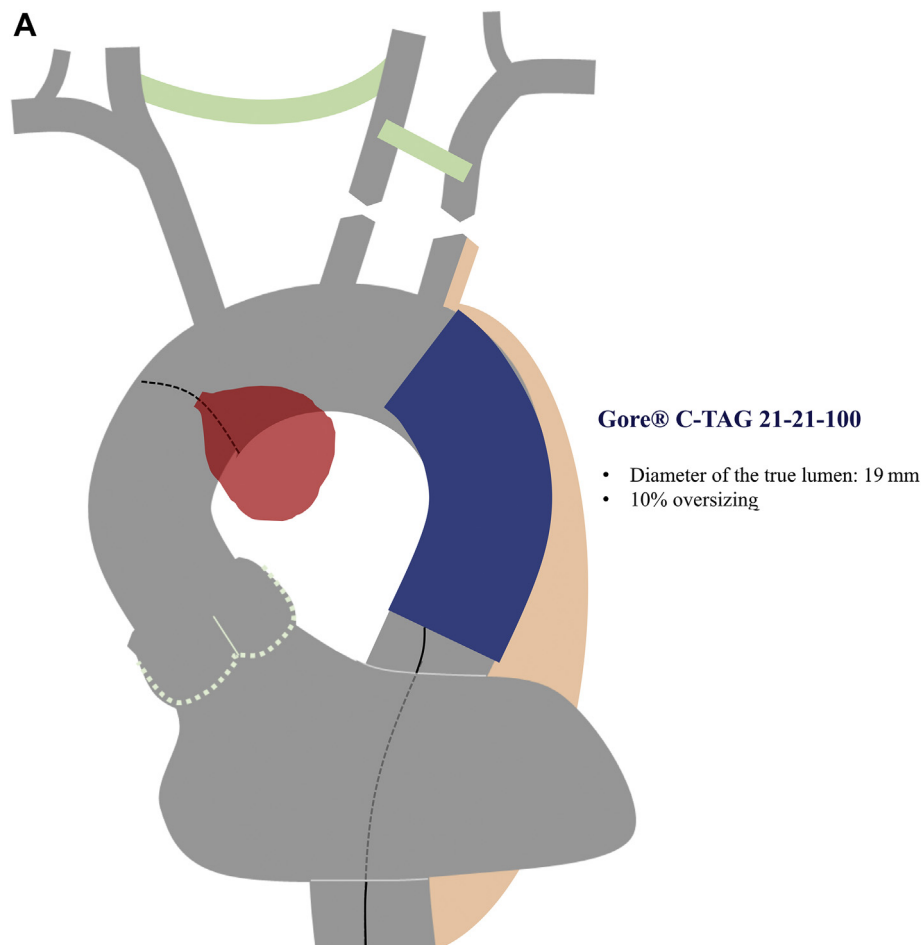


Figure 3. Schematic representation of the endovascular steps employed in this intervention. (A) Firstly, thoracic endovascular aneurysm repair (TEVAR; Conformable GORE TAG 21–21-100 [W.L. Gore and Associates, Flagstaff, AZ, USA]) with deployment in the proximal descending thoracic aorta, distal to the left subclavian artery take off (zone 3). (B) A second TEVAR, as well as a self expanding covered stent, were then positioned for deployment in zone 0. (C) Parallel graft (PG) deployment. (D) Distal parallel graft extension with a balloon expandable covered stent (Viabahn VBX Balloon Expandable Endoprosthesis, 11–79; W.L. Gore and Associates).

