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Iliac branch device: A possible solution for the preservation of the inferior mesenteric artery in complex aortic endovascular procedure

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ABSTRACT

A 76-year-old man was admitted with a bilateral iliac obstructive disease and an abdominal aortic aneurysm. The right internal iliac artery was patent as well as the inferior mesenteric artery (IMA) that measured 5 mm. Patient performed TEVAR one year before for a thoracic descending aorta aneurysm. He underwent an endovascular aneurysm repair with an inner abdominal branch device and an iliac branch device (IBD) was used to preserve IMA patency. The IBD may be an alternative endovascular device to save IMA in extensive aortic coverage in patients at high risk of spinal cord ischemia.

Introduction

Spinal cord ischemia (SCI) is an unpredictable complication during aortic surgery for Thoraco-abdominal aortic aneurysm (TAAA).The risk is increased by extensive aortic coverage, occlusion of spinal collaterals, perioperative hypotension, lower limb ischemia and use of single stage repair.[1] Preservation of the collateral network plays a key role and the maintenance of the subclavian and the internal iliac artery patency is recommended whenever possible.[2–4] The inferior mesenteric artery (IMA) may play a role in reducing the risk of SCI when the pelvic circulation is compromised by an occlusive disease involving the internal iliac arteries.

Herein we describe a case of a patient affected by abdominal aortic aneurysm (AAA) and bilateral iliac obstructive disease who had previously undergone TEVAR for a thoracic descending aortic aneurysm. The surgical approach consisted in the preservation of the inferior mesenteric artery through an iliac branch device (IBD) and of the patent right internal iliac artery (IIA) through a parallel graft technique.

Case report

A 76 years old man with a history of descending thoracic aneurysm (type B Safi), pararenal aortic aneurysm (maximum outer diameter 48 mm) and chronic obstructive peripheral artery disease (PAD) was accepted to our department for an increase of the abdominal aortic sac (> 1 cm rate/year) and claudication (Rutherford III). He was also previously treated (January 2019) with a thoracic endograft (Zenith Alpha, Cook Medical, Bloomington, IN) and endarterectomy of the left common femoral artery for a thoracic descending aorta aneurysm.

He was a former smoker and had a history of hypertension, myocardial infarction with E.F. > 35% and had an angioplasty and stenting of the circumflex artery and a transcatheter aortic valve implantation (TAVI).

The last CT scan (September 2020) showed an increase of the pararenal aortic aneurysm with a maximum outer diameter of 64 mm, patency of subclavian artery, right internal iliac and inferior mesenteric arteries. Six couples of patent lumbar arteries were also identified. The IMA had a diameter greater than 5 mm. The left IIA was occluded, while the right common iliac artery (CIA) presented stenosis greater than 70% and the external iliac artery showed a long stenosis greater than 50% (Fig. 1).

A two staged endovascular procedure was planned combined with the direct revascularization of the IMA and of the right IIA to reduce the risk of spinal cord ischemia.

The first step, under general anesthesia, consisted in a bilateral surgical access of the common femoral arteries and the revascularization of the right common iliac artery with a 11 × 79 mm VBX (W.L. Gore & Associates, Inc.; Flagstaff, Arizona) stent, through the left femoral access.

Afterwards we deployed a branched COLT II device,[5–8] an inner branched stent-graft, 36 × 18 × 180 mm by Jotec® (GmbH/ Criolife; Hechingen, Germany/Kennesaw, Georgia) through the right surgical femoral access.

