



# Aortic valve sparing and hybrid arch frozen elephant trunk repair for mega-aortic syndrome

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## Clinical vignette

A 69-year-old female presented with increasing shortness of breath (NYHA class II) and was previously followed for aneurysmal dilatation of her thoraco-abdominal aorta with a chronic type B aortic dissection. Repeat computed tomography (CT) demonstrated severe dilatation of her ascending aorta, aortic arch, descending aorta, and thoraco-abdominal aorta with the chronic type B aortic dissection extending from the proximal descending thoracic aorta to the renal arteries. Pre-operative transthoracic echocardiography revealed moderate central aortic insufficiency with a dilated aortic root and ascending aorta. Other past medical history included an ongoing 50-pack-year smoking history, chronic obstructive pulmonary disease, and remote cholecystectomy.

We performed a pre-operative left carotid-subclavian bypass before aortic arch reconstruction, in order to facilitate more proximal arch anastomosis and shorten circulatory arrest times (1). The patient was subsequently brought to the hybrid operating room, where we describe the hybrid arch frozen elephant trunk reconstruction performed with aortic valve-sparing operation using the re-implantation technique.

## Surgical techniques

### Preparation and cannulation

Cardiopulmonary bypass was achieved with right axillary artery cannulation with an 8 mm Dacron graft and central venous cannulation with a target cooling temperature of

25 °C. Using ultrasound guidance, a 6-French sheath was placed in the right common femoral artery. A guidewire and Judkin's Right-4 catheter were advanced up into the aortic arch under transesophageal echocardiographic visualization, taking care to remain in the true lumen of the aorta.

### Aortic exposure and cross-clamp

The aortic root, ascending aorta and aortic arch were skeletonized, gently isolating the innominate and carotid vessels. The aortic cross clamp was carefully applied and transverse aortotomy was made, allowing for ostial delivery of cold Del-Nido cardioplegia. The valve was then examined, revealing pliable cusps along with a dilated and thinned aortic wall. As such, we scalloped out all three sinuses and created the left main and right main coronary buttons.

### Creation of coronary buttons and proximal aortic anastomosis for the valve-sparing root re-implantation

Three full-thickness 4-0 plegetted polypropylene traction sutures were used to elevate the commissures. A subannular row of nine non-plegetted, 2-0 Ethibond sutures was passed from inside to outside the left ventricular outflow tract (LVOT), starting from the non-coronary cusp and moving clockwise. The 2-0 Ethibond sutures were then passed through the base of a 28 mm straight Dacron ring-graft, and the graft was lowered into place. We then tacked up all three commissures at 120° from each other as high up in the sinuses as possible. We sewed the hemostatic layer by

running 4-0 polypropylene sutures from the nadir of each of the sinuses all the way up to the top of the commissures.

### Circulatory arrest and aortic resection

We initiated circulatory arrest at 25 °C by decreasing flows to 2 L/min through the right axillary artery, and placed clamps at the base of the innominate and carotid arteries. We resected the involved ascending aorta and proximal arch.

### Distal aortic anastomosis and Thoraflex graft deployment

We placed 2-0 Ethibond sutures radially around the aortic circumference in zone 2, just distal to the origin of the left common carotid artery. We passed an Amplatz-extrastiff wire through the previously placed JR4 diagnostic catheter into the mediastinum, in order to gain through-and-through access. Subsequently, we selected a 28×30×100 mm Thoraflex hybrid-graft and using a body-floss technique for stabilization, we passed the Thoraflex along the guidewire through the zone 2 arch, deep into the descending aorta, and deployed it. Next, we passed the circumferential Ethibond sutures through the sewing collar of the Thoraflex graft and tied them down. We ran a second layer of 2-0 Prolene for secured hemostasis. A cross-clamp was placed in the body of the Thoraflex, between the perfusion-limb and carotid-limb, to enable early lower-body reperfusion through the Thoraflex side-limb at 30 °C. We constructed the carotid-limb directly to the left common carotid artery using a running 6-0 Prolene suture, and the clamp was moved proximally in the arch graft to allow antegrade bilateral cerebral flow.

### Coronary re-implantation, arch and epiaortic vessel completion

We re-implanted the coronary buttons and anastomosed the aortic valve-sparing graft to the arch graft with a 5-0 Prolene. The reperfusate was administered and the cross-clamp was removed. We then completed the head vessel reconstruction by anastomosing the innominate-limb to the innominate artery.

### Weaning from cardiopulmonary bypass

We weaned the patient from cardiopulmonary bypass without

ionotropic support, and the right axillary and Thoraflex perfusion side-limb grafts were transected.

### Post-operative outcome

Post-operative transesophageal echocardiogram and CT demonstrated excellent aortic valve function with no aortic insufficiency, no gradient across the valve, and preserved biventricular function. The frozen elephant trunk (FET) was well-seated in the descending aorta.

### Comment

The hybrid arch FET technique continues to experience increasing adoption, as it simplifies arch reconstruction with more proximal anastomosis, along with more extensive treatment using the distal hybrid endograft. Results from our group and others support the use of the FET to facilitate single-stage operations in anatomically suitable patients, more effective distal endovascular reconstruction, elimination of proximal 1A endoleaks, and in the promotion of true lumen expansion and false lumen collapse in aortic dissection (2). The multibranch Thoraflex hybrid graft can also simplify head-vessel branch reconstruction while shortening circulatory arrest and overall operative times.

When performing extensive arch reconstruction, there is a common tendency to seek the most expeditious and simplified concomitant procedures required, especially at the aortic root. Aortic valve-sparing root replacement is a robust and well-proven technique, used to manage patients with aortic root aneurysms and favorable aortic cusp morphology (3). Patients with mega-aortic syndrome frequently have dilated aortic roots with pliable cusps and thus, would be well-suited to an aortic valve-sparing operation to avoid the complications associated with prosthetic valves (4). A recent study by the International-Aortic-Arch-Surgery-Study-Group specifically found that adding an aortic root procedure to elective arch surgery does not increase post-operative morbidity or mortality (5). We believe that the addition of an aortic valve-sparing root replacement for the management of an aortic root aneurysm during a hybrid FET repair procedure confers the benefits of preserving the native valve, whilst also preventing an increase in the risk of morbidity and mortality associated with the procedure in high-volume, experienced aortic centres.

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None.

## Footnote

*Conflicts of Interest:* MWA Chu has received speaker's honorarium from Medtronic, Edwards Lifesciences, LivaNova, Terumo Aortic, Abbott Vascular and Boston Scientific. The other authors have no conflicts of interest to declare.

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