B

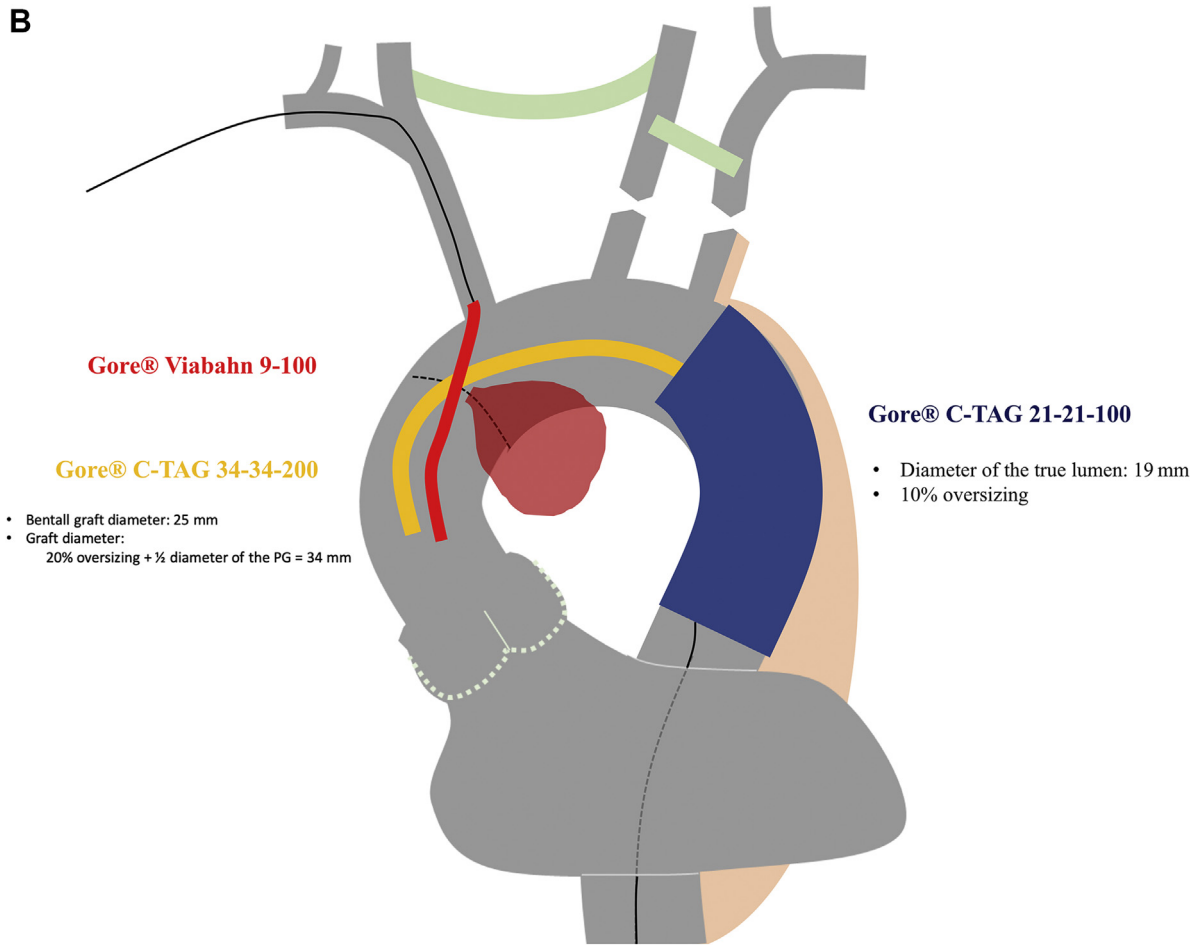


Figure 3. (continued).

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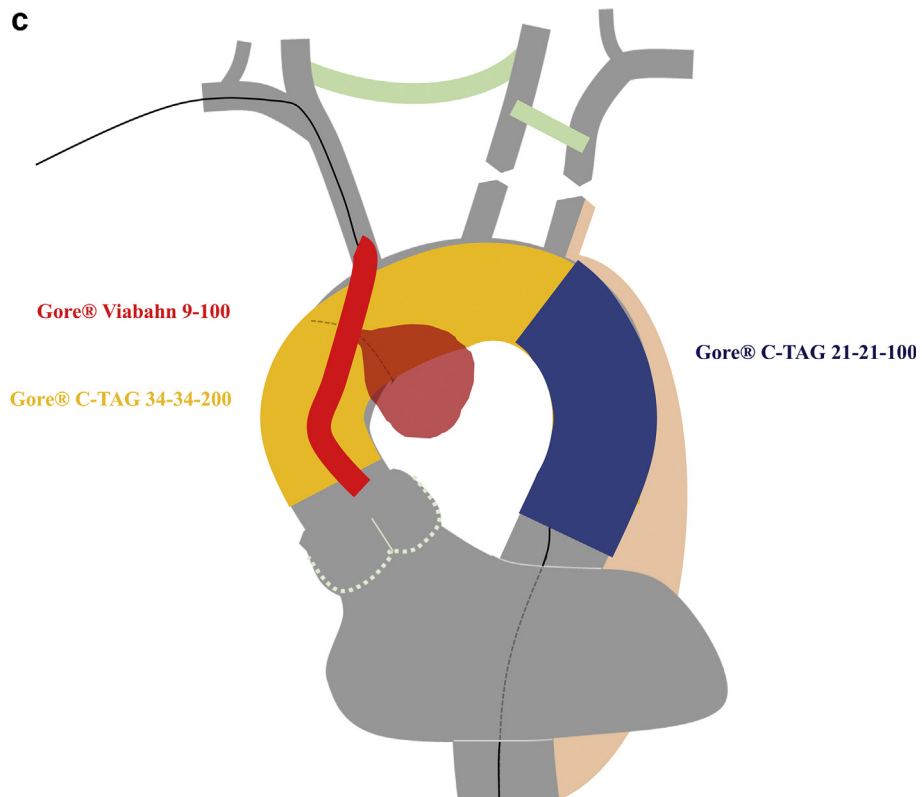