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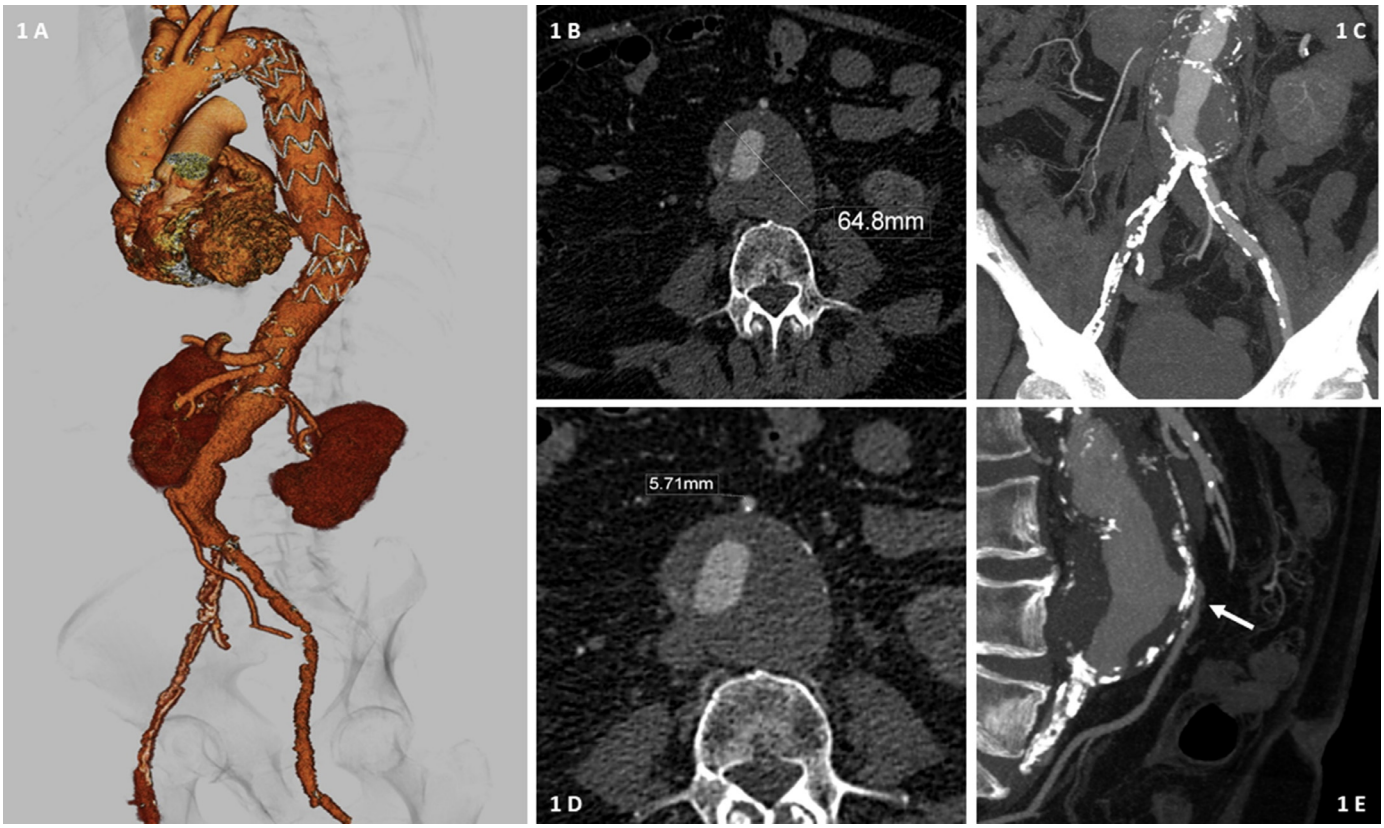

Fig. 1. A, Volume Rendering pre-operative CT scan; B, Maximum infrarenal aortic diameter; C, Right iliac axis obstruction; D, Maximum inferior mesenteric artery (IMA) diameter; E, IMA origin (white arrow).

The right iliac bifurcation was restored with a CERIB (Covered Endovascular Reconstruction of Iliac Bifurcation) technique releasing into the 11 × 79 mm VBX stent, previously deployed in the common iliac artery, a 8 × 59 mm VBX stent in the internal iliac artery (IIA) from the left side and a 8 × 59 mm in the external iliac artery (EIA) from the right.

Next, an iliac branched device (IBD) E-liac 18 × 14 × 65 mm by Jotec® (GmbH/ Criolife; Hechingen, Germany/Kennesaw, Georgia), was connected proximally to the COLT II device in order to preserve the inferior mesenteric artery (IMA). The IBD was connected distally to the aortic bifurcation by means of a double barrel technique using two 11 × 79 mm VBX stents. The revascularization of the right external iliac artery was completed deploying a 8 × 15 mm Viabahn (W.L. Gore & Associates, Inc.; Flagstaff, Arizona) stent-graft (Fig. 2).

