Facilitated aortic arch repair with the frozen elephant trunk technique

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Abstract

The frozen elephant trunk, combining together surgical and endovascular techniques, has been developed to treat patients with extensive disease of the thoracic aorta. In this article, we report three cases in which the frozen elephant trunk could facilitate surgical arch repair and patients’ management.

Keywords: Great vessels; Cerebral protection; Cardiac other

1. Introduction

The frozen elephant trunk procedure [1] has been developed to treat patients with extensive disease of the thoracic aorta, and preliminary results have been encouraging [2,3].

In this article, we report three cases in which the mentioned procedure facilitated the surgical repair.

1.1. Case 1

In 2010, a 72-year-old man, who had undergone a supra-coronary ascending aorta replacement for an acute type A aortic dissection in 1996, was referred to our institution. Imaging techniques (Fig. 1A) documented a chronic residual dissection involving the aortic arch (58 mm), a saciform isthmus dilatation with a heavily calcified aortic wall, and a moderate aortic regurgitation.

The patient underwent aortic valve replacement with a biological prosthesis and arch replacement using, as already described by us [2], the frozen elephant trunk technique. The distal anastomosis was performed proximal to the subclavian artery origin allowing the E-vita stent-graft to cover the dilated and calcified aortic isthmus. The arch vessels were re-implanted using the separated graft technique with a four-branched aortic graft.

Postoperative course was uneventful and the predischarge computed tomography (CT) scan showed a nice reconstruction of the aortic arch with exclusion of the isthmus dilatation (Fig. 1B).

1.2. Case 2

In 2009, a 61-year-old man was referred to our institution for an acute aortic syndrome characterized by intramural hematoma of the ascending aorta and dissection of the remaining aorta with massive left hemothorax. The patient presented with hemodynamic instability requiring fluid infusion and vasoconstrictors. The CT scan showed rupture of the false lumen at the distal aortic arch into the left pleural space (Fig. 1C).

The emergent procedure contemplated arch replacement with the frozen elephant trunk technique. The distal anastomosis was performed proximal to the left subclavian artery origin allowing the E-vita stent-graft to cover the distal arch and proximal descending aorta where both the entry tear and the false lumen rupture were located. The arch vessels were re-implanted, using the separated graft technique, with a four-branched aortic graft.

Postoperative course was uneventful and the predischarge CT scan showed a correct arch repair with good exclusion of the ruptured aorta by the stent-graft (Fig. 1D).

1.3. Case 3

In 2010, a 55-year-old man, who had already undergone a Bentall procedure for an acute type A aortic dissection in 2000, was referred to our institution for abrupt onset of back pain. The CT scan documented a chronic postdissection aneurysm of the descending thoracic aorta (75 mm), a dissected aortic arch with entry tears located at the bifurcation of the innominate artery, and in proximity of
the distal anastomosis of the composite graft. All visceral vessels were originating from the true lumen except for the left renal artery. A reentry tear was located in the abdominal aorta (Fig. 1E). As pain relief could not be effected despite intravenous (IV) infusion of anti-impulse and antihypertensive medications, the patient was transferred to the operation theatre for an urgent operation 3 days after hospitalization.

The procedure consisted of arch replacement with the frozen elephant trunk technique. The left common carotid and the left subclavian arteries with an aberrant left vertebral artery were re-implanted 'en bloc', whereas the innominate artery was re-implanted separately after extended flap fenestration (the right carotid artery was perfused by the false lumen only).

Postoperative course was uneventful with relief of back pain and postoperative CT scan showed thrombosis of the false lumen in the descending thoracic aorta (Fig. 1F). As expected, the abdominal aorta reentry tear prevented left kidney malperfusion. Despite achievement of complete false lumen thrombosis, we indicated (patient on waiting list) a secondary endovascular extension to cover the still-dilated descending thoracic aorta.

2. Discussion

The frozen elephant trunk procedure aims to treat patients with extended disease of the thoracic aorta. In this article, we intended to report its use in unusual settings.

The first two cases refer to patients who, despite different underlying pathologies, had in common a very challenging aortic tissue at the distal arch: the heavy isthmus calcification in patient 1 and the distal location of the entry tear and rupture in patient 2. Both patients would have required a deep distal anastomosis, potentially at risk for dreadful complications (bleeding and aortic rupture) that we could avoid by performing the distal anastomosis proximal to the left subclavian artery and allowing the E-vita stent-graft to carry out the distal part of the repair.

The third case challenged us for selection of the best procedure. The two-stage approach with arch replacement and elephant trunk could not be an option since we were not addressing the descending aorta threatening rupture. Isolated replacement of the descending aorta would have resulted, without an extended fenestration of the arch flap, in high pressurization of the arch false lumen and brain malperfusion. On the other hand, the replacement of the aortic arch and descending thoracic aorta through a left thoracotomy with deep hypothermia and circulatory arrest was excluded due to the complexity of the procedure and the strong likelihood of inadequate myocardial and cerebral protection. Thus, we eventually aimed to effect thrombosis and depressurization of the false lumen to prevent aortic rupture and successfully opted for the frozen elephant trunk procedure.

In conclusion, in the above-mentioned cases, the frozen elephant trunk procedure significantly facilitated our surgical repair and strategy.

References