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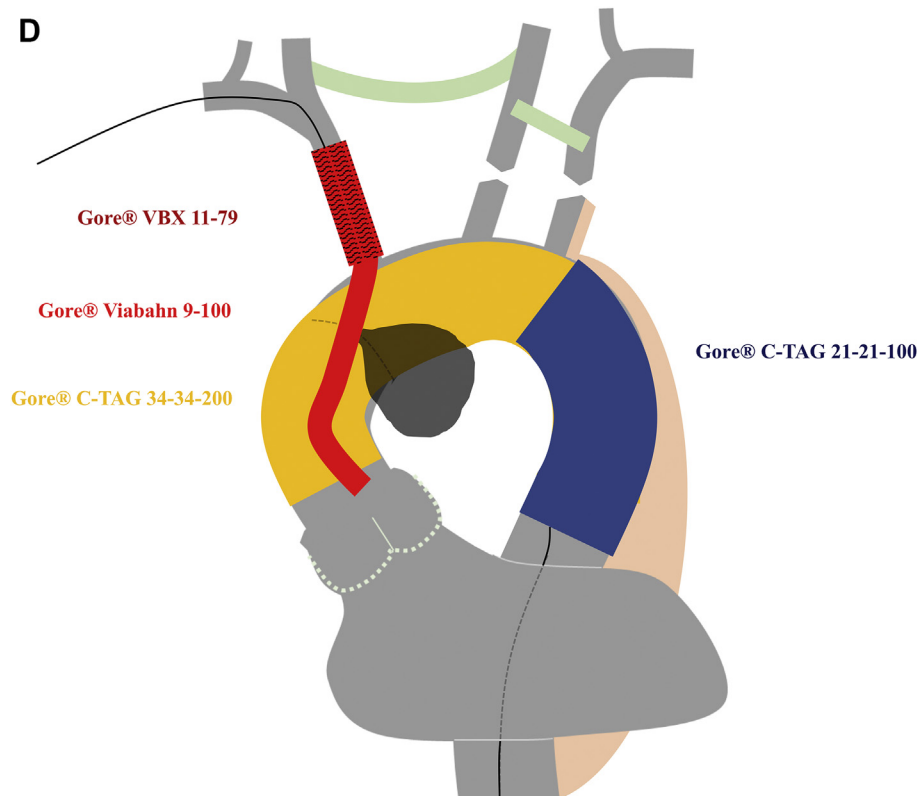


Figure 3. (continued).

Completion angiography confirmed successful exclusion of the anastomotic pseudo-aneurysm, with proper perfusion of the supra-aortic trunks (Fig. 4A), as well as the left renal artery, the latter maintained as a result of the multiple visceral entry tears located at this level (Fig. 4B).

The peri-operative period was uneventful, and the patient was extubated 12 hours later with no neurological deficit. There was significant improvement of the hoarseness five days after the intervention, and the patient was discharged on the tenth post-operative day, on single antiplatelet therapy and anticoagulation, the latter mandatory owing to the presence of a mechanical aortic valve.

A six month follow up CTA confirmed pseudo-aneurysm exclusion, with no evidence of endoleak, graft kinking, or stenosis (Fig. 5).

