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Case Report

# Management and follow-up of patient with circumferential type B aortic dissection using GORE thoracic-branch endograft ☆

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ABSTRACT

Type B aortic dissection with high-risk features such as a large entry tear, false lumen, and circumferential dissection has a greater chance of progression and rupture without definitive surgical intervention. Traditional thoracic endovascular aortic repair of dissection with proximal zone 1 landing requires extensive aortic arch debranching to minimize the risk of ischemic stroke with endograft deployment. Recent developments in endovascular grafts for thoracic endovascular aortic repair have allowed for an optimized approach in challenging cases. We present the case of a 53-year-old male with circumferential type B aortic dissection and higher-risk features treated with a staged right-to-left carotid bypass and subsequent thoracic endovascular aortic repair with a GORE® TAG® Thoracic Branch Endoprosthesis for zone 1 proximal landing.



## Introduction

Aneurysmal type B aortic dissection (TBAD) is a rare but potentially lethal vascular pathology, with a significant risk of aortic rupture. Although uncomplicated type B aoretic dissections have historically been approached with first-line optimal medical therapy (OMT), several features portray poorer clinical outcomes. These findings include: [1] intimal entry tear >10 mm [2], false lumen >22 mm, and [3] maximal thoracic aortic diameter >40 mm. Multiple studies have demonstrates that these findings carry a higher risk for progression to complicated TBAD without definitive surgical intervention [2,3]. In patients with high-risk features, combination treatment with prophylactic thoracic endovascular repair (TEVAR) has demonstrated favorable aortic remodeling and increased aortic-specific survival compared with OMT alone, with delayed treatment-associated worse outcomes [4–6].

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For thoracoabdominal aortic dissections without a suitable proximal landing zone (PLZ) distal to the origin of the left subclavian artery (LSA), aortic arch debranching can be pursued to increase the PLZ, improve graft seal, and reduce perioperative morbidity [7–9]. Traditionally, TEVAR with proximal zone 1 landing over the left common carotid artery (LCCA) entailed surgical revascularization of the LCCA and LSA via bypass or transposition from the branches of the innominate artery [10]. TEVAR utilizing a branched endoprosthesis has emerged as an alternative for achieving optimal proximal landing in the aortic arch while minimizing the risk of stroke [11]. In this case, we describe a staged RCCA-LCCA bypass and zone 1 TEVAR using a GORE® TAG® Thoracic Branch Endoprosthesis for LSA branch endoprosthesis for the treatment of circumferential TBAD with several high-risk features.

## Case presentation

A 53-year-old male with a medical history of long-standing uncontrolled hypertension, smoking, and pre-diabetes presented to the emergency department with a 5-hour history of tearing substernal pain radiating to the back. Computed tomography angiography (CTA) of the thorax, abdomen, and pelvis revealed a TBAD spanning just beyond the LSA to the right external and left internal iliac arteries, with involvement of the proximal celiac artery (Fig. 1). A concomitant ascending aortic aneurysm of 53 mm and a maximum false lumen diameter of 27 mm with circumferential involvement of the descending aorta were observed. The patient had significant high-risk features, including a large entry tear, thoracic diameter > 4 cm, and false lumen diameter 2.7 cm. A discussion was performed with the patient, and after risk benefits, the patient opted for surgical repair. Following aggressive blood pressure control with no evidence of expanding dissection or symptomatic disease, the patient was discharged and scheduled for elective two-stage right-to-left carotid bypass and branched thoracic endovascular aortic repair TEVAR with LSA stenting.

Three months after discharge, the patient underwent the first stage of treatment with a right-to-left CCA bypass. Exposure of the RCCA and LCCA was achieved via dissection along the anteromedial border of the sternocleidomastoid muscle, and an anterior tunnel was created below the strap muscles. Following arteriotomy of the right CCA, an end-to-side anastomosis with an 8 mm ringed Bioline (Maquet Cardiovascular, Wayne, NJ, USA) graft was formed using a running 5-0 prolene suture (Fig. 2A). Division of the left CCA was performed, and the distal stump was anastomosed in an end-to-end fashion to the biolene graft with a running 6-0 prolene GORE-TEX suture (Fig. 2B). The patient tolerated the procedure well, and his immediate postoperative neurological examination revealed no deficits. His postoperative hospitalization was uncomplicated, and he was discharged on postoperative day one with daily administration of 325 mg aspirin. The interval between carotid carotid bypass and TEVAR was uneventful, with no episodes of neurologic deficits or cardiovascular events reported by the patient.

