SCIENTIFIC LETTER

HYBRID TREATMENT OF JUXTARENAL AORTIC ANEURYSM THE VASCULAR SURGEON AND HIS KNOWLEDGE OF THERAPEUTIC OPTIONS

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ABSTRACT

The management of juxtarenal aneurysms is challenging. In general, the indication for endovascular repair often becomes complicated due to the anatomy and unfavorable characteristics of its proximal neck or because it compromises visceral arteries. In these cases, open surgery is associated with significant morbidity and mortality especially in the immediate postoperative period. In selected patients, visceral aortic debranching can improve the proximal aneurysm neck and facilitate endovascular exclusion. We present a clinical case of aortic juxtarenal aneurysm solved using a hybrid technique, hepatorenal bypass through conventional surgery, and endovascular repair in two surgical stages.

Keywords: *Hybrid surgery, hybrid treatment, juxtarenal aneurysm, hepatorenal bypass*

Received: 03/12/2021 Accepted: 03/20/2021

CLINICAL CASE

We present the case of a 79-year-old male patient. Former smoker with high blood pressure, chronic venous failure previously treated with bilateral saphenectomy.

Also, he had chronic kidney disease, and creatinine levels of 1.4-1.9. The patient also had chronic obstructive arteriopathy, intermittent claudication of his left lower limb, and remained on medical therapy.

While on medication, a juxtarenal aortic aneurism with a maximum diameter of 68 mm was found at the 2-year outpatient follow-up.

The coronary computed tomography angiography performed revealed the presence of a 68 mm juxtarenal aneurysm in its maximum diameter. Other findings were single left kidney, stenosis due to calcium deposits originated at renal artery level, a 9 mm infrarenal aortic neck due to a circumferential annular calcification. The length of the superior mesenteric artery until the left renal artery was 18 mm. Also, presence of left iliac artery occlusion.

After considering the options available, a hybrid approach was decided: hepatorenal bypass via laparotomy (Dacron® given the lack of venous capital). The renal arterial stenosis is solved with a modified neck as the anchor site at the origin of the SMA. The aortic stenosis was treated with CP stent implantation for a correct delivery and positioning of the device. A PTFE graft (expanded polytetrafluoroethylene) was implanted through femorofemoral crossing bypass surgery in a two-stage surgical approach.

During the first-stage surgical approach, a hepatorenal bypass via transperitoneal access was performed (in the supraumbilical region) followed by common hepatic artery dissection through the pars flaccida of the lesser omentum. The 10 mm Dacron graft was tunneled through the retro-duodenal portion until the renal access. No complications were reported.

The patient remained hemodynamically stable at the intensive care unit for 48 hours without ventilatory support with serum creatinine levels of 1.2 mg/dL, and preserved diuresis.

Given the patient's respiratory status while in his home, he was readmitted to undergo the second-stage surgical approach. A 28 mm x 14 mm x 102 mm Endurant® AUI stent graft system was implanted via right side before the angioplasty of the CIA lesion at superior mesenteric artery ostium level followed by the ipsilateral implantation of a 16 mm x 13 mm x 156 mm Endurant® stent graft close to the iliac bifurcation. Afterwards, a 28 mm Numed® CP stent mounted on a BIB balloon was advanced.

The patient improved without complications and was discharged from the hospital after 72 hours.

In our case, open surgery was ruled out due to the magnitude of the surgery and presence of a fenestrated device. Although the aortic diameter at proximal anchorage level was between 22 mm and 23 mm, the presence of a 9 mm infrarenal stenotic annular calcification and right iliac artery occlusion complicated the technique even more. In addition, the long-term patency of the renal branch was dubious. Similarly, the chimney graft technique was not proposed given the aforementioned anatomy, the origin of the renal artery perpendicular to the aorta, its severe calcific aortic stenosis, and high risk of disruption between the endovascular prosthesis and the renal stent, which could jeopardize the long-term patency of the chimney.

DISCUSSION

Conventional surgery of juxtarenal aneurysms often requires suprarenal or supraceliac aortic clamping, which is associated with a higher mortality and morbidity and due to visceral ischemia. The rate of renal failure increases significantly after conventional surgery both in juxtarenal and type

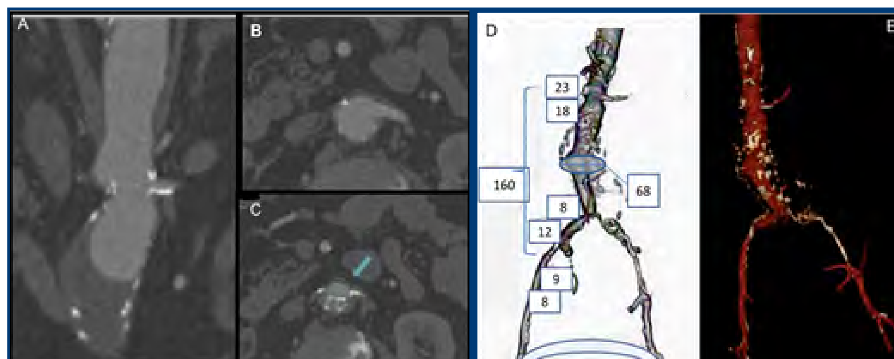

FIGURE 1-A. Preoperative coronary computed tomography angiography. Juxtarenal aneurysm (sagittal projection) without infrarenal neck. **1-B.** Left renal artery. **1-C.** Presence of a 9 mm infrarenal stenotic annular calcification (arrow). **1-D.** Surgical plan. Measures in mm. Presence of a 68 mm maximum aortic diameter. Segment to be covered of 160 mm. 23 mm aortic diameter at superior mesenteric artery (SMA) level. Proximal anchorage neck at inferior mesenteric artery (IMA) level of 18 mm in length. Presence of an 8 mm stenosis at right common iliac artery (CIA) level. Femorofemoral crossing bypass surgery for PTFE graft implantation. **1-E.** 3D reconstruction of the case.

