



Staged treatment of mega aortic syndrome using the frozen elephant trunk and hybrid thoracoabdominal repair

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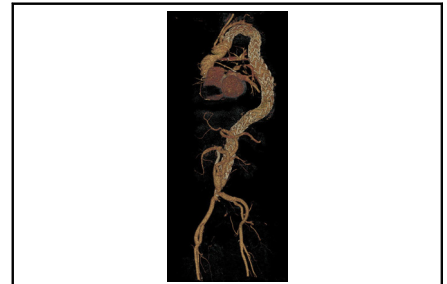
ABSTRACT

Objective: We report our experience with a staged hybrid approach for the treatment of extended aortic disease, also known as “mega aortic syndrome.”

Methods: A total of 15 patients (10 male, 5 female) underwent staged repair of the thoracoabdominal aorta, consisting of 3 separate stages (repair of ascending aorta and aortic arch using the frozen elephant trunk technique and hybrid thoracoabdominal repair with debranching of the renovisceral branches and stent graft implantation).

Results: The procedure was completed in 14 patients. After the first stage (repair of ascending aorta and aortic arch), no mortality or spinal cord ischemia occurred. One patient required temporary dialysis. After the thoracoabdominal repair, permanent paraplegia developed in 1 patient. One patient died intraoperatively after aneurysm rupture. The in-hospital mortality for the complete repair reached 6.7%. None of the surviving patients required permanent dialysis. Interval aortic events consisted of 1 contained rupture.

Conclusions: The concept of a staged hybrid repair of the mega aortic syndrome is technically feasible. The frozen elephant trunk technique represents an attractive treatment option, offering an adequate landing zone for later thoracoabdominal repair in patients with extended aortic disease. For completion of the repair, a staged hybrid approach with renovisceral debranching and aneurysm exclusion using off-the-shelf stent grafts shows promising results with low surgical morbidity and mortality. (*J Thorac Cardiovasc Surg* 2017;154:1842-9)



Postoperative computed tomography scan with 3-dimensional reconstruction after completion of the hybrid procedure, depicting patent bypass grafts after debranching and complete exclusion of the aneurysmatic aorta.

Central Message

A multistaged approach (FET and hybrid thoracoabdominal repair) in the treatment of extensive aortic disease is technically feasible and shows promising results with acceptable mortality and morbidity.

Perspective

Mega aortic syndrome is a challenging clinical entity for both the patient and the surgical team. Data regarding treatment options for such pathologies are limited. We present our concept of a multistaged approach using both open and endovascular techniques for the different operation stages, describing an alternative treatment option with promising results for this challenging pathology.

See Editorial Commentary page 1850.

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The aneurysmatic dilatation of the whole aorta, involving the ascending aorta, the aortic arch, and the descending and abdominal aorta, may it be of degenerative origin or a



Scanning this QR code will take you to a supplemental video for the article.



Abbreviation and Acronym

FET = frozen elephant trunk

consequence of aortic dissection and also known as “mega aortic syndrome,” is a relatively rare entity and requires extensive repair procedures. Open surgical treatment is currently the standard treatment, and although adjunctive measures have reduced mortality and morbidity, both remain significant. Endovascular techniques for treating extended aortic aneurysms are rapidly evolving; a total endovascular approach in this case is nevertheless still not feasible, given the lack of specific devices to treat all vital branches, as well as individual anatomic limitations and various configurations of the aneurysmatic aorta. Hybrid procedures have been introduced to minimize surgical trauma by creating adequate landing zones for endovascular repair using off-the-shelf stent grafts.¹ Furthermore, studies have indicated that staging the aortic repair attenuates surgical trauma and seems to reduce morbidity,^{2,3} although aneurysm-related interval mortality³ and patient compliance to undergo the latter stages⁴ remain important issues. Our concept consists of open repair of the ascending aorta and the aortic arch using the frozen elephant trunk (FET) technique⁵ and completion with a staged hybrid repair of the thoracoabdominal aorta.⁶ We present our patient cohort to assess the outcome in terms of technique feasibility and safety.

PATIENTS AND METHODS**Data Collection**

Patients were included in a registry with prospective collected data. After completion of the procedure, frequent follow-up was performed at 1, 3, 6, and 12 months by means of clinical examination, ultrasound, and computed tomography scans. Annual follow-up was performed thereafter. Approval from the ethics committee was obtained, and patients signed a written informed consent preoperatively.