One month after carotid bypass, branched TEVAR with LSA stenting was performed with ultrasound-guided left common femoral and left brachial percutaneous access. A 34 mm × 15 cm GORE (W.L. GORE, Phoenix, AZ) TAG thoracic branch endoprosthesis (TBE) was placed just distal to the innominate artery origin (Fig. 3). Through-and-through brachiofemoral access was achieved prior to deployment of the main device, through which a 12 mm GORE subclavian branch stent was deployed and postdilated. We anticipated difficulty with wire

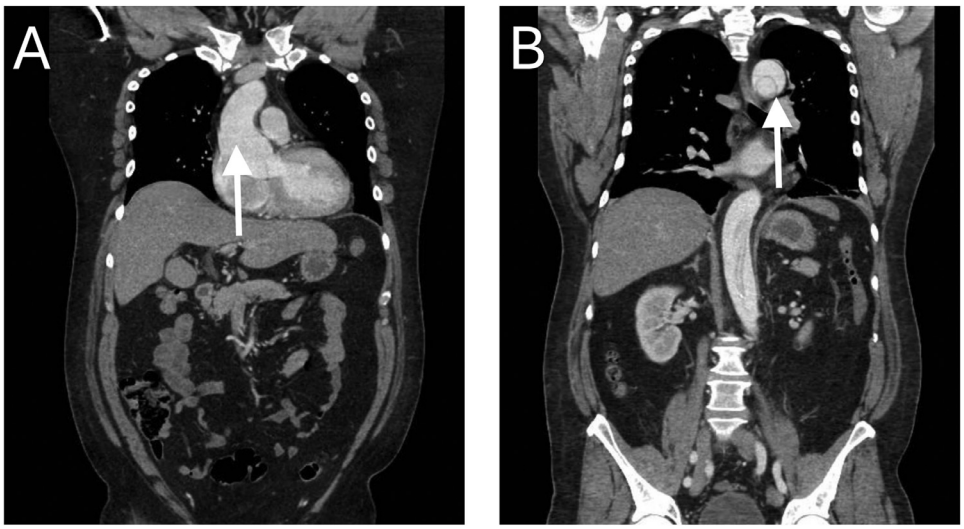


**Fig. 1. – (A) Computed Tomography of the chest showing TBAD extending from the LSA to the right external and left internal iliac arteries. Significant features include aneurysmal dilation of the ascending aorta to 53 mm (white arrow shows that the proximal ascending aorta is not aneurysmal), an entry tear of 12 mm distal to the LSA, proximal descending aorta diameter of 40 mm, and a maximum false lumen diameter of 27 mm with circumferential involvement in several areas. (B) Coronal view showing the aortic dissection marked by the white arrow.**

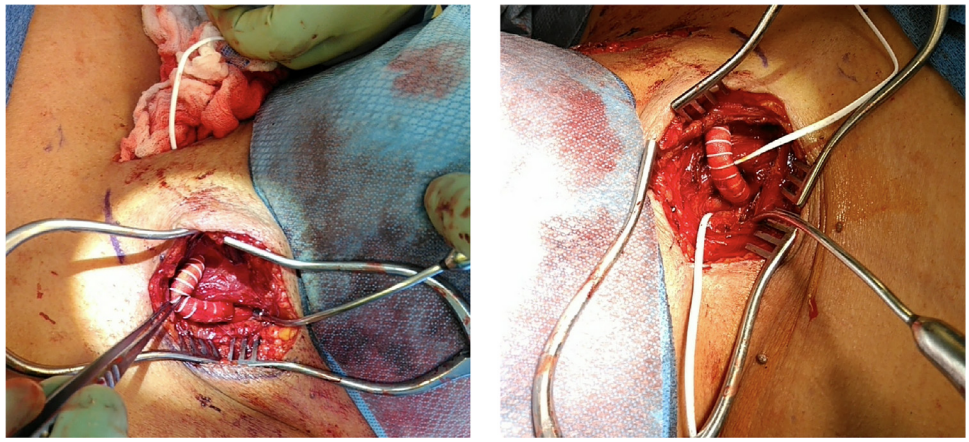

**Fig. 2 – Intraoperative photographs of graft anastomosis to from right common carotid artery to the left common carotid artery.**

