Hybrid rescue technique after failure of a standard multibranched stent graft

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ABSTRACT

A 78-year-old woman presented with type IIIC and IIID endoleaks after endovascular treatment for a thoracoabdominal aortic aneurysm. Mating between the ruptured segments of superior mesenteric artery stent graft was performed. After failed attempts at relining the right renal artery stent graft, a hybrid approach was used to connect the side branch to the target vessel: a stent graft was deployed into the side branch of the main graft and it was temporarily occluded with a balloon. After opening the sac, a stent graft was deployed into the right renal artery and the two stent grafts were connected with a running suture. Follow-up examination performed 1 month postoperatively by computed tomography imaging confirmed the effectiveness of this treatment. (J Vasc Surg Cases and Innovative Techniques 2019;5:338-42.)

Key Words: Thoracoabdominal; Hybrid technique; Multibranched graft; BEVAR

Endovascular repair with standard off-the-shelf multibranched (OTSMB) stent graft has been increasingly used to treat thoracoabdominal aortic aneurysms (TAAAs). It is estimated that just over 50% of patients are suitable for this device, both for elective and emergency procedures. Technique limitations include abnormal anatomy of target arterial vessels and difficulty accessing them. Moreover, excessive distance or angulation between side branch and target vessel may be considered risk factors for complications and reintervention.[1] A reintervention rate of 17% has recently been reported and it most commonly involved correction of stented visceral vessels due to endoleak or stenosis (mainly of the renal vessels).[2] In a recent systematic review, Hu et al[3] reported a rate of endoleak of 15.1% after endovascular repair of TAAAs, with 32.1% of endoleaks being type III.[3] Conservative management or endovascular techniques, such as relining and/or endovascular thrombectomy, have been described in selected cases.[4-6] Complete graft removal and aortovisceral revascularization is considered an invasive technique with a prohibitive perioperative risk; data regarding this particular technique are scarce. The use of hybrid techniques after side branched failures was recently published, but evidence of successful clinical application is limited by the small number of treated patients.[7,8]

The patient's consent was obtained to publish case details and images.

CASE REPORT

A 78-year-old woman was treated 2 years before presentation at our institution for a type III (according to Crawford classification) TAAA (minimum transverse diameter of 7 cm). Surgical repair by means of standard thoracophrenolaparotomy was initially attempted by a team of skilled cardiac surgeons, but the procedure had to be aborted owing to severe adhesions compromising the surgical field. An endovascular procedure was then planned. During the first stage OTSMB graft (Zenith t-Branch; Cook Medical, Bloomington, Ind) was deployed and extended proximally and distally with a tubular and a bifurcated stent graft respectively to obtain complete graft sealing. In the second stage, side branches were bridged by means of balloon-expandable stent grafts (Atrium V12, Maquet, Wayne, NJ): proximal 7 × 60 stent graft plus distal 6 × 40 bare metal stent were used for the right renal artery (RRA) and 8 × 40 plus 8 × 60 stent graft were used for the superior mesenteric artery (SMA). Because the left renal artery was both of a small (diameter 3 mm) and duplicated, it was embolized with Onyx 34 (Medtronic, Minneapolis, Minn) and coils. The celiac trunk seemed to be chronically occluded. Both side branches for the celiac trunk and left renal artery were occluded with a plug. The postoperative period was uneventful. After discharge, the patient refused clinical and radiologic follow-up.

After 2 years, the patient was referred to our institution for persistent abdominal pain and presence of an abdominal pulsatile mass. A computed tomography scan documented a large TAAA (diameter, 95 mm) with no signs of rupture (Fig 1), fracturing of the stent graft in the SMA (type IIID endoleak), and complete dislodgement of the stent graft of the RRA from its own side branch (type IIIC endoleak; Fig 2).

Open surgical treatment with graft removal was excluded because of the prohibitive perioperative risk.

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Fig 1. A, Computed tomography scan at presentation, 2 years after the endovascular treatment of thoracoabdominal aortic aneurysm (TAAA). **B,** Fracture of the superior mesenteric artery (SMA) stent graft. **C,** Dislodgement of stent graft of right renal artery (RRA; target native vessel diameter, 4.5 mm) from the side branch.

