Ruptured Thoracoabdominal Aneurysm Treatment With Modified Chimney Stent Graft

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A 76-year-old woman presented with symptomatic contained-ruptured thoracoabdominal aneurysm at the level of the superior mesenteric artery (SMA) and the hepatic artery origin from the SMA. The chimney technique for celiac trunk, SMA, and right renal artery (periscope configuration) was performed. An endovascular leak from the distal landing zone of the SMA stent graft was treated using a second modified stent graft with the SMA branches preservation. The 18-month follow-up computed tomography angiography demonstrated the aneurysm exclusion, no endovascular leak, and visceral and renal arteries patency.


Open repair of thoracoabdominal aortic aneurysms (TAAA) has evolved significantly over the last decades, but still remains a challenging procedure in vascular surgery. High morbidity and mortality rates have been reported even in high-volume centers [1]. The hybrid approach for TAAA was considered less invasive, but this was not confirmed in clinical practice [2]. Total thoracic endovascular repair has become an alternative to the open surgical or hybrid treatment of TAAA [3]. Fenestrated and branched endovascular grafts require from 4 to 6 weeks for manufacture, so the surgeon-modified devices offer another treatment option in emergency settings [4]. Several techniques have been described to preserve visceral revascularization during total endovascular repair of ruptured or symptomatic TAAAs with the off-label use of off-the-shelf devices [5–7].

We report a novel approach to preserve the visceral revascularization during thoracic endovascular repair using the chimney technique with a modified stent graft, and the 18-month follow-up results.

A 76-year-old woman presented with back pain. Her medical history included chronic obstructive pulmonary disease and congestive heart failure (ejection fraction of 40%). Contrast-enhanced computed tomography angiography (CTA) demonstrated a 53-mm contained-rupture thoracoabdominal aneurysm at the level of the superior mesenteric artery (SMA). The SMA presented early branching (24 mm), and the hepatic artery originated from this vessel (Figs 1A, 1B).

Under local anesthesia, after systemic heparinization administration, through the right percutaneous femoral approach, a 26-21-100 mm Gore cTag endoprosthesis (WL Gore & Assoc, Flagstaff, AZ) was deployed for the aneurysm exclusion. Two 7 × 10 mm Viabahn stent grafts (WL Gore) were implanted in the celiac trunk and the SMA, through the open right and left brachial access, respectively. Each Viabahn stent graft was reinforced with a 7 × 80 mm Protégé stent (GPS/Everflex; ev3 Endovascular, Plymouth, MN). A 6 × 50 mm Viabahn stent graft was deployed in the right renal artery (RA) in a periscope configuration using the left percutaneous femoral approach and was reinforced with a 7 × 40 mm Protégé stent (Figs 2A, 2B). The left RA stenting was not necessary, because the distance between the two RAs (19 mm) offered good sealing for the thoracic endovascular graft.

Endovascular graft and stent ballooning were performed in a kissing fashion. Completion angiography demonstrated the aneurysm exclusion, no endovascular leak, and visceral and renal arteries patency (Fig 2C). The 1-month CTA revealed an endovascular leak from the distal landing zone of the SMA stent graft, with TAAA shrinkage (maximum diameter of 49 mm; Figs 2D, 2E). A second intervention was performed. Through the left brachial access, two 0.014-inch Pilot guidewires (Abbott Vascular Devices, Abbott Park, IL) were used to cannulate the SMA branches because of the vessel aberrant anatomy (Fig 3A). Considering the small distance (<2 cm) available before the hepatic artery origin, a 6 × 50 mm Viabahn stent graft was introduced over the two Pilot guidewires after the stent tip removal (Figs 3B, 3C). The SMA selective angiography demonstrated no endovascular leak and SMA branches patency (Fig 3D). The postoperative course was uneventful. The patient was discharged on a regimen of oral double antiplatelet therapy (clopidogrel 75 mg per day for 3 months and aspirin 100 mg per day indefinitely). The patient underwent CTA control before discharge, at 1, 6, 12, and 18 months after the second procedure. The 18-month follow-up CTA confirmed the aneurysm exclusion and aneurysm sac shrinkage (maximum diameter of 35 mm; Fig 3E).

Comment

Open surgical treatment of TAAA continues to be a demanding procedure, associated with mortality rates of 5% to 14% in referral centers [1]. In the emergency setting, the mortality rate reported of 48% renders this complex intervention almost prohibitive, especially in high-risk patients [4]. The less invasive hybrid approach, in contrast, failed to demonstrate better results in terms of morbidity and mortality rate in several experiences reported [2, 3]. The widespread use of endovascular technology and the continuous improvement of technical
skills in the endovascular field extended the benefits of the total endovascular approach to patients with aortic aneurysms involving the visceral vessels. The fenestrated and branched devices, with their limited availability in emergency, were in these circumstances substituted by the off-label use of readily available materials in the chimney and sandwich configurations [5, 6].

The sandwich technique was not used in our patient because a single thoracic endovascular graft was sufficient for the aneurysm exclusion. The chimney technique
was performed using two brachial accesses for the celiac trunk and SMA and two femoral accesses for the two RAs patency and thoracic endovascular graft delivery. No spinal cord drainage was used, considering the short aortic portion treated.

Patel and colleagues [8] performed a literature review on the chimney grafts, indications, techniques, and results. For the investigators, the ideal endovascular graft oversizing remained unanswered. Increasing oversizing decreased gutter areas, but main endovascular graft infolding of most oversized stent grafts was detected. In our case, the endovascular graft oversizing was 31% proximally and 25% distally, considering the double chimney technique for celiac trunk and SMA and the periscope chimney for the right RA. The cTag device was chosen for its flexibility and conformability. We performed endovascular graft and chimney stents adequately overlapping to create long and helical gutters and reduce the risk of type I endovascular leak.

Our approach was complicated by the presence of endovascular leak from the SMA stent graft distal landing zone. The aberrant anatomy of the SMA required two guidewires and the use of a second modified stent graft. The long tip was removed because of the short landing zone before the vessel branching. To our knowledge, this is the first case of a modified Viabahn chimney stent graft use reported in the literature.

The chimney technique is currently recommended as the bailout procedure in unintentional branches coverage or in the urgent setting for patients considered unfit for TAAA open repair. Available materials modification by highly skilled operators may offer a second bailout option in selected cases. Early results have demonstrated the chimney technique safety and feasibility. However, concern remains regarding long-term durability of the technique and type I endovascular leak. Long-term follow-up remains mandatory.

References