Surgical Technique

The open repair of the ascending aorta and the aortic arch is performed through a median sternotomy (partial or total) using circulatory arrest. The procedure is carried out under mild hypothermia with selective antegrade cerebral perfusion. Arterial and venous cannulation is preferably achieved via the right subclavian artery and the right atrium, respectively, and cardiopulmonary bypass is established. The patient is cooled and the aorta is cross-clamped. Antegrade or retrograde blood cardioplegia is applied. The patient is placed in the Trendelenburg position, the aorta is then transected, and brain perfusion is initiated. Backflow is controlled after inserting Fogarty catheters or clamping. In selected patients, cannulation of the left carotid artery also can be performed. Transection of the aortic arch is continued, and the supra-aortic vessels are dissected as an island patch. The stented part of a hybrid graft is then deployed in the descending aorta over a stiff guidewire, which is introduced in an antegrade fashion or using a through-and-through technique via the common femoral artery. The hybrid graft is then anastomosed to the proximal descending aorta using a pledgeted continuous, nonabsorbable suture. The proximal part of the hybrid graft (“not stented”) is then unfolded, and after excision of a corresponding segment on the cranial surface, a patch anastomosis with the arch vessels is carried out, using a pledgeted continuous, nonabsorbable suture. The reconstruction is de-aired,

the graft is clamped proximally, and perfusion is reestablished. The proximal anastomosis with the native ascending aorta or preexisting grafts is completed while the patient is being warmed (Figure 1). After de-airing, the aortic clamp is removed and additional adjunct procedures are carried out if necessary (ie, aortocoronary bypass or valve reconstruction). Decannulation is then performed, and the procedure is completed (Figure 2).

We have previously described the hybrid procedure for thoracoabdominal repair.⁶ Through a median laparotomy and a transabdominal approach, the abdominal aorta and the origins of the celiac trunk, the superior mesenteric, and the renal arteries are exposed. In cases with extended aneurysmatic dilation reaching the aortic bifurcation or even further, an infrarenal repair with a tube or bifurcated graft is carried out to provide an adequate landing zone and facilitate debranching. Grafts originating from the infrarenal aorta, the iliac arteries, or the aortic graft are then anastomosed to the renovisceral arteries (Video 1). Alternatively, hybrid grafts are used to avoid complete dissection of the target vessels and reduce anastomosis and thus ischemia time. The origins of the renovisceral vessels are then ligated, and the operation is completed (Figure 3).

Stent grafts are introduced during a third stage via the common femoral artery, which is surgically dissected or over an iliac conduit after retroperitoneal exposure to achieve exclusion of the aneurysm (Figure 4). A through-and-through guidewire technique is sometimes used to facilitate stent graft deployment and reduce procedure-related complications. Radiopaque markers placed intraoperatively allow for optimal identification of the distal landing zone. A spinal drainage is placed to monitor spinal fluid pressure.

RESULTS**Demographic Data and Comorbidity**

From 2007 to 2016, 15 patients were identified, of whom 10 (66.7%) were male and 5 (33.3%) were female. Six

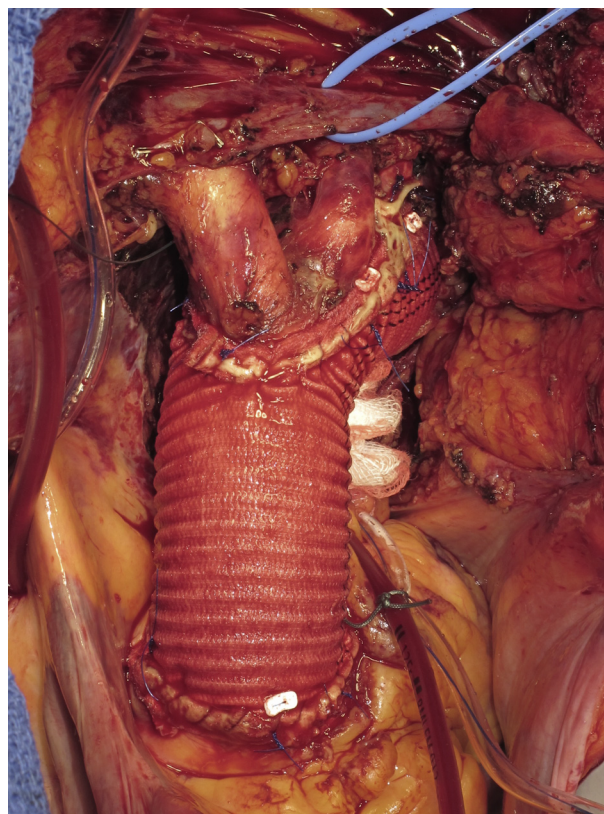


FIGURE 1. Intraoperative situs after repair of the ascending aorta and aortic arch.

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