DISCUSSION

Anastomotic pseudo-aneurysms are rare but potentially serious complications of ascending aorta prosthetic replacement, especially when symptomatic.³

Open surgery represents a durable solution for the majority of cases, although certain lesions and anatomies, such as anterior anastomotic pseudo-aneurysms, are associated with potentially lethal bleeding risk when chest re-entry is attempted. Although adjunctive strategies, such as extracorporeal circulation, could reduce this risk, such an approach was not favoured at a multidisciplinary team discussion. Completely endovascular treatment options are an alternative in such scenarios, and several techniques

have been described, including branched and fenestrated repairs, multivessel parallel graft techniques and physician modified stent grafts.^{4–7} Although effective, none of these techniques was considered in this case. Custom made devices have interesting results, but are not an option in urgent settings;⁷ multivessel parallel graft repairs provide off the shelf solutions but are plagued with significant type I endoleak and re-intervention rates;⁵ and physician modified stent grafts are complex interventions, restricted to experienced centres.⁶

Considering these limitations in a patient requiring expedited repair, a hybrid solution with target vessel parallel grafting was determined the most viable option. Two main challenges were anticipated: short proximal sealing length and large target vessel diameter, the latter requiring large devices to cross the proximal sealing zone, with increased risk of gutter related endoleak.

In order to manage the proximal landing zone, supra-aortic trunk debranching was performed initially. By doing so, the number of target vessels requiring revascularisation was reduced to one, allowing for proper proximal sealing through zone 0 TEVAR with a single chimney to the brachiocephalic trunk.

Although this strategy provided an adequate proximal seal, such a seal could be compromised by gutter related endoleak, particularly if a large parallel graft crossing the sealing zone was implanted. By using a parallel graft size reduction technique, this risk was further reduced. The rationale of this technique is to taper the parallel graft by using a smaller self expandable covered stent across the

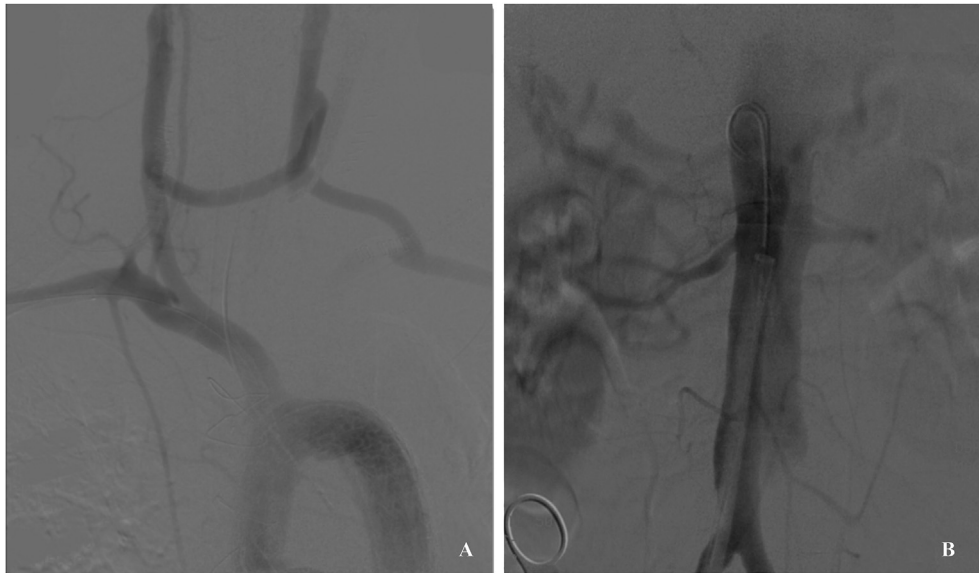


Figure 4. (A) Completion angiography revealing total pseudo-aneurysm exclusion and normal perfusion of all supra-aortic trunks. (B) Completion angiography revealing left renal artery perfusion.