IV thoracoabdominal aneurysms. Also, significant hematic losses have been reported as well as longer stays at the intensive care unit[1].

Surgical planning and taking into consideration the exclusion criteria of the simple techniques to perform endovascular repairs paved the way for complex alternative techniques.

Given the anatomical limitations of the proximal neck, endovascular repair is only possible if the proximal release and implantation site changes.

It can be achieved through endovascular approach by placing fenestrated devices, expanding the proximal seal zone, and keeping visceral arteries patent through the fenestra created with the stents. Modules can be accessed via bilateral femoral and iliac access. Also, there needs to be enough arterial lumen to be able to insert a 20-Fr to 22-Fr introducer sheath, lack of excessive angulations with calcium, and sealing zone external diameters > 19 mm and < 32 mm[2,8].

The chimney graft technique, used in visceral or supra-aortic branches, was introduced to handle conventional endoprostheses and treat lesions with difficult proximal or distal anchorage sites[8]. However, it is ill-advised in the presence of calcific stenosis of some aortic segment like at the origin of target vessels. Complications like apposition defects of the endoprosthesis on the aortic wall (fabric wrinkling and proximal stents) have been reported. Also, dissections due to false routes or residual stenoses due to incorrect visceral stent release[3].

CP stent implantation —a metal balloon-expandable stent with high radial strength— is a bail-out technique to treat aortic stenosis and hostile necks. Its release prevents stent graft infolding and allows a correct coaptation between the aortic wall and the device. It is used to treat aortic stenoses and for the correct delivery of the stent in cases of aortic stenosis[6].

Regardless of technology and costs involved, “hybrid surgery” is the solution in complex situations and extends the applicability of the existing endovascular technology[4], an option for patient who, due to associated morbidities, are at high risk of undergoing conventional surgery[7].

It avoids thoraco-phreno-laparotomy, monopulmonary ventilation, prolonged visceral ischemia, and aortic clamping. It reduces the time on intensive therapy and the short and mid-term morbidity and mortality.

Direct visceral surgery requires training and is associated with a short and controlled ischemia time. These procedures have proven satisfactory for the management of occlusive disease, and for the revascularization of renal mesenteric and celiac arteries[6].

Treatment can be performed in 1 or 2 surgical acts, being the patency of visceral reconstruction and endovascular exclusion both satisfactory. The drawback of the two-staged surgical approach is the risk of ruptured aneurysm in between procedures. However, the advantage of the one-staged procedure is the immediate control of the integrity and patency of the system[1,4,5].

We should mention that the hybrid approach can only be performed by trained vascular surgeons experienced in the use of all possible therapeutic options. Similarly, the indications of the manufacturer regarding endovascular surgery should be observed for the safety of the patients. Nonetheless, the training of young surgeons in conventional surgeries of the aorta and its branches is a matter of concern; alternative training methods, whether simulated methods or cadaver-based surgeries should be provided; still, these methods are not the topic of discussion of this article.

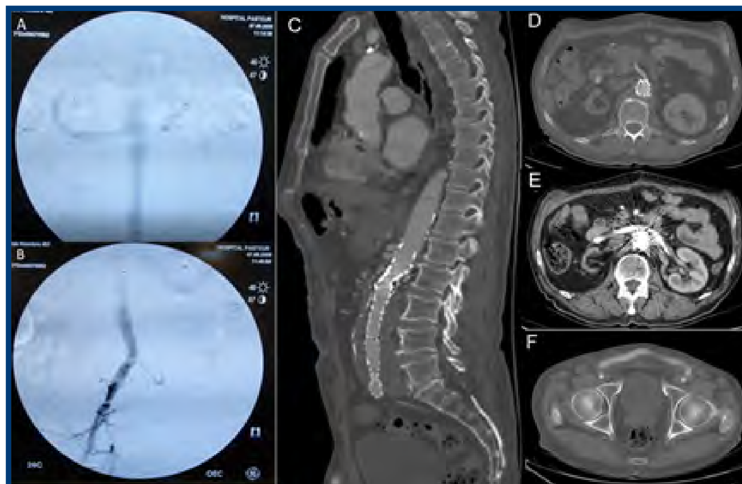

FIGURE 2-A. Patent hepatorenal bypass. **2-B.** Lack of endoleaks and patency of devices implanted. **2-C.** 7-day follow-up coronary computed tomography angiography (sagittal projection): correct device apposition, aneurysmatic sac thrombosis, patency of modules, lack of endoleaks. **2-D.** Proximal neck anchoring at the beginning of the patent superior mesenteric artery. **2-E.** Patent hepatorenal bypass, metal artifact due to endovascular devices. **2-F.** PTFE graft implanted through femorofemoral crossing bypass surgery.

CONCLUSIONS

Hybrid surgery offers the possibility of treating this type of aneurysms successfully without aortic clamping, extracorporeal circulation or thoracotomy. At the same time, the duration of visceral ischemia is reduced.

Although no study has confirmed yet that that it can reduce postoperative morbidity and mortality significantly compared to traditional open surgery, these theoretical advantages make it a non-negligible option in frail patients.

Results depend on the meticulous previous surgical planning, knowledge of access routes to visceral arteries, the transposition techniques available, and the correct outcome of the endovascular stage.

Peripheral vascular surgery dominates all the options known to this date for the management of this entity bringing safety and good results to the patients.

Vascular surgery training programs should guarantee that these skills are kept and nurtured.

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