PARAPLEGIA AFTER A FROZEN ELEPHANT TRUNK PROCEDURE Successful reversal by immediate spinal liquor drainage

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Abstract

We report a patient who presented with paraplegia after ascending aorta and arch replacement using the frozen elephant trunk technique. Immediate postoperatively cerebrospinal fluid drainage allowed successful reversal of spinal chord injury. Early awakening of patients following a frozen elephant technique is mandatory because it allows recognition and treatment of this complication by prompt cerebrospinal liquor drainage.

PARAPLEGIA AFTER A FROZEN ELEPHANT TRUNK PROCEDURE

Successful reversal by immediate spinal liquor drainage

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ABSTRACT

We report a patient who presented with paraplegia after ascending aorta and arch replacement using the frozen elephant trunk technique. Immediate postoperatively cerebrospinal fluid drainage allowed successful reversal of spinal chord injury. Early awakening of patients following a frozen elephant technique is mandatory because it allows recognition and treatment of this complication by prompt cerebrospinal liquor drainage.

INTRODUCTION

Paraplegia due to spinal cord injury (SCI) is a devastating complication of surgery of the thoracic aorta. In patients requiring aortic arch replacement, the frozen elephant trunk (FET) is becoming the preferred method to treat complex aortic pathologies in a single stage. However, the incidence of paraplegia following FET, either in patients with acute aortic dissection or chronic aneurysms is still a major concern[1,2]. Although lumbar cerebrospinal fluid drainage (CSFD) is one of the most frequently used techniques for prevention of paraplegia its role in spinal cord protection is difficult to ascertain from available studies. One of the major issues concerning CSFD relates to when it should be employed and whether alone or combined with other strategies[3].

The present case demonstrates the effectiveness of immediate use of CSFD in reversing paraplegia after a FET for a chronic aortic aneurysm.

CASE REPORT

A 69-year-old man was referred for the treatment of a chronic aneurysm involving the ascending aorta and arch. An angio-computed tomography (CT) revealed dilatation of the ascending aorta (58mm) and the aortic arch (57mm) with thrombotic stratification (Fig. 1A, B). A transthoracic echocardiogram showed normal left ventricular function with moderate aortic regurgitation.

At operation arterial perfusion was through the right axillary artery and venous drainage through the right atrium. After aortic cross-clamping, the proximal aorta was opened and the heart arrested with crystalloid cardioplegia. The aortic valve was repaired by plication of the prolapsed non-coronary and left cusps. At 26° of esophageal temperature antegrade cerebral perfusion was started through the right axillary and selective cannulation of left carotid artery. After observing an adequate back-flow, the left subclavian artery origin was occluded to avoid a possible subclavian steal. During perfusion adequacy of flow was continuously controlled and blood pressure in the brachiocephalic vessels maintained between 50 and 70 mmHg. The ascending aorta and arch were replaced with a FET using a quadrifurcated 30/36 mm Thoraflex graft (*Vascutek Ltd, Inchinnan, Scotland*). Prior to distal anastomosis a catheter was advanced through the graft into the descending aorta for visceral perfusion; systemic perfusion was restarted by cannulating the 4^{th} side branch of the graft and the left subclavian and left carotid arteries were reattached to the graft. During rewarming the proximal aortic anastomosis was completed and the brachiocephalic artery reattached to the graft. Aortic cross-clamp, circulatory arrest and total cardiopulmonary bypass times were 176, 40, and 230 minutes.

After 4 hours, suspension of sedation with complete awakening of the patient, evidenced complete paraplegia while tactile and painful sensibility was maintained. Corticosteroid therapy was immediately started together with CSFD by inserting a catheter in the subarachnoid space between L4 and L5. After insertion of the needle a leakage of about 30 ml of liquor occurred under pressure. Initially, CSF pressure was 25 mmHg and a total of 100 mL of spinal liquor were drained to reach and maintain a target pressure less than 10 mmHg. Continuous monitoring of CSF pressure was performed in the following 96 hours with a target spinal chord perfusion pressure of >70 mmHg. This goal was achieved by maintaining a mean arterial pressure >80 mmHg, CSF pressure <10 mmHg, and central venous pressure <10 mmHg. Five hours later, when definitely woken up, the patient started to regain motility of both legs with a complete resolution of the neurological deficit after few days.

