

Experience with thoracic endovascular aortic repair applied in treating Stanford type B aortic dissection: An analysis of 98 cases

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Abstract

Background. Thoracic endovascular aortic repair (TEVAR) has been frequently applied in Stanford type B aortic dissection since thoracic aortic diseases were first treated with artificial vessels.

Objectives. The aim of this study was to analyze the clinical value of TEVAR applied in treating Stanford type B aortic dissection.

Material and methods. Between January 2007 and April 2014, 167 consecutive Stanford type B aortic dissection patients were treated with TEVAR and retrospectively analyzed.

Results. All patients had a successful operation. A total of 98 patients were followed-up and the duration of the follow-up ranged from 3 to 63 months with a mean of 25.6 ± 8.4 months. Proximal type I endoleak occurred in 18 patients with an incidence rate of 18.37% and a cuff was deployed in 7 patients, in whom the endoleak disappeared after 3 months. Two patients died in the perioperative period: one died from aortic dissection rupture, while the other died from infectious shock. One patient died from acute myocardial infarction during the follow-up period. Tears occurred in the end piece of stent grafts in 12 patients, and additional TEVAR was performed. One patient had a proximal retrograde type A dissection; the patient was in an acceptable state of health apart from persistent chest and back pain, and is still in follow-up. Spinal cord ischemia, stent displacement and collapse did not occur.

Conclusions. TEVAR is reliable and safe, and it can be widely applied in treating Stanford type B aortic dissection.

Key words: thoracic endovascular aortic repair, Stanford type B aortic dissection, clinical value

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Introduction

Thoracic endovascular aortic repair (TEVAR) has been frequently applied in Stanford type B aortic dissection since thoracic aortic diseases were first treated with artificial vessels.^{1–3} The indications for TEVAR have been broadened continuously with the development of endovascular techniques. In our study, 167 consecutive patients with Stanford type B aortic dissection were treated with TEVAR. Among them, 68 patients completed follow-up, and the therapeutic effect was then analyzed.

Material and methods

General data

A total of 167 patients with Stanford type B aortic dissection, including 112 males and 55 females (aged 32–82 years), were treated with TEVAR in the Department of Vascular Surgery in Chengde Medical University Affiliated Hospital (China) from January 2007 to April 2014. All 167 patients were admitted for sudden chest and back pain; 96 patients were complicated with hypertension, 15 patients with diabetes mellitus, 6 patients with coronary artery disease, and 2 patients with renal failure. Among them, 3 patients had a rupture of aortic dissection or rupture aura, 2 patients had a rapid augmentation of dissecting aneurysm, 1 patient had severe pleural effusion, 2 patients had severe ischemia of the internal organs, 2 patients had acute lower limb ischemia and acute spinal cord ischemia, and 6 patients had persistent pain and unmanageable hypertension. Other patients were in stable condition. Blood pressure control and analgesia were administered in all patients. Preoperatively, aortic computed tomography angiography (CTA) was performed to make a definite diagnosis and to evaluate the site of tears, the length of the proximal landing zone and the status of the access vessels in all patients. All 167 patients had no tear/dissection of the aortic arch and were classified with Stanford type B aortic dissection. In addition, all patients had acute dissection. Dissection of the abdominal aorta was found only in 1 patient, but the tear extended to the abdominal aorta and even to the iliac artery in 117 patients.

Operative techniques

A hybrid operation was performed in 20 patients. The site of aortic tears was located between the left subclavian artery and the left common carotid artery in 12 patients, and they underwent a right common carotid–left common carotid–left subclavian artery bypass. The site of aortic tears was located between the left common carotid artery and the brachiocephalic trunk in 5 patients, who underwent an ascending aorta–right common carotid–left common carotid–left subclavian artery bypass.