Seven days after the first step, a percutaneous left brachial access was used to connect the visceral arteries to the graft branches. The IMA was connected to the E-liac branch (Fig. 2 B, C) using a 6 × 100 mm Covera stent (Bard Medical, Georgia, USA) secured proximally with a 8 × 57 mm E-ventus stent (Jotec/Cryolife, Kennesaw, Georgia) and relined distally with a 6 × 40 mm bare stent (Eucatech AG, Weil am Rhein, Germany). The right renal artery (RA) was connected using 6 × 80 mm Covera stent and fixed into the graft branch with a 7 × 57 mm E-ventus stent. A 6 × 80 mm Covera stent linked proximally with a 6 × 28 mm E-ventus stent was used for the left RA. The superior mesenteric artery (SMA) was attached with a 8 × 80 mm Covera stent attached proximally with a 9 × 57 mm E-ventus stent. Last, the celiac artery (CA) was connected with a 9 × 60 mm Covera stent secured proximally with a 10 × 37 mm E-ventus stent.

Five days later, the patient was discharged at home with dual antiplatelet therapy. The CT scan performed 1 year later documented complete exclusion of the abdominal aortic aneurysm patency of visceral vessel stents and absence of endoleaks (Fig. 2).

Discussion

Maintenance of pelvic circulation seems to be associated to a reduced risk of ischemic colitis, buttock claudication, erectile dysfunction and spinal cord ischemia during the treatment of extensive aorto-iliac aneurysmal disease.[9]

For what concerns SCI, the reported incidence ranges between 0% and 10% for thoracic endovascular aortic repair (TEVAR) and between 0% and 30% for endovascular TAAA repair.[10] SCI may have variable clinical presentations ranging from paraparesis or paraplegia, sensory deficits, ataxia and autonomic dysfunction.

Although it has a multifactorial etiology, infarction secondary to absolute low perfusion (loss of intercostals and poor collateral supply), reperfusion injury after transient peri-procedural low perfusion and arterial embolization arising from intra-aortic manipulation are the main predisposing factors.[11,12]

As reported in European guidelines,[2] spinal fluid drainage, mean arterial pressure above 100 mm Hg, hemoglobin above 10 g/dL, transcutaneous oxygen measurement above 95%, staged procedures are considered as possible preventive strategies. Collateral networks preservation is also recognized as a valid solution; surgical techniques available include custom-made fenestrated endoprosthesis, parallel graft techniques and branched devices.

IMA preservation during EVAR should be considered in case of celiac artery, superior mesenteric artery or bilateral IIA occlusion.[13] Moreover the SVS guidelines report that the IMA reimplantation during open surgery is beneficial in patients of advanced age and when intraoperative blood loss has been substantial.[14]

In our case, considering the extensive aortic coverage (> 200 mm) required for the endovascular procedure and the bilateral iliac-femoral obstructive disease, we chose to preserve both the only patent hypogastric artery performing a CERIB technique and the IMA using an iliac