A control CT scan ruled out possible acute aortic events confirming the adequacy of repair (Fig. 1 C), while a

nuclear magnetic resonance showed signs of medullary ischemic lesion (Fig. 1 D). The subsequent course was uncomplicated, the patient discharged to the ward on postoperative day 6 and transferred to a rehabilitation center to continue a program of physiokinesitherapy. At 1-year follow-up he has recovered completely from his neurological injury.

DISCUSSION

In patients undergoing FET for chronic arch and/or descending aorta aneurysms SCI has been reported in up to 20% of cases[4]. Although CSFD has been a useful method to relieve paraplegia after repair of type B acute aortic dissection[5], its role before, during and after surgery for extended aortic aneurysms has not yet been clearly defined. Indeed, there are still insufficient data to recommend the prophylactic use of CSFD when FET is performed to treat patients with thoracic aortic pathologies involving the aortic arch.

Katayama et al. reported postoperative SCI in 3.5% of patients undergoing FET mostly for acute aortic dissection preoperative CSFD being used in <10% of cases[6]; they concluded that paraplegia may be prevented by avoiding deep insertion of the stent graft and by maintaining an elevated blood pressure postoperatively. According to a recent meta-analysis, FET was associated to more adverse neurologic events in acute type A dissection while a significantly lower risk of SCI was related to the use of a stent of 10 cm indicating that a stent 15 cm or greater or coverage extending up or beyond T8 should be avoided[7]. On the other hand, analyzing patients undergoing FET for acute aortic dissection others found that the level of deployment of the distal edge of the stent graft did not influence development of post-repair paraplegia[8].

In the present case pre-operative partial occlusion of intercostal branches due to intra-aortic thrombotic stratification may have resulted in chronic SCI. During surgery, temporary circulatory arrest and missed antegrade perfusion of the left subclavian artery may have worsened chronic SCI; nevertheless, during the procedure an evident subclavian artery backflow indicated adequate flow in the left vertebral artery while perfusion of the descending aorta was maintained with a catheter inserted into the graft with adequate perfusion pressures. Furthermore, post-operative CT scan showed a correct position of the short stent of the Thoraflex graft, which was inserted under direct vision verifying absence of intercostal branches in the covered thoracic aorta. The mild ischemia due to the surgical procedure associated to pre-existing chronic SCI may justify both the post-operative paraplegia and its rapid reversal with CSFD.

The present case confirms that CSFD can effectively reverse paraplegia after a FET procedure and that a successful outcome may be obtained by early awakening the patient for accurate assessment of the neurological status and timely detection of SCI. Furthermore, when using FET in atherosclerotic aortic aneurysms with diffuse thrombotic wall stratification it may be reasonable to consider the prophylactic use of CSFD.

Author contributions

Igor Vendramin, MD: Drafting article

Nunzio Davide De Manna, MD: Data analysis

Sandro Sponga, MD: Data Collection

Andrea Lechiancole, MD: Data analysis

Massimo Sponza, MD: Data interpretation

Elisabetta Auci, MD: Data collection

Tiziana Bove, MD: Data collection

Uberto Bortolotti, MD: Critical revision of article

Ugolino Livi, MD: Approval of article

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LEGEND

Fig. 1: A, B) Angio-computed tomography showing dilatation of the ascending aorta

and arch with thrombotic deposition in the descending aorta (*arrowheads*);

C) Angio-computed tomography after correction; D) T2-weighted nuclear magnetic

resonance demonstrating spinal cord ischemic injury with presence of focal

hyperintense intramedullary lesions at T3 to T6 levels (*arrowheads*).