Masters of Cardiothoracic Surgery

Open thoracoabdominal surgery after frozen elephant trunk

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Keywords: Thoracoabdominal aortic aneurysm (TAAA); frozen elephant trunk (FET); second stage; chronic dissection; Marfan syndrome

Submitted Aug 26, 2025. Accepted for publication Sep 08, 2025. Published online Sep 25, 2025.
doi: 10.21037/acs-2025-evet-20
View this article at: https://dx.doi.org/10.21037/acs-2025-evet-20

Clinical vignette

A 31-year-old male patient with Marfan syndrome (197 cm, 85 kg, body mass index 21.9 kg/m^2, body surface area 2.16 m^2) presented with a progressively enlarging thoracoabdominal aortic aneurysm (TAAA) based on a chronic aortic dissection, Stanford Type A, DeBakey I. He had already undergone aortic root remodelling (Yacoub), ascending aorta and proximal aortic arch repair for acute aortic dissection (AADA) at the age of 23 years in an external hospital. Marfan syndrome was diagnosed shortly after. Over the course of 7.5 years, the patient had developed a significant aortic regurgitation, aortic arch aneurysm, and TAAA down to the aortic bifurcation. He had undergone redo aortic root replacement with a mechanical valved conduit (On-X aortic valve 23 mm, CryoLife, Atlanta, GA, USA; Gelweave 30 mm, Terumo Aortic, Inchinnan, Scotland, UK) and a complete aortic arch replacement with frozen elephant trunk (FET; Terumo Aortic Thoraflex 100 mm/40 mm). The postoperative course was uneventful; 4.5 months after FET implantation he developed new-onset chest pain. Computed tomography angiography (CTA) showed an increasing diameter of the TAAA (maximum of 60 mm of the descending and abdominal aorta) and a contained rupture at the level of the distal portion of the FET stent graft. Urgent open surgical repair was indicated.

Surgical technique

Preparation

After normalising international normalized ratio (INR) and bridging the patient with heparin, a cerebrospinal fluid (CSF) drain was placed the day prior to surgery. The patient was intubated using a double lumen tube. Subsequently, the patient was placed in a modified lateral decubitus position on a vacuum mattress with the chest turned right and the pelvis rotated counter clockwise to allow femoral vessels access for extracorporeal circulation (ECC, femoro-femoral bypass).

Exposure

For the open Crawford II TAAA repair, two thoracotomies were performed via the 5th and 7th intercostal spaces. The costal margin was transected and a left pararectal abdominal incision performed, followed by retroperitoneal dissection. The diaphragm was transected with a distance of 2–3 cm to the chest wall. The aorta was exposed from the distal aortic arch to the bifurcation. Clamp sites for staged clamping were prepared.

Operation

After heparinization, ECC was initiated via the left femoral vessels and the patient cooled to 32 ℃. A branched, collared aortic graft (Gelweave 'Siena' 4 branch Plexus graft, 28 mm; Terumo Aortic) was divided into a collared portion for proximal repair and a branched, non-collared portion for distal abdominal repair. To accommodate the FET stent graft diameter of 40 mm, the collar was trimmed accordingly. The aorta was clamped near the proximal level of the FET stent graft and distal to the FET graft.

The aorta was opened, and the FET graft exposed. Back-bleeding intercostal arteries (ICAs) of the proximal descending aorta were closed. The collared portion of the 'Siena' graft was anastomosed to the FET stent graft. The aortic wall was used as reinforcement. Thereafter, the proximal aortic clamp was placed distally and meticulous hemostasis at the proximal anastomosis ensued. After repositioning of the distal aortic clamp, three large ICAs (T7-9) were blocked with Fogarty catheters (Edwards Lifesciences, Irvine, CA, USA) and reimplanted into the aortic graft using the island technique. Thereafter, distal perfusion was stopped, and the abdominal aorta was opened from the diaphragm to the aortic bifurcation. Perfusion catheters were placed into the celiac trunk (CT), superior mesenteric artery (SMA), and both right and left renal arteries (rRA + lRA). Large lumbar arteries were closed. The length of the branched portion of the 'Siena' graft was adjusted and anastomosed to the aortic bifurcation. Distal perfusion was restarted, the graft deaired and clamped. The proximal and distal graft portions were shortened and anastomosed. The aortic grafts were declamped to facilitate length estimation for visceral branches. Visceral arteries were re-anastomosed to the four plexus branches (sequence: rRA, SMA, CT, lRA). Finally, a large additional ICA at the level of the diaphragm was additionally reimplanted using a separate perfusion graft.

Completion

After rewarming, weaning from ECC and hemostasis, the aortic graft was covered with bovine pericardium and the chest/abdomen closed.

Discussion

Clinical results

We have achieved good clinical results using the FET technique as a platform for endovascular as well as open completion operations of multilevel aortic pathologies (1,2). We first presented our 'Siena' technique for FET extensions at the Techno College of the 31st EACTS annual meeting in Vienna in October 2017. Since then, it has become our universal method for open distal repair after FET or TEVAR. The prosthesis collar dramatically facilitates the size adjustment between endovascular grafts and the distal aortic graft. Other groups have described a similar approach with the 'Siena' graft (3,4). However, for long distances between the collared anastomosis and the visceral arteries we suggest to use our two-portion 'Siena' technique described here (i.e., reconfiguring the 'Siena' graft into a proximal collared and distal non-collared portion) to reduce the length of visceral branches.

Open completion operations may be performed in two stages, as shown here, or in three stages after a second-stage TEVAR extension. The latter can further reduce surgical invasiveness but does not allow reimplantation of ICAs. In addition, proximal ICAs cannot be surgically closed and might result in Type II endoleaks. Especially in Marfan patients, open TAAA repair remains an important cornerstone of aortic treatment with excellent early and sustainable long-term clinical results (5).

Acknowledgments

We thank Anna Junge (https://www.medjunge.com) for videotaping and Daniela Martens (https://grafikdesign-martens.de) for video editing and inlay illustrations.

Footnote

Funding: None.

Conflicts of Interest: The authors have no conflicts of interest to declare.

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Cite this article as: Martens A, Beckmann E, Shrestha M. Open thoracoabdominal surgery after frozen elephant trunk. Ann Cardiothorac Surg 2025;14(5):392-394. doi: 10.21037/acs-2025-evet-20