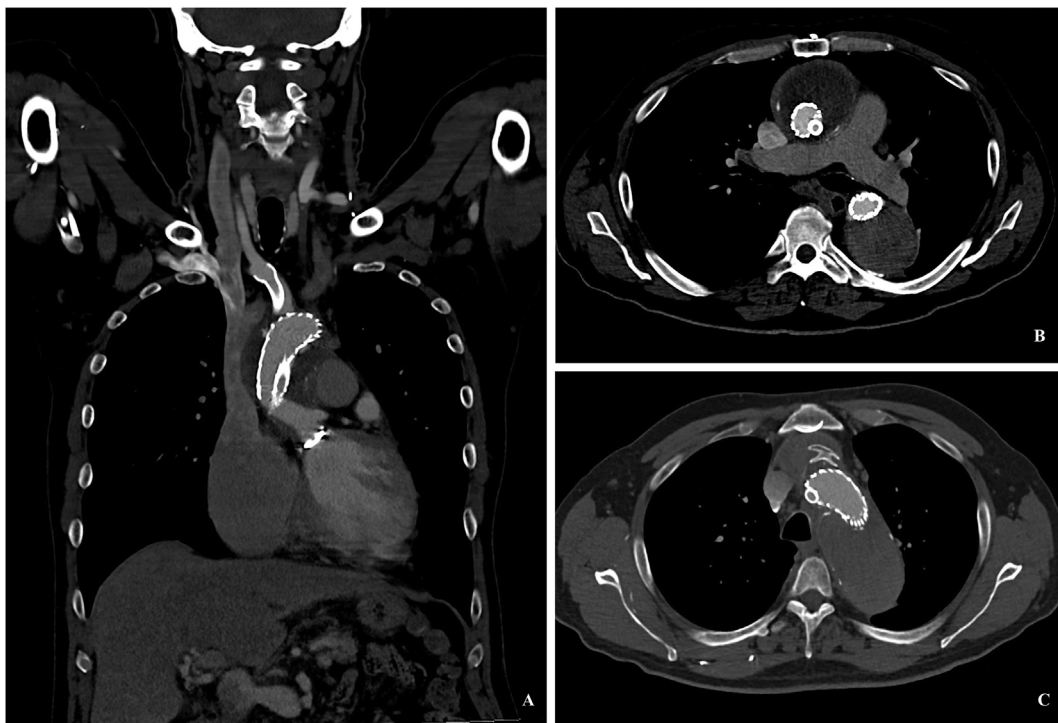


Figure 5. (A–C) Six month post-operative computed tomography angiography confirming aneurysm exclusion.

sealing zone, and a wider balloon expandable covered stent, with the ability to over dilate to large diameters, sealing distally in the target vessel. The decision to use a proximal 9 mm stent was based on its low profile (therefore reducing the risk of gutters), reasonable size (no expected flow reduction), and gentle taper with the 11 mm balloon expandable covered stent that was required for target vessel sealing. Further relining was performed owing to the increased torque forces that are observed in the aortic arch, and high radial force exerted by the aortic stent graft. Thus, a balloon expandable covered stent was implanted in the

stent overlap area, given its high radial force and possibility to taper and conform to the diameters of the two stent grafts in position. Proximal relining was performed with a standard self expanding stent.

Regarding the main graft, the optimal diameter was estimated according to the following formula: graft diameter = 20% oversizing of the landing zone + half the diameter of the parallel graft.² The decision to use the newer conformable TAG device (W.L. Gore and Associates) contributed to the success of the case given its deployment mechanism, conformability, and shorter leading olive.

Unlike other devices, this stent graft is initially deployed to an intermediate diameter, which not only eliminates the windsock effect, but also allows for its repositioning in the desired landing zone. The ability to angulate the device further increases its conformability to the arch and the presence of a shorter leading olive reduced the risk of potentially life threatening complications secondary to crossing the mechanical valve.⁸ Rapid pacing was employed, but these characteristics may eliminate the need for its use.

Although effective in the short term, the absence of long term results is acknowledged with the risk of chimney occlusion, responsible for total brain perfusion. Additionally, the extensive supra-aortic trunk manipulation will not allow for an upper approach if a fenestrated/branched intervention is needed in the future for false lumen exclusion due to aneurysmal degeneration.

The patient remains under strict surveillance with no complications reported after six months follow up.

CONCLUSION

Symptomatic anastomotic pseudo-aneurysms after Bentall procedure are high risk complications, and require urgent repair. When located anteriorly, they are particularly prone to rupture during open surgical repair.

Hybrid interventions with supra-aortic trunk debranching, parallel grafting, and landing zone 0 TEVAR, may be a viable solution in such scenarios and, although technically demanding, are potentially life saving. However, the risk of intra-operative complications is not negligible, not all anatomies are suitable for this technique, and long term follow up studies are required to confirm durability.

CONFLICT OF INTEREST

None.

FUNDING

None.

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