One patient was complicated with innominate aneurysm and underwent an innominate aneurysm resection and an ascending aorta–right common carotid–left common carotid–left subclavian artery bypass. One patient showed the left vertebral artery dominance, as revealed by preoperative angiography, and underwent a left vertebral–left common carotid artery anastomosis. Thoracic endovascular aortic repair was then performed after 1 week. One patient still had a malperfusion of the right lower extremity after TEVAR, so a femoral–femoral artery bypass was then performed with artificial blood vessels.

In the study conducted by Nienaber et al., all patients received TEVAR.⁴ All stent grafts were deployed with the common femoral artery approach via unilateral femoral access. When the primary tear was close to the left subclavian artery and/or the left common carotid artery, a debanching of the common carotid artery was first performed by a right common carotid artery–left common carotid artery bypass, and the origin of the left subclavian artery and/or the left common carotid artery was then covered with the stent graft. A left common carotid artery–left subclavian artery bypass was performed either immediately before, or after TEVAR on the basis of a radiographic evaluation of vertebrobasilar circulation. Adjunctive stenting of the iliac arteries and the visceral branches should be performed for static malperfusion after the deployment of a thoracic stent graft when considered necessary on the basis of angiographic assessments.

Results

All patients had a successful operation. A total of 210 stent grafts were deployed; 7 were used for sealing proximal endoleaks and 35 for distal tears. Debranching was not performed, because all patients suffered from Stanford type B aortic dissection. In our study, we tried to follow-up with all 167 patients, but 47 patients refused to participate in follow-up, because they were far away from our hospital, and 20 patients could not be reached. A total of 98 patients were followed-up, and the rate of follow-up was 58%. The duration of follow-up ranged from 3 to 63 months and the mean was 25.6 ± 8.4 months. Proximal type I endoleak occurred in 18 patients with an incidence rate of 18.37% and a cuff was deployed in 7 patients, in whom the endoleak disappeared after 3 months. Two patients died in the perioperative period: one died from a rupture of aortic dissection and the other died from infectious shock. One patient was admitted for sudden coma and died from acute myocardial infarction. A total of 12 patients had a tear in the end piece of a stent graft after TEVAR, and additional TEVAR was performed. One patient had a proximal retrograde type A dissection and a tear in the end piece of a stent graft. The tear in the end piece of the stent graft was sealed, but the proximal tear was not successfully sealed. Therefore, graft replacement of the ascending aorta

was recommended, but this procedure was not performed, because open surgery was not suitable for the patient – a senior in poor condition. The patient is in acceptable health at the present time, except for persistent chest and back pain, and is still in follow-up. The remaining patients had no complications during follow-up.

Discussion

Operation opportunity

Whether type B dissection in the acute phase should be treated with TEVAR or not is still controversial.⁵ In this study, the 16 patients who were treated with TEVAR within 1 week of onset had no recurrent tears or dissection thrombosis after TEVAR. The indications for emergency TEVAR include: 1. dissection rupture or rupture aura, a rapid augmentation of dissecting aneurysm and severe pleural effusion; 2. severe ischemia of the internal organs; 3. acute lower limb ischemia and acute spinal cord ischemia; 4. persistent pain and unmanageable hypertension.⁶ A selective operation might be performed on patients without the above-mentioned indications.

Extension of the proximal landing zone

The length of the proximal landing zones should be greater than 1.5 cm to seal off the primary tear and to avoid proximal type I endoleak, and the branch vessels should be sealed to achieve a sufficient length of the landing zones for the tears around the aortic arch.⁷ In that study, a hybrid operation was frequently used for securing the blood supply of important vessels; 12 patients underwent a preventive right common carotid–left common carotid–left subclavian artery bypass and 5 patients underwent an ascending aorta–right common carotid–left common carotid–left subclavian artery bypass before TEVAR. The end piece of a stent graft with a length of 150 mm was usually located in the junctional zone between the aortic arch and the descending part of the aorta, because the stent graft shifted forward to the proximal part of the innominate artery. The intima of the artery can be torn because of the elastic stress of a stent graft (1 patient had this complication in our study) or a tear can occur in the end piece of a stent graft because of long-term elastic stress. According to our experience, the length of a stent graft should be greater than 200 mm, and the end piece of a stent graft should cross the aortic arch with a distance long enough to reduce the elastic stress of the end piece. The alternative method was deploying a stent graft into the descending part of the aorta before TEVAR in order to avoid the impact and shearing of blood flow against the intima of the aorta, which could reduce the risk of a recurrent rupture. Short stent grafts can only be used for tears in short and straight segments; long and tapered stent

