Elephant trunk in a small-calibre true lumen for chronic aortic dissection: cause of haemolytic anaemia?

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Abstract

OBJECTIVES: The elephant trunk technique for aortic dissection is useful for reducing false lumen pressure; however, a folded vascular prosthesis inside the aorta can cause haemolysis. The purpose of this study was to investigate whether an elephant trunk in a small-calibre lumen can cause haemolysis.

METHODS: Inpatient and outpatient records were retrospectively reviewed.

RESULTS: Two cases of haemolytic anaemia after aortic surgery using the elephant trunk technique were identified from 2011 to 2013. A 64-year-old man, who underwent graft replacement of the ascending aorta for acute Stanford type A aortic dissection, presented with enlargement of the chronic dissection of the descending aorta and moderate aortic regurgitation. A two-stage surgery was scheduled. Total arch replacement with an elephant trunk in the true lumen and concomitant aortic valve replacement were performed. Postoperatively, he developed severe haemolytic anaemia because of the folded elephant trunk. The anaemia improved after the second surgery, including graft replacement of the descending aorta. Similarly, a 61-year-old man, who underwent total arch replacement for acute Stanford type A aortic dissection, presented with enlargement of the chronic dissection of the descending aorta. Graft replacement of the descending aorta with an elephant trunk inserted into the true lumen was performed. The patient postoperatively developed haemolytic anaemia because of the folded elephant trunk, which improved after additional stent grafting into the elephant trunk.

CONCLUSIONS: A folded elephant trunk in a small-calibre lumen can cause haemolysis. Therefore, inserting an elephant trunk in a small-calibre true lumen during surgery for chronic aortic dissection should be avoided.

Keywords: Aortic surgery • Surgical complications • Haemolysis

INTRODUCTION

Haemolytic anaemia is a rare complication following aortic surgery [1], and haemolysis related to the elephant trunk has not been reported till date. We report 2 cases of haemolytic anaemia caused by fragmentation of red blood cells (RBCs) in the folded elephant trunk.

CASE REPORT

Case 1

A 64-year-old man with a height of 166 cm, body weight of 53 kg and body surface area of 1.59 m², who had undergone graft replacement of the ascending aorta for acute Stanford type A aortic dissection 9 years before, presented with enlargement of the middle descending aorta (59 mm) and moderate aortic valve regurgitation. Computed tomography (CT) revealed an initial entry at the origin of the left subclavian artery. CT also revealed that all four abdominal branches arose from the true lumen. A two-stage surgery involving graft replacement of the aortic arch with concomitant aortic valve replacement followed by graft replacement of the descending aorta was scheduled. In the first surgery, the aortic arch was replaced with a 22-mm polyester graft with four branches (Triplex; Terumo, Tokyo, Japan), and a distal anastomosis was made between the graft and true lumen of the aorta with a 5-cm-long elephant trunk made of an 18-mm Dacron graft (Gelweave; Terumo). The aortic valve was replaced with a 21-mm bioprosthesis (Carpentier-Edwards PERIMOUNT Magana Ease, Edwards Lifescience, Irvine, CA, USA). After the patient was discharged home, he declined the second-stage surgery because of lethargy. Four months later, he was readmitted with dizziness and dyspnoea. Haematological examinations revealed the following: haemoglobin, 6.5 g/dl; haematocrit, 21.2%; relative reticulocyte count, 34.9%; haptoglobin, <10 mg/dl; total bilirubin, 1.3 mg/dl; direct bilirubin, 0.4 mg/dl; lactate dehydrogenase, 845 IU/l; Coombs negative status and red cell fragmentation, indicating haemolytic anaemia. CT revealed that the elephant trunk was folded (Fig. 1) and echocardiography showed no paravalvular leakage of the aortic
valve. The ankle–brachial pressure index was 0.83 in the right leg and 0.92 in the left. It was thought that the haemolysis was caused by fragmentation of RBCs in the folded elephant trunk. Following this, the patient required repeated blood transfusions; however, he rejected the second procedure. One year after the initial procedure, CT revealed a progression of the descending aortic enlargement, and the patient eventually consented to the surgery. During the surgery, through left thoracotomy, the proximal descending aorta was clamped and the elephant trunk was anastomosed with another 18-mm Dacron graft (Gelweave). After declamping the elephant trunk, it was stretched from 5 to 10 cm by arterial pressure. A distal anastomosis was made between the graft and the true lumen. The postoperative course was uneventful and his haemolysis subsided.