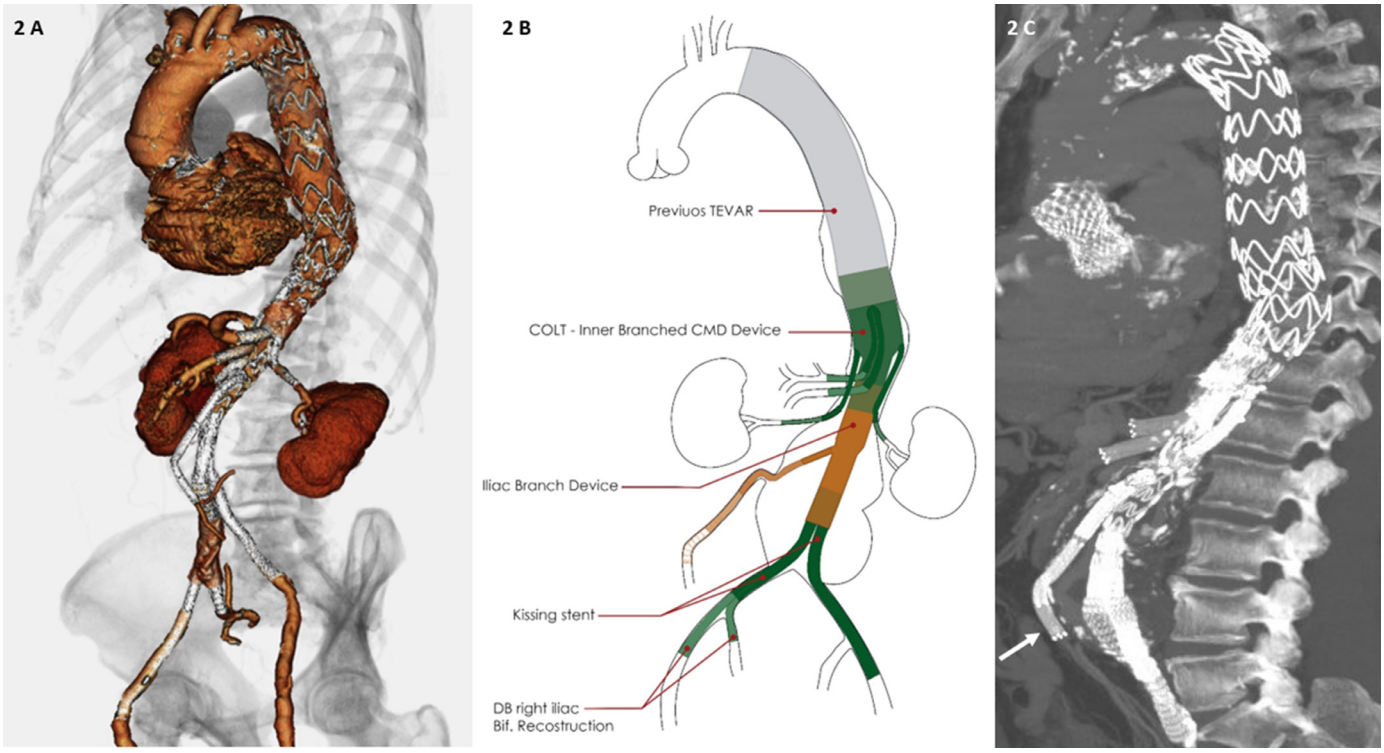

Fig. 2. A, Volume-rendering post-operative CT scan; B, Drawing of the preoperative planning, CMD, custom made device, DB, double-barrell; C, MIP reconstruction, IMA preservation (white arrow).

branch device (IBD). Moreover, the IMA had a diameter of 5 mm which meant on one side an increased risk of type II endoleak and on the other hand the importance of this artery in the collateral network. In literature limited reports[15,16] describe IMA revascularization and generally the endovascular approach performed is the parallel graft technique, an off-label approach most likely employed in urgent and emergent treatment of complex aortic pathologies. Kostiuk et al.[16] described a patient with an infrarenal AAA, internal iliac arteries compromise from prior PAD and a compensatory hypertrophic IMA (5 mm) treated through a Ch-EVAR technique. Since the patient was unfit for an IMA surgical reimplantation and considered the absence of commercial dedicated devices for IMA preservation, EVAR with IMA chimney stenting was the treatment chosen. Moreover, Ullery et al.[17] reported that a frequent criticism of the parallel graft technique is the early gutter-related type Ia endoleaks with an incidence ranging between 0% and 37,5% and a 3,3% reintervention rate. In our opinion, in this anatomical setting and because of the complexity of the endovascular procedure, the iliac branch device was the best option for the IMA preservation in the attempt to reduce the risk of SCI. The IBD represented a valid solution since it reduced the risk of gutter endoleak and provided a more stable system. The IBD was used out of label since according to the literature[18] it finds application in case of aneurismatic disease of the aorto-iliac or isolated iliac district for preservation of the internal iliac artery. Despite the current recommendations, IBD might be considered a suitable solution for the revascularization of aortic branches due to its structural characteristics. Zander et al. and Taher et al. described two clinical cases of endovascular repair of abdominal aortic aneurysms in which renal arteries were successfully preserved with the use of an iliac side branch device.[19,20]

The IBDs available are three: the Gore Excluder Iliac Branch Endoprosthesis, the Zenith Iliac branched device by Cook and the E-liac stent graft system. We chose the E-liac stent graft system because of the size compatibility with the branch device. The E-liac stent graft is designed in three different proximal and distal diameter configurations (proximal from 14 to 18 mm, distal from 10 to 14 mm) and a single length of 65 mm. The side branch diameter is 8 mm.

These features allowed us to connect safely the IBD to the branch device and link it to the aortic bifurcation with a parallel graft technique.

Conclusion

Thus, according to our experience, the IBD may be considered an alternative solution for preservation of the IMA in complex aortic endovascular procedure when a poor pelvic circulation is documented to preserve the risk of SCI and visceral ischemia.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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