Video-atlas of hybrid thoracoabdominal aortic aneurysm repair

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Although open surgical repair of thoracoabdominal aortic aneurysm (TAAA) has evolved significantly over the last few decades, technical challenges and current morbidity and mortality of the inclusion technique are still significant, particularly in patients with extensive aneurysms or prior aortic surgery and in poor surgical candidates. Hybrid TAAA repair is an appealing technique and may represent a "bridge" solution as we wait for larger series and reproducible results from the evolving experience with total endovascular TAAA repair with fenestrated and branched endografts.

Key Words: Thoracoabdominal aortic aneurysm (TAAA); extensive aneurysms; total endovascular TAAA repair

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Introduction

Conventional open surgical treatment of thoracoabdominal aortic aneurysm (TAAA) over the past decades has been the inclusion technique. This challenging procedure has substantially evolved over the years, particularly in organ protection strategies, enabling experienced surgical centers to have much lower mortality and morbidity rates than previously reported.

A limited number of patients, however, are poor candidates to open surgical repair due to the presence of severe respiratory and cardiac failure or previous thoracic surgery.

Operative technique

We present a case of a large type III thoracoabdominal aneurysm in a 72-year-old gentleman. He was unfit for open surgery due to severe chronic obstructive pulmonary disease (FEV1 <1.09 liters) and previous right lobectomy, in addition to a history of coronary artery disease and myocardial infarction (left ventricular ejection fraction of 30% with mild mitral valve incompetence) (*video 1*).

Preoperative computed tomography (CT) scan shows the aneurysm that involves the thoracoabdominal aorta. An infrarenal aortic neck was recognized.

A staged hybrid intervention was then planned.

In the first step, the patient underwent open surgical repair of the abdominal aortic aneurysm with rerouting of the visceral arteries.

Through a median laparotomy and a transperitoneal access, the infrarenal aorta was prepared.

Both renal arteries and the superior mesenteric artery (SMA) were isolated at their origin after mobilizing the left renal vein.

To access the celiac trunk, the lesser omentum was opened. The celiac trunk was isolated at its origin and ligated to prevent a type II endoleak. An end-to-end anastomosis was performed. After systemic heparinization (50 UI/kg of body weight), the infrarenal aorta and iliac arteries were clamped. The aneurysm sac was opened and thrombus was removed.

A customized graft with four branches was prepared on the bench, tailored to the patient's anatomy.

Proximal anastomosis was performed as close as possible to the renal arteries to get enough aortic graft as a distal landing zone for the 'future' thoracic aortic stent graft.

The distal anastomosis was then performed in a routine

fashion.

Following aortic revascularization, visceral arterial re-routing was started with the most difficult vessel to access.

In this case, the left renal artery was clipped at the origin and the kidney perfused with a rapid infusion of cold crystalloid solution. An end-to-end anastomosis was then performed and the kidney was reperfused.

Using the same procedure, the right kidney was then detached from the aorta and re-anastomosed to another side branch of the graft.

About 3 cm of the SMA from its origin from the aorta was isolated and mobilized. The artery was then cut close to the aorta and reattached to the graft. The risk of mesenteric ischemia during this step is usually very low, thanks to a well developed collateral network.

The superior branch to the celiac trunk is tunneled via a retro-pancreatic route. In this case, after ligating the celiac trunk at the origin, an end-to-end anastomosis was performed.

The use of radiopaque markers may improve the accuracy of the distal stent graft deployment.

In the second stage, a CT scan was obtained to check the adequate patency of the visceral vessels and to plan the stent graft implantation.

Spinal cord drainage was inserted preoperatively and the pressure kept below 10 cmH_2O during the procedure and for three postoperative days. Careful invasive arterial pressure monitoring was performed during and after the procedure in order to maintain the mean arterial pressure above 75 mmHg; the use of hypotensive drugs was avoided during and after the procedure. The patient was intubated and intraoperative use of transesophageal echocardigram (TEE) was a useful adjunct to monitor the cardiac status during the procedure and confirm the adequate exclusion of the aneurysm in the thoracic aorta.

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An initial arteriography was done to visualize the proximal and distal necks. Patency of the branches to the visceral vessels was again checked.

In this case, two commercially available stent grafts (Bolton Medical, Barcelona, Spain, the first cylindrical 46 mm × 150 mm, the second and distal conical 42 mm × 38 mm × 200 mm) were inserted through a surgical femoral access with direct puncture of the artery without adjunctive conduits and deployed under fluoroscopy and TEE guidance.

Completion angiogram was obtained to show accurate and effective deployment of the stent grafts, which was later confirmed by postoperative a CT scan.

Comments

Based on our series of selected high-risk patients, many concerns such as the long-term durability of endograft materials, outcomes of visceral bypasses, and the fate of the excluded TAAA, still remain unsolved. Larger study cohorts with longer follow up are needed to make statistically meaningful comparisons with standard open surgery and account for all the biases related to the learning curve, continuous technical progress and materials improvements typical of the evolving nature of hybrid TAAA repair.

Currently, standard open surgery through the inclusion technique in high-volume centres is the gold standard for TAAA treatment. Hybrid repair should still be reserved as an alternative to simple observation in patients unfit for the inclusion technique.

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