grafts should be used for tears around the aortic arch.^{8,9} For tears in the left subclavian artery and with a distance shorter than 4 cm between the tears and the proximal part, the left subclavian artery was routinely sealed to achieve the greatest possible length of the landing zones. This method carries the potential risk of cerebral ischemia and left upper extremity ischemia, but ischemia can mostly be compensated for by the contralateral circle of Willis, the arteries in the chest wall and those around the shoulder. In our study, no patients had complications of cerebral ischemia or left upper extremity ischemia.

Treatment of multiple tears

The aorta dissection usually involves multiple tears. It is widely accepted that distal tears should be treated at the same time as proximal tears if they are large and are located above the renal artery, and that distal tears may be left untreated temporarily if they are far away from proximal tears and have a small regurgitation volume. In this study, distal proximal tears were sealed in 35 patients. Our experience demonstrated that distal tears should be selectively sealed after the first tear was sealed, and indications included the occurrence of distal ischemia and a luminal diameter at a tear exceeding 5 cm.

Complications of thoracic endovascular aortic repair

Proximal type I endoleak is the most frequent complication, which can induce an early dissection rupture following TEVAR.¹⁰ In our study, proximal type I endoleak occurred in 18 patients. A cuff was deployed in 7 patients and the endoleak disappeared after 3 months. Our experience showed that: 1. the utmost extension of the landing zones via an artificial vessel bypass can effectively prevent type I endoleak; 2. the maximum length of the proximal landing zones can be achieved by sealing the left subclavian artery in order to prevent type I endoleak; 3. precise localization can be achieved with a secondary low dose and through low-pressure angiography via the brachial artery after 2 segments of proximal stent grafts were opened, which might help avoid the waste of the proximal anchoring length.

Retrograde type A dissection is a fatal complication after TEVAR, which can induce cerebrovascular ischemia, cardiac tamponade and coronary artery infarction with a mortality rate of up to 27.3%.¹¹ One patient had multiple serpentine tears and prominent edema in the aortic wall, and the stent graft used for sealing the first tear was oversized by less than 5% of the aortic diameter. The patient had a retrograde type A dissection and a recurrent tear in the distal end of the stent graft after 2 months. In order to avoid the occurrence of retrograde type A dissection, our experience showed that: 1. the status of the aorta should be carefully evaluated with CTA before TEVAR;

in patients with intramural hematoma of the ascending artery and aortic arch, edema in the aortic wall, a serpentine dissection of the aorta, and multiple tears in the aorta, TEVAR should be performed after edema has disappeared; 2. a stent graft should be oversized by less than 5% of the aortic diameter; 3. tapered stent grafts should be used.

Spinal cord ischemia is a severe neurological complication after TEVAR with an incidence rate of 0–15%.¹² Spinal cord ischemia did not occur in our study. Drainage of cerebrospinal fluid was not routinely adopted for all patients, but only for patients with a high risk of spinal cord ischemia before TEVAR and for patients with evidence of spinal cord ischemia after TEVAR.

Nowadays, the effectiveness of TEVAR in preventing the expansion and rupture of the aorta still needs to be confirmed by prospective, random and controlled studies. However, we believe that TEVAR will become widely applied in treating aortic dissection with the development of endovascular techniques and stent grafts.

Conclusions

TEVAR had a high success rate and a low rate of occurrence of complications when applied in treating Stanford type B aortic dissection. Therefore, it was reliable and safe, and it had immense potential for treating Stanford type B aortic dissection.

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