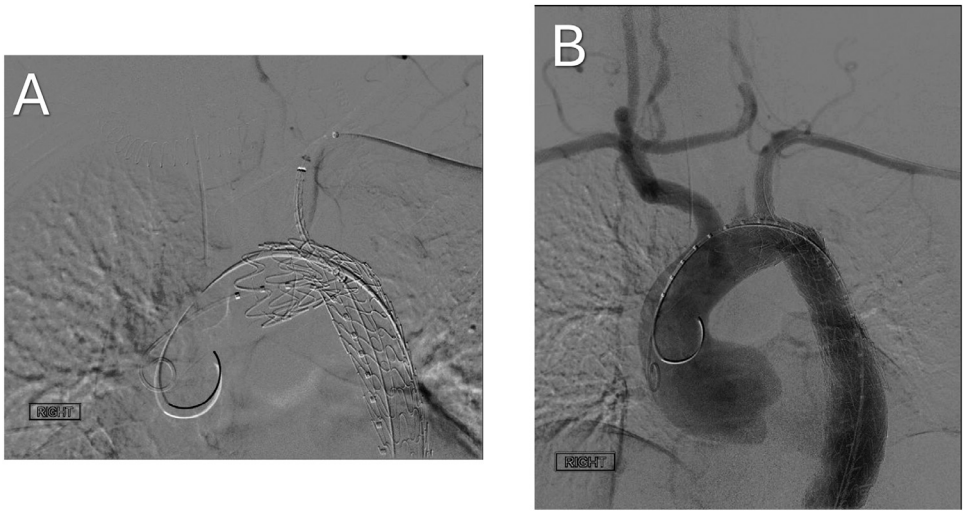


**Fig. 3. – (A) Intraoperative angiography showing positioning of the GORE TAG TBE along with deployment of the graft. (B) Completion angiography demonstrating patency.**

wrap owing to the angulation of the aorta; however, this did not prove to be an issue in this case. To ensure an adequate distal seal and promote false lumen regression, a 37 mm × 15 cm GORE stent was positioned in the proximal descending aorta, and the Knickerbocker technique was used to close the false lumen (Fig. 3D) [23]. The graft position, absence of endoleak, patency of the LBE, stents, carotid bypass, and aortic branches were confirmed via completion angiography (Fig. 3).

Following the procedure, the patient was admitted to the surgical ICU. He demonstrated no neurologic deficits or signs of bleeding and was able to ambulate independently; he was later discharged on postoperative day one. A month later, a CTA chest with a 3D aortogram demonstrated patency of the LBE, LSA stent, and left-to-right carotid bypass with a stable descending aneurysmal sac of 58 mm and no evidence of endoleaks, graft occlusion, or expansion of the dissection (Fig. 4).

## Discussion

Optimal proximal endograft landing in TEVAR is paramount for successful entry tear coverage and favorable aortic remodeling with true lumen expansion [12,13]. Conventionally, a PLZ in ≥20 mm of healthy aorta is recommended [14], with inadequate coverage associated with a higher risk of endoleak and potentially lethal retrograde type A dissection (RTAD) [15,16]. However, the proximity of the entry tear to the LSA ostium may warrant a landing zone within the aortic arch, historically necessitating surgical revascularization of the aortic arch. Although an aggressive PLZ with revascularization protects against aortic-related mortality and the need for reintervention when a suitable segment of the healthy aorta is not present in a more distal PLZ [17], extensive aortic arch debranching carries an inherent risk of complications including embolic stroke and long-term bypass occlusion. Furthermore,

