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**Authors:** Altug Tuncer, MD, Mustafa Akbulut, MD, Taylan Adademir, MD, Serpil Tas, MD, Adnan Ak, MD, Özgür Arslan, MD, Benay Erden, MD, Mesut Şışmanoğlu, MD

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Frozen Elephant Trunk and Antegrade Visceral Debranching in the surgical treatment of Type B Aortic dissection: an alternative method

Altug Tuncer¹ M.D., Mustafa Akbulut¹ M.D., Taylan Adademir¹ M.D., Serpil Tas¹ M.D., Adnan Ak¹ M.D., Özgür Arslan¹ M.D., Benay Erden³ M.D., Mesut Şışmanoğlu¹ Prof. M.D.
¹Kartal Kosuyolu Heart and Research Hospital, Department of Cardiovascular Surgery, Istanbul, Turkey.

Short Title: An Alternative Method for Type B Aortic Dissection Treatment

The authors have no conflict of interest.

Key Words: Aortic dissection, Intervention, Surgery

Corresponding Author:
Dr. Taylan Adademir
Kartal Kosuyolu Heart and Research Hospital, Department of Cardiovascular Surgery, Istanbul, Turkey.
Phone: +90(216)5001500
Fax: +90(216)4594321
E-mail: taylanadademir@gmail.com
Abstract

Intervention is inevitable in complicated Type B aortic dissections. Classical surgical procedures and endovascular interventions are far from ideal treatments due to high periprocedural complications and mortality. Particularly, when the anatomy is difficult, there is a need for alternative methods. We present the combined use of frozen elephant trunk and antegrade visceral debranching methods, utilized in the treatment of a 54-year-old male patient with complicated Type B aortic dissection.
Introduction

The classical surgery for Type B aortic dissection, which is performed by opening of the thoracic and abdominal cavities and replacement of the aorta and its branches, carries high morbidity and mortality, and requires experience. Reports indicating mortality rates higher than 20%, even from the most experienced centers, clearly demonstrate the need for alternative methods(1).

Although endovascular interventions commonly used today report successful early and intermediate term results in case of anatomical convenience, retrograde dissection and endoleak rates are considerably high. While problems related to the intervention site, such as bilateral iliac artery stenosis or dissection may prevent access to the lesion, solutions such as fenestrated and custom-made grafts may fail in cases with visceral organs supplied from a false-lumen (2).

Combined use of frozen elephant trunk (FET) procedure with antegrade visceral debranching is an alternative surgical technique used for the first time at our center for the treatment of complicated Type B aortic dissection. The indications, and the superiorities and limitations, of this technique (compared to classical surgery and endovascular interventions) is presented in the light of the treatment of a case admitted to our clinic with acute Type B aortic dissection.

Case Presentation

A 54-year-old male patient having no systemic disease except hypertension was admitted to the emergency service of our hospital with complaints of back-pain and abdominal pain for a week. Contrast-enhanced computed tomographic angiography revealed a dissection flap starting 5 mm distal to subclavian artery, involving coeliac and right renal arteries, and extending to both common iliac arteries(Figure 1). The diameter of the descending aorta was 68 mm at the level of the subclavian artery, 47 mm at the level of aortic truncus and 32 mm at
the level of diaphragm. The patient was referred to our department and hospitalized for advanced investigation and treatment. As his back pain, abdominal pain and signs of malperfusion worsened, he was taken to emergency surgery.

**Surgical Technique**

After a central venous catheter was introduced through the right jugular vein, arterial pressure monitoring was started by placing a left radial line, cerebral pulse oximetry monitoring was accomplished and a catheter was placed for cerebrospinal fluid pressure measurements, the surgery was initiated. The right axillary artery was exposed. Following median sternotomy, the abdomen was opened by a midline incision, and the celiac trunk and right renal arteries exposed and secured with surgical tape. After systemic heparinization, right axillary arterial and two stage unicaval venous cannulation, cardiopulmonary perfusion was started. The patient was cooled. A Dacron Y-tube graft (24 x 12) was passed through the transverse sinus. Perfusion pressure was reduced and the proximal end of the Dacron tube graft was anastomosed end to side to the ascending aorta anterior to the transverse sinus under side clamping. When the transesophageal temperature reached to 25°C, an aortic cross clamp was placed and heart was arrested by antegrade tepid blood cardioplegia. After cardiac arrest, the cross clamp was moved to the brachiocephalic artery and antegrade selective cerebral perfusion (flowrate; 10-15 mL/kg/min) was established. Aortotomy was performed distal to the left subclavian artery and it was observed that the dissection flap was 10-15 mm distal to the left subclavian artery. Single 4/0 pledgeted prolene sutures were placed into the aorta distal to the subclavian artery. A 24 mm x 150mm E-Vita Open Plus (JOTEC® GmbH, Germany) graft was introduced through the subclavian artery to the level of 7th vertebra and deployed according to the recommendations of the graft manufacturer. The proximal end of the graft was sutured to the aorta distal to the subclavian artery using pre-placed prolene sutures. After
primary closure of the aortotomy, air was evacuated, the clamp was removed and selective
antegrade cerebral perfusion (58 minutes) was discontinued.
The implanted Dacron tube graft was passed through the aortic hiatus to the abdominal cavity.
The proximal ends of celiac and right renal arteries were ligated and distal ends were
anastomosed end-to-end with the legs of the Dacron graft. The surgery was completed in a
total perfusion time of 140 minutes.
The patient, whose intensive care stay was prolonged due to respiratory complications, was
transferred to the ward on postoperative day 6. He was discharged uneventfully on
postoperative day 15.
In follow-up performed at 1, 6 and 16 months, the diameter of the descending aorta was
measured as 58, 56 and 55 mm, respectively, in control contrast enhanced computed
tomography, and it was observed that descending aorta was completely thrombosed at the
level of the graft and bypass grafts were patent. There were no clinical signs of malperfusion
(Figure 2).