The patient declined the possibility of having the side branch of the RRA occluded—in case of procedural failure—owing to the subsequent need for permanent dialysis. We therefore elected to perform an endovascular relining of the SMA through left brachial access with a self-expandable stent graft (Viabahn; W. L. Gore & Associates, Flagstaff, Ariz) and a balloon-expandable stent graft (LifeStream; Bard, Tempe, Ariz). Multiple maneuvers were attempted to bridge the RRA, but it was impossible to access the renal artery with the new stent graft and the procedure was ultimately aborted.

The patient later consented to undergo a new procedure. Via left brachial access, a self-expandable stent graft (Covera; Bard, Tempe, Ariz) was deployed into the side branch of the RRA that was temporary occluded with an inflated balloon. Complete exclusion of the aneurysm was confirmed by intraoperative ultrasound examination. A median laparotomy was then performed. The aneurysmal sac was opened and this allowed inspection of the aortic graft and the dislodged stent graft of the RRA (Fig 3). The previously implanted rigid stainless steel stent graft inside the RRA was removed and a new self-expandable stent graft (Viabahn; W. L. Gore & Associates) was deployed into the artery. The edges of the two stent grafts were directly connected with a 6-0 Prolene running suture (Fig 4). Total time of renal ischemia was 27 minutes. Through brachial access, a self-expandable stent graft was ultimately deployed across the suture (Viabahn; W. L. Gore & Associates). After angiography confirmed regular patency of the stents and no signs of leak, the sac was closed. Time of fluoroscopy and time of procedure were 32 and 207 minutes, respectively. The total amount of contrast medium and blood loss were 45 and 190 mL, respectively.

Postoperative complications included gastric bleeding complicated by respiratory insufficiency, which were treated with endoscopic embolization and medical therapy in the intensive unit care, where the patient remained for 3 weeks before being transferred to the rehabilitation unit.

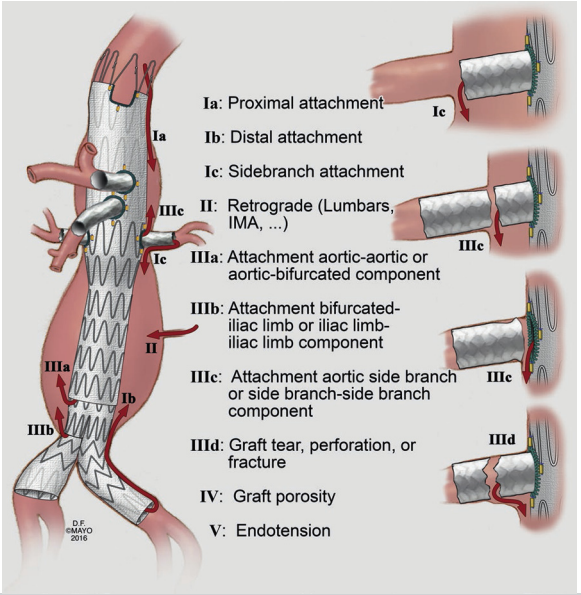

Fig 2. New proposed classification for endoleaks in patients with complex aortic repairs.[11] *IMA,* Inferior mesenteric artery.

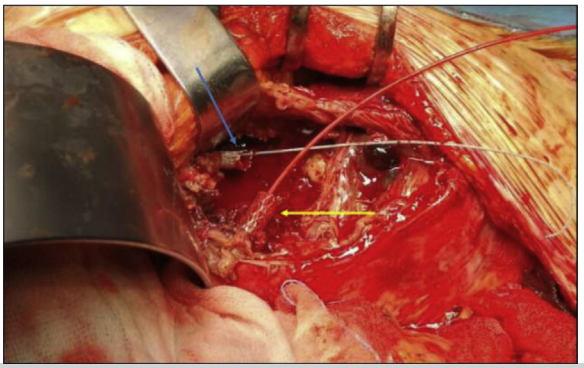

Fig 3. Intraoperative field after opening the aneurysm sac. Temporary occlusion with inflated balloon into the stent graft of the side branch of the renal artery (*blue arrow*) and stent graft into the right renal artery (RRA), temporarily occluded with a balloon catheter (*yellow arrow*).

