How-to-do-it

Secondary elephant trunk fixation with endovascular stent grafting for extensive/multiple thoracic aortic aneurysm

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Abstract

Four patients who underwent secondary elephant trunk fixation by endovascular stent grafting are presented and the advantage of this method to treat multiple/extensive thoracic aortic aneurysm is discussed. In two of them, the elephant trunk installation has been performed at another hospital for extensive aortic aneurysm. In two other patients, the aortic arch replacement and the elephant trunk installation were performed through median sternotomy, initially for multiple aortic lesions, including both arch and descending aorta. No neurological deficit, stroke nor spinal cord injury was encountered during the follow-up period (24–40 months). The diameter of the aneurysms decreased markedly in three patients. In one patient, the aneurysm expanded gradually and type II endoleak was treated by coil embolization. In one patient, who showed marked shrinkage of the aneurysm, the stent graft kinked mildly. Based on the low mortality rate of well-established aortic arch surgery, concomitant elephant trunk installation which was followed by the secondary fixation with endovascular stent grafting might be useful to treat multiple/extensive thoracic aneurysm from distal arch to descending aorta.

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1. Introduction

The elephant trunk procedure was developed to facilitate multiple-stage surgery for an extensive thoracic aortic aneurysm [1]. For the second-stage operation, the graft replacement has been performed through thoracotomy. However, the elephant trunk might be the best suitable condition as the proximal neck of the stent graft [2,3]. To avoid the multiple invasive procedures for thoracic aortic aneurysms, we indicated less-invasive endovascular stent grafting to fix the elephant trunk.

2. Patients

The staged surgical procedures of four patients in whom the elephant trunk (ET) was fixed by endovascular stent grafting (ESG) secondary to the replacement of the aortic arch were shown in Fig. 1.

Patient 1 and Patient 2 were referred to by other hospital due to the enlargement (> 70 mm) of extensive aortic aneurysm from distal arch to descending aorta after ET installation. In these patients, the aortography revealed a massive leakage around ET.

Patient 3 and Patient 4 were admitted for the multiple aortic lesions. Patient 3 had complication of aneurysms of the arch, descending (50 mm), abdominal aorta and bilateral internal iliac arteries. Patient 4 had the annulo-aortic ectasia complicated with severe aortic regurgitation, arch aneurysm and descending aneurysm (45 mm). In these patients, enlargement (55 mm) of descending aneurysm was confirmed to be 3–15 months after the initial surgery.

In all patients, the conventional graft replacement through thoracotomy was considered. However, the ESG to fix ET was indicated due to the history of the heart failure which was treated by IABP support after the initial arch surgery and the history of thoracotomy to anchor ET in Patient 1, the high age (> 75-year old) in Patient 2 and Patient 3, and the long history of aortic regurgitation in Patient 4.

3. Technique

All ETs were made of Dacron graft of 20-26 mm in diameter and 120-150 mm in length. All SGs were made with a self-expanding Gianturco Z-stent (50 or 75 mm long, 30 or 40 mm diameter, Cook, Inc., Bjaeverskov, Denmark) and a thin-wall Dacron graft (30-40 mm diameter, UBE woven graft, Ube, Inc., Yamaguchi, Japan), and were installed
endoluminally through a 20 or 22Fr sheath via the femoral artery under local anesthesia.

4. Results

No neurological deficit, including a stroke after TAR and a spinal cord injury after SG placement, was observed. No hospital death and no late death were encountered during the follow-up period (24–40 months [median 32 months]).

In Patient 4, SG migration with type I endoleak occurred 2 days after, which was successfully treated by additional SG placement.

The aneurysms shrunk markedly in three patients: 65–51 mm in Patient 2, 55–36 mm in Patient 3 and 55–38 mm in Patient 4. In Patient 1, the aneurysm enlarged from 79 to 90 mm during 22 months due to type II endoleak from left internal thoracic artery, which was treated by coil embolization.

In Patient 2, who showed marked shrinkage of the aneurysm, SG kinked mildly. To prevent this complication, multiple SGs and 'bare' stent were placed to fix the longer part of ET in Patients 3 and 4.

5. Discussion

Based on the low hospital mortality rate of the elective total arch replacement through median sternotomy in our institute (5–7%) and the development of ESG which is the absolutely less-invasive technology [4], we applied the secondary ET fixation with ESG in a patient with multiple/extensive thoracic aortic aneurysm with high risk.

The less invasiveness of this staged strategy is obvious comparing with the one-stage aortic arch replacement through thoracotomy which needs circulatory arrest under deep hypothermia [5]. A similar method, the introduction of stent graft for a distal anastomosis during aortic arch surgery ('open stent graft' or 'frozen elephant trunk'), has been reported [6,7]. However, spinal cord dysfunction is the most serious complication of this technique [8]. Furthermore, the precise deployment of stent graft is not promising during the circulatory arrest without fluoroscopic guidance.

In this series, we have not observed any neurological deficit including stroke and paraplegia, and SG could be placed precisely under fluoroscopic guidance.

We encountered the kinking of ET after the shrinkage of the aneurysm in Patient 2. It occurred due to the longitudinal shortening of the aneurysm and thicker graft material of ET; comparing with the usual stent graft, it might have worsened this effect. To prevent the kinking of ET, we installed relatively longer ET (120 mm, 150 mm) subsequently in two patients and fixed these ETs with several SGs and bare stent.

Secondary elephant trunk fixation with endovascular stent grafting is useful as the alternative strategy to treat extensive/multiple thoracic aortic aneurysm; however, further investigation about the kinking of ET is desired.

References