



Normothermic frozen elephant trunk surgery without circulatory arrest: how we do it in Ancona

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Introduction

Over the last decade, thanks to important advances in surgical techniques and methods of end-organ protection, clinical results after frozen elephant trunk (FET) surgery have progressively improved. However, prolonged extracorporeal circulation (ECC) time and hypothermic circulatory arrest (HCA) continue to affect patients' clinical outcomes (1). Here we present a modified FET technique that, by avoiding HCA, aims at further improving clinical results.

Clinical vignette

The patient was an 81 years old male with a 6 cm aortic arch aneurysm extending to the origin of the left subclavian artery. The ascending and descending aorta were slightly dilated; preoperative risk factors included smoking history and renal insufficiency with creatinine of 1.4 mg/dL.

Surgical technique

The aorta and the heart were exposed through a median sternotomy and the anonymous vein and arch vessels extensively isolated. The proximal landing zone at the offspring of the left subclavian artery (zone 2) was marked with multiple large hemoclips. After systemic heparinization the innominate artery (IA) and the right femoral artery were cannulated for ECC arterial inflow.

Following this, surgical left femoral access was obtained; under controlled hypotension, supported by an extra-stiff Back-up Meier guidewire (Boston Scientific, USA),

a 34×34×90 mm³ Valiant Navion Evo[®] without freeflo (Medtronic, USA) endograft was deployed with the proximal landing zone on the hemoclip markers. Using a 11 FR introducer, a Reliant balloon (Medtronic, USA) was retrogradely advanced into the stent graft and, under fluoroscopy, inflated to simulate aortic clamping.

The right atrium was cannulated with a two-stage cannula, a left vent was placed and normothermic ECC was initiated. The left subclavian artery was ligated at the origin and anastomosed distally to an 8 mm graft. The latter was perfused separately with a flow adjusted to equilibrate the left and right radial artery pressures. The aorta was clamped and cardioplegic arrest obtained with cardioplegia delivered through an aortic needle. The left carotid artery was ligated at the origin and distally cannulated and perfused for antegrade selective cerebral perfusion (ASCP). The IA was gently clamped and the aortic balloon inflated keeping the lower body perfused from the femoral artery. The clamp was removed from the ascending aorta and, with a bloodless operative field, the proximal aorta was resected from the sinotubular junction to the endoprosthesis. A 30 mm 4-branched vascular graft was anastomosed to the distal aorta with bites internally taking the endograft and externally reinforced by a Teflon felt. The arch graft was clamped and the aortic balloon deflated. After the proximal anastomosis between the graft and the aortic root was performed to reperfuse the heart, the three arch vessels were anastomosed to the three branches of the graft to complete the aortic reconstruction. ECC was weaned off without inotropic support and the chest was closed as standard. Cardiopulmonary bypass (CPB) and cross clamp times were

120 and 56 minutes respectively. The patient was extubated after four hours without neurological complications and total blood loss within the initial 24 hours was 350 cc. The patient was transferred to the ward the following morning and uneventfully discharged on post operative day (POD) 6.

Comment

Over the last decade, the development of better anesthesiologic and surgical strategies have allowed FET surgery to improve its outcomes and increase its popularity. Nevertheless, FET interventions continue to carry a significant mortality and morbidity that are mostly related to prolonged ECC times and HCA (2).

In our institution the proficient collaboration between cardiac and vascular surgeons has allowed the initial development of a FET technique that contemplates normothermic ECC and avoids HCA. Such approach involves (I) a combined femoral and IA cannulation for ECC arterial return that allows continuous upper and lower body perfusion, (II) ASCP with total brain perfusion, (III) a retrograde trans-femoral stent graft deployment and (IV) its occlusion with a balloon following the same route. Different from other previously reported techniques (3), our approach completely avoids circulatory arrest and allows a normothermic ECC conduction while providing a perfectly bloodless and maneuverable operative field, as the balloon is retrogradely (and not antegrade) advanced into the stent graft for aortic clamping. While all arch aneurysms confined to the proximal descending thoracic aorta could be treated with our technique, patients with acute or chronic dissection would not be ideal candidates for inadequate stent graft sealing or potential aortic injury during endoclamping. Additional limitations include the execution of a graft-stent graft distal anastomosis that may be more prone to bleed and the increased operative time required for the stent graft deployment, the latter, in our opinion, well justifiable by

the potential clinical benefits related to HCA avoidance.

We are well aware robust data are required to demonstrate safety and efficacy of our approach.

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None.

Footnote

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

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