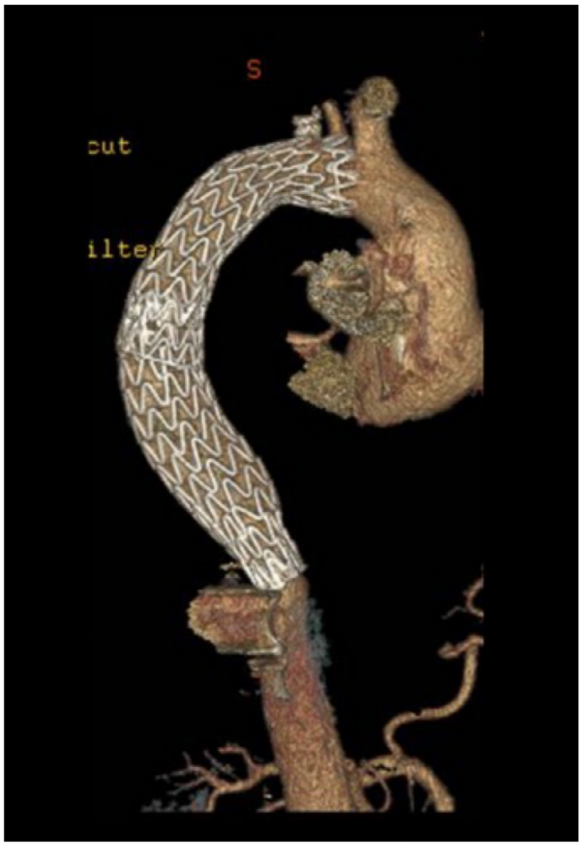


**Fig. 4 – Three dimensional aortogram demonstrating zone 1 proximal placement of GORE TAG TBE, Patency of the LSA stent, stable aneurysmal dilation of the ascending aorta with observed patency of the right-to-left carotid bypass.**

proximal endograft deployment in zone 0 (proximal to the origin of the innominate artery) carries a greater risk of technical failure and early postoperative endoleak than PLZ 1 or 2 [18]. Various surgical options were considered for this patient, including but not limited to open intervention and the use of different endovascular grafts. Open intervention for aortic dissection is rarely performed, and the patient elected not to proceed with this option because of larger surgical morbidity and mortality. Additional options included carotid bypass followed by subclavian artery transposition or bypass with proximal subclavian artery coiling. Additional procedures for the subclavian artery carry inherent risk, and for this patient, the best option included using the GORE TAG TBE to minimize surgical risk. TEVAR with a single-branched endoprosthesis provides an endovascular alternative to surgical revascularization of the LSA with a zone 2 landing.

Our case highlights several key aspects of branched TEVAR for the treatment of TBAD with an unfavorable anatomy. The primary entry tear was at the ostium of the LSA and in close proximity to the LCCA origin, necessitating a landing in proximal zone 1 for favorable sealing of the endograft. To protect LCCA flow, an RCCA-LCCA bypass was planned in anticipation of TEVAR. Although TEVAR with a double-branched physician-modified endoprosthesis could serve as a complete endovascular alternative in this case, multibranched TEVAR carries additional periprocedural concerns. Tazaki et al. observed a periprocedural stroke prevalence of 33% in patients with a double-branched Inoue Stent Graft compared to 7.8% in those with single-branched endografts [19]. Similar outcomes were observed by Czerny et al., with a combined stroke rate of 20% in patients receiving Bolton Relay plus double-branched endoprosthesis [20]. Furthermore, the presence of a comorbid ascending aortic aneurysm measuring 53 mm maximally at the root rendered proximal deployment of a double-branched endograft at a greater risk of complications. Multiple studies have reported a greater risk of RTAD with more proximal endograft deployment, ascending aorta diameter ≥40 mm, and stent-graft oversizing by ≥10% [21,22].

## Conclusion

This case demonstrates the safety and efficacy of a staged RCCA-LCCA bypass and zone 1 TEVAR with an LSA-branched endoprosthesis for the treatment of high-risk TBAD with a comorbid ascending aortic aneurysm. Carotid-carotid bypass and single-branched TEVAR may be favorable options for TBAD requiring proximal zone 1 landing.

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## Patient consent

Informed consent was obtained for use of de-identified in- formation for publication per our Institutional Review Board policy.

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