Case 2

A 61-year-old man with a body height of 167 cm, body weight of 59 kg and body surface area of 1.67 m², who had undergone graft replacement of the ascending aorta and the total aortic arch for acute type A aortic dissection 2 years before as well as thoracic endovascular aortic repair for enlargement of the dissected descending aorta 1 year before, presented with enlargement of the dissected descending aorta. The diameter of the lower descending aorta was 45 mm and of the abdominal aorta was 40 mm. Again, all the major visceral branches arose from the true lumen.

During the surgery, through left thoracotomy, the descending aorta was replaced with a 22-mm Polyester graft (Triplex, Terumo). A distal anastomosis was made between the graft and the true lumen of the aorta using another 2-cm elephant trunk made of a 20-mm polyester graft (Triplex, Terumo) inserted into the true lumen. Postoperatively, the patient developed haemolytic anaemia requiring repeated transfusion. Haematological examinations revealed the following: haemoglobin, 6.8 g/dl; haematocrit, 21.6%; relative reticulocyte count, 31.4%; total bilirubin, 2.9 mg/dl; direct bilirubin, 1.0 mg/dl; lactate dehydrogenase, 1730 IU/l; Coombs negative status and red cell fragmentation, indicating haemolytic anaemia. CT revealed that the elephant trunk was folded in the small true lumen (Fig. 2). Transoesophageal echocardiography revealed a jet in the elephant trunk. It was thought that the haemolysis was caused by fragmentation of RBCs in the folded elephant trunk. Transluminal balloon angioplasty was performed to unfold the graft but was unsuccessful. Hence, endovascular insertion of a stent graft (Gore-Tag, W.L. Gore Associates, Inc., Flagstaff, AZ, USA) was performed. The haemolysis quickly subsided after the procedure, and CT demonstrated that the graft stayed in a tubular configuration. The patient is doing well without recurrence of anaemia after the surgery.

DISCUSSION

Haemolytic anaemia is a rare complication following aortic surgery. Shingu et al. reported haemolysis resulting from a kinked prosthetic graft or felt strip after ascending and total arch replacement [2]. Izumi et al. reported haemolysis resulting from disturbance of blood flow by a jet of blood at the site of constriction or the reversed inner felt after ascending aortic replacement [1]. Sekine et al. reported haemolysis resulting from proximal anastomotic stenosis caused by an inverted felt strip after hemiarch replacement and distal anastomotic stenosis caused by a small
native aorta, relatively large elephant trunk graft and inappropriate anastomotic handling after total arch replacement [3]. The mechanism of haemolysis in these reports was fragmentation of RBCs caused by a prosthetic graft or felt strip inside the aorta and not an elephant trunk. The elephant trunk technique for aortic dissection is useful for reducing false lumen pressure [4], and clamping the elephant trunk during the second surgery enables proximal descending aortic surgery without hypothermic circulatory arrest. However, several possible complications are associated with the elephant trunk technique [5]. These include entrapment of the trunk in the smaller dissected aortic lumen downstream without adequate distal re-entry, paraplegia caused by thrombosis of the Adamkiewicz artery, thromboembolic complications resulting from an old clot in the blind aortic pocket surrounding the trunk and splitting of the anastomosis on clamping the elephant trunk during the second-stage surgery. In addition to these complications, the present cases suggest that haemolysis caused by the elephant trunk should be considered if the patient develops haemolytic anaemia after an aortic surgery. The elephant trunk was inserted into the true lumen in the present cases to reduce the false lumen pressure and to slow enlargement of the remaining chronic aortic dissection downstream. However, as a consequence, the folded elephant trunk caused significant haemolysis. To prevent folding of the elephant trunk, the intimal flap should be resected in the chronic phase of aortic dissection to allow a larger space for the elephant trunk if the true lumen diameter is small. In summary, haemolytic anaemia was caused by a folded elephant trunk in two cases of chronic aortic dissection, which were successfully treated by unfolding the elephant trunk by open aortic surgery and stent grafting. When inserting an elephant trunk during surgery for chronic aortic dissection, care must be taken to avoid folding it.

Conflict of interest: none declared.

REFERENCES