Follow-up computed tomography scans performed 1 month later confirmed regular patency of the visceral vessels with no signs of leakage (Fig 5). Even if further radiologic follow-up was refused by the patient, the clinical outcome after 6 months from the procedure was uneventful.

DISCUSSION

Total endovascular repair with fenestrated and branched grafts is evolving and is becoming an accepted alternative to open surgery, with technical success rates ranging from 82.2% to 100%.[4] Whereas the clinical application of custom-made grafts remains limited because of long manufacturing times, the use of standard OTSMB stent grafts is widely increasing. Their standard configuration allows treatment of around 50% of patients affected by TAAA.[9] Although early results are encouraging, data from recent literature remains limited because of small series of cases and heterogeneous populations.

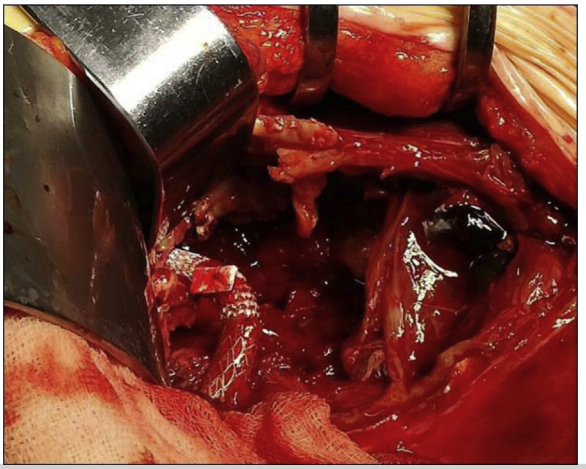

Fig 4. Intraoperative field after direct connection with running suture of the two stent grafts (proximal edge of the stent graft into the right renal artery [RRA] and the distal one into the side branch).

The main limitations of the endovascular approach, both with fenestrated and branched grafts, are related to arterial access and target vessels. Endoleaks and stenoses/occlusions of the stent grafts have been described with short- and midterm follow-up.[10] To quickly identify the etiology of different endoleaks and to plan the appropriate treatment, a detailed classification system has been recently prosposed.[11] Renal arteries showed to be the target vessels most prone to complications.[6] Many hypotheses have been suggested, such as the lack of an ideal stent graft, excessive distance or angulation between side branches and the target vessel, the diameter of the visceral artery, the relative high resistance perfusing an end organ and material fatigue (owing to respiratory motion), but none of these seemed to be statistically significant. It was concluded that the cause of visceral stent graft failure has most likely a multifactorial etiopathogenesis.[6] In our case, sac enlargement may also be considered an additional risk factor for stent graft dislodgement. Regardless of the reason for visceral branch loss, its occurrence is such an important event in the postoperative period to deserve further engineering research into product development.

Radiologic follow-up is imperative independent of the stent graft used. A standardized protocol of postoperative imaging may help in identifying graft failures and those conditions prone to develop complications.

Although endovascular techniques are usually able to solve the majority of postoperative complications and provide a positive outcome for the patient, there are several cases in which endovascular treatment was rendered ineffective. For such patients, open surgical