Discussion
Early intervention in cases with acute Type B dissection is not recommended as classical
surgery carries high morbidity and endovascular interventions carry risk of retrograde
dissection and have unknown long-term results. Surgical or endovascular interventions are
indicated in complicated cases i.e.; in cases with rupture, treatment resistant hypertension,
uncontrolled pain and malperfusion syndrome(3,4). There is an increasing trend for
endovascular interventions in recent years as they promise more successful results than
medical and classical surgical treatment in cases with life-threatening ruptures (5). Besides
problems related to the intervention site (which may make the intervention impossible, e.g.
bilateral iliac artery stenosis or dissection), the routine use of this intervention is restricted due
to the risk of retrograde thoracic aortic dissection during and after the procedure and Type Ia endoleaks (6).

Another vulnerable point in endovascular interventions is the presence of a dissection flap involving visceral artery branches in patients with malperfusion. Perfusion defect is among the most important factors increasing mortality in these patients (1,7). In the presence of dynamic obstruction, organ perfusion and symptoms can be improved after an endovascular procedure, but the treatment options for patients with continued malperfusion or static obstruction are segmentation of the dissection flap, interventions using non-covered stents, or extra-anatomic bypass (8,9). Although the early results of non-covered stents are encouraging, long-term outcomes and problems related to their use are not yet known.

We thought that restoration of blood flow of malperfused organs via the dissected iliac artery was not convenient in our case, in which we felt that access by femoral route was not safe due to bilateral iliac artery dissection. Extra-anatomic bypass solutions performed to the malperfused organ supplied from a dissected artery may be problematic, not only because of structural problems of the artery but also due to the turbulence that would be produced by retrograde flow. Although high patency rates are reported in the literature, potential problems related to retrograde flow are not known (10).

This case is the first isolated type III aortic dissection case in the literature in which antegrade perfusion of the malperfused organs was provided from the ascending aorta (preserved from dissection) and the intimal rupture closed by open frozen elephant trunk procedure instead of using the unsafe femoral route.

Our surgical method carries the potential to answer many problems. It provides direct visualization of the primary tear in the aorta. It permits closure of the rupture with a graft, completely overcoming Type Ia endoleaks and risk of retrograde dissection by suturing the proximal end of the graft to the aorta. It provides convenience for a probable second surgery
by the graft placed to the descending aorta. It achieves simultaneous perfusion of all visceral
organs by antegrade (according to the direction of the flow) debranching. Thus, we believe
there are multiple advantages of this method. The need for cardiopulmonary bypass and
selective antegrade cerebral perfusion for the application of the procedure are the greatest
disadvantages.

Conclusion

Frozen elephant trunk method is an alternative in the treatment of cases with complicated type
III aortic dissection, in which the femoral route cannot be used for some reason. This method,
while preventing the proximal spread of dissection, removes the risk of type 1a endoleaks.
The graft, by stabilizing the dissection flap in the descending aorta, preserves perfusion of the
organs supplied from the true lumen. After the procedure, the visceral organs with
malperfusion can be supplied in the normal flow direction by the vessel preserved from
dissection (antegrade) in the same session. Besides these advantages, the greatest handicap of
the procedure is the need for cerebral perfusion and cardiopulmonary bypass during the
procedure. We suggest that this method can be an alternative in selected cases.
References


Figure Legends

Figure 1. Preoperative 3D CT-angiography image

Figure 2. 3D CT-angiography images at postoperative follow-up