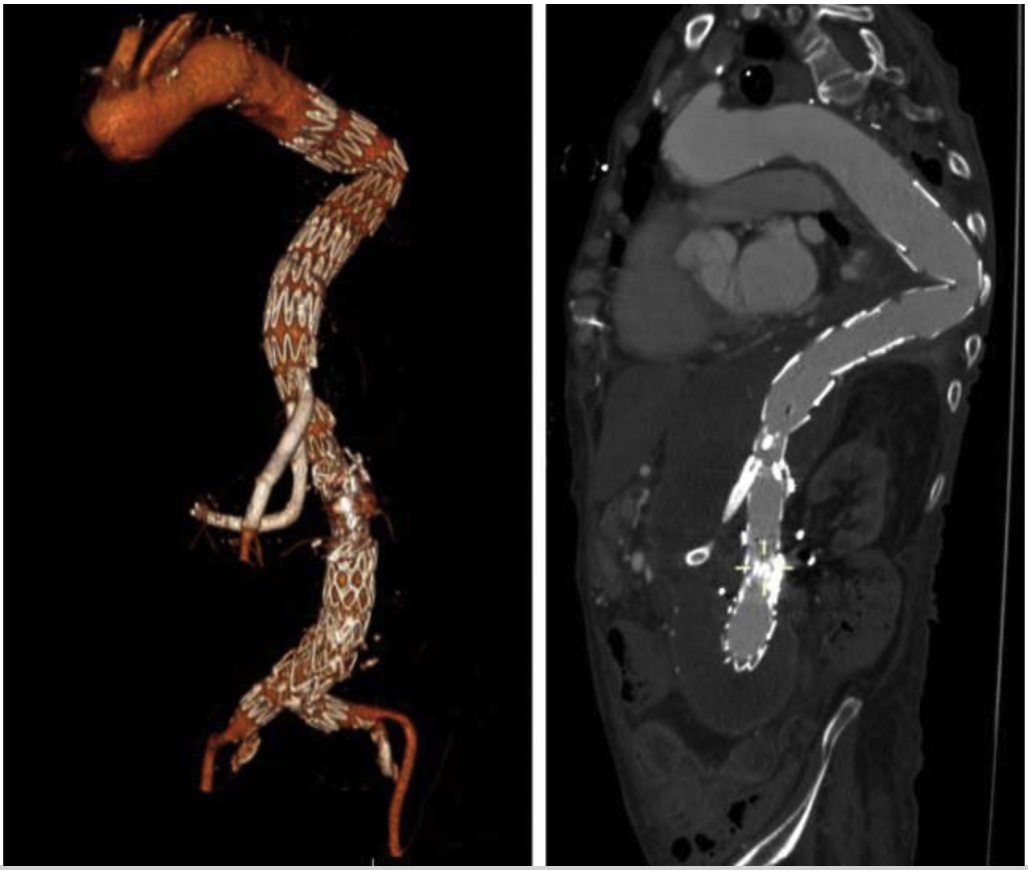

Fig 5. Computed tomography scan after 1 month of follow-up showing regular patency of the visceral grafts without any sign of leakage.

conversion with complete graft removal is considered the only option, despite its significantly greater perioperative risk. The current literature lacks of evidence to support this alternative procedure. Hybrid approaches have been described, but their clinical application is currently limited.[7,8] In all those cases, indications for treatment were always different from ours and no previous technique described saccotomy of TAAA, as in our case.

In this case report, we describe a hybrid approach to treat stent dislodgement after multiple ineffective attempts at mating the stent graft to the side branch. During the endovascular phase, we elongated the side branch of the RRA with a self-expandable stent graft and we achieved sac exclusion by balloon inflation inside its lumen. The use of a self-expandable graft was preferred because of the flexibility of the nitinol skeleton. Transabdominal ultrasound examination confirmed absence of flow inside the aneurysm after inflation of the balloon, decreasing the risk of intraoperative bleeding. During the surgical phase, the sac was opened at the level of the RRA and the stainless steel stent graft inside the RRA was removed because it was considered excessively rigid. A more flexible self-expanding nitinol stent graft was instead deployed into the RRA. The two edges of the stent grafts were easily drawn together and connected with a 6-0 Prolene suture. Suturing the two stent grafts proved difficult to perform, as the suture tended to catch on the polytetrafluoroethylene of the stent graft, making relining with an additional covered stent necessary at the end of the procedure.

The aim of our report was to describe an alternative approach to side branch dislodgement after branched endovascular aortic aneurysm repair. This technique may be useful for clinicians treating endovascular failure of side branch bridging before considering graft removal. Of note, procedural time, the amount of contrast medium, and blood loss are comparable with those of other totally endovascular procedures.

CONCLUSIONS

The wide diffusion of totally endovascular repair of TAAA is related to an increased risk of stent graft-related complications. The management of these complications requires technical skills and expertise both in open and endo procedures, but it also requires skills such as creativity and ability to improvise, which extend beyond traditional technical surgical skills.

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