Institutional report - Vascular thoracic

Endovascular stent-graft treatment of thoracic aortic dissection

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Abstract

Endovascular stent-graft implantation technique is a newly developed, effective and less invasive method in treating thoracic aortic dissection (TAD). Our study was designed to further verify the feasibility, the efficacy, and safety of this technique. We present a 4-year follow-up report of endovascular stent-graft treatment over 36 cases of acute TAD patients and 40 cases of chronic TAD patients. The mortality and comorbidity rates were evaluated thoroughly. In our study, the deployment of the stent-grafts was successfully performed in 75 cases. The hospital cumulative 30-day mortality rate was 1.3%. The instant endoleak rate was 15.8% (12 patients). All endoleaks were successfully treated with a second stent. All patients in local anesthesia were transported to the general ward after the intervention and were discharged from hospital within 1 week. Our preliminary results showed endovascular stent-graft implantation technique offered good peri-operative morbidity and mortality rates. Stent-graft placement over TAD produced a low incidence of spinal cord ischemia, cardiac and pulmonary complications, less hospital stay, less blood transfusion and became the first choice of TAD patients in our department.

Keywords: Thoracic aortic dissection; Endovascular treatment; Stent-graft; Electron beam computed tomography

1. Introduction

The invention of endovascular stent-graft treatment of thoracic aortic dissection (TAD) is considered an evolutionary step towards less invasive surgical intervention for vascular diseases. Since first being introduced in 1994 by Dake et al. [1], this technique acquired much recognition and became more and more popular. Thoracic stent-grafts are now used with confidence in the management of a wide variety of thoracic aortic pathologies, including acute and chronic dissection, intramural hematoma, penetrating ulcer, traumatic injuries, and other diseases [2–4]. From April 2002 to March 2006, we treated 76 patients with thoracic aortic dissection with endovascular stent-graft implantation technique. This report presents the experience of a single high-volume center in China over a 4-year period.

2. Material and methods

This study was designed as a single center’s (university hospital) experience. Between April 2002 and March 2006, 76 consecutive patients with thoracic aortic dissection (Stanford type B) underwent endovascular stent-graft implantation at Xi Jing Hospital, Xi’an, China. There were 62 male and 14 female patients with a mean age of 62 years (28–71 years). The pathology of treatment is listed in Table 1 and medical comorbid condition is listed in Table 2. Eight patients out of the group underwent a previous operation, including 3 Bentall’s procedures, 2 arch replacements, 2 ascending aorta replacements and 1 CABG. All patients routinely underwent a pre-interventional vascular staging that included the use of electron beam computed tomography (EBCT) or magnetic resonance imaging (MRI), transthoracic echocardiography (TTE), and angiography as well as coronary angiography in some cases. Two types of stent-graft systems were used in our study. The TALENT (Medtronic, Sunrise, FL) was used in 15 patients; the AEGIS (Microport, Shanghai, China) was used in 61 patients.

All procedures were performed in the catheter room with the patient under epidural anesthesia or local anesthesia. Patients were placed in the dorsal decubitus position. Drapes were arranged to include the abdomen and both groins in the operative field, thus affording access to the common femoral arteries and, if needed, the iliac arteries or the abdominal aorta. Through a left percutaneous brachial access, a 5-F pigtail catheter was introduced to the thoracic aorta for preliminary angiography. Precise location of the primary tear of the dissection and the range of the aneurysm was confirmed by angiography. The diameter of the stent-graft was oversized by 20% in relation to the diameter of the landing zone, to ensure a satisfactory seal. Prior to the deployment of the stent-graft, 1 mg/kg or 5000 U heparin was given intravenously. Then the stent-
Table 1
Thoracic aortic pathology disease treated with stent-grafts

<table>
<thead>
<tr>
<th>Pathology</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute dissection</td>
<td>36</td>
<td>47.4</td>
</tr>
<tr>
<td>(Penetrating ulcer)</td>
<td>4</td>
<td>5.3</td>
</tr>
<tr>
<td>(Post-traumatic)</td>
<td>3</td>
<td>3.9</td>
</tr>
<tr>
<td>Chronic dissection</td>
<td>40</td>
<td>52.6</td>
</tr>
<tr>
<td>(Para-anastomotic)</td>
<td>2</td>
<td>2.6</td>
</tr>
<tr>
<td>Total</td>
<td>76</td>
<td>100</td>
</tr>
</tbody>
</table>

3. Results

In a 4-year period, 76 TAD patients were managed with stent-graft implantation. The mean duration of the stent-graft procedure and fluoroscopy time were 78 min and 12 min, respectively. In the group, 55 patients did not receive any blood transfusion. The average hospitalization time before intervention was 9.3 days. The mean ICU time was 1.2 days. Most of the patients were transported to general wards immediately after the intervention except 3 hemodynamically unstable cases, who were returned to ICU for further treatment (details in Table 3).

The mean diameter of the implanted stent used in our study was 35.3 mm and the mean length of the covered area of the stent was 98.5 mm. Among the 76 patients treated interventionally, the deployment of the stent-grafts at the intended position was successfully performed in 75 cases. One patient with pseudoaneurysm in the LSCA position had difficulty in deploying the stent-graft because the stent became 90° angular kinking inside the descending aorta and the patient was returned to open surgery after aortography (Fig. 1). No strut failure was found in either the TALENT or the AEGIS group. The primary endoleak rate was 15.8% (12 patients) and all endoleaks were categorized as type I endoleak. These patients received a second stent-graft in an overlapping manner immediately after the first stent-graft implantation. All endoleaks were successfully treated with a second stent. In 10 cases, the left subclavian artery (LSCA) was partially or totally occluded, and two carotid-carotid bypasses were set up in advance. No symptom of blood stealing or extremity dysfunction was found (Fig. 2).

The mean follow-up period in our study was 15 months (range, 2 to 48 months). Intra-operative mortality was not observed. The hospital mortality and cumulative 30-day mortality rate was 1.3%. One patient, combined with mitral valve insufficiency and aortic valve insufficiency, died because of heart failure 7 days after implantation. The comorbidity included: fever, central nerve system disorder, renal failure etc. Twelve patients (15.8%) presented a post-implantation syndrome, described by Blum et al. [5], with...
preservative therapy in selected TAD patients represents a potential alternative to open surgery and medical colleagues in Stanford, endovascular technology now represented a dilemma. Thanks to the pioneering work of Dake and anesthesiologic methods, and medical therapy has been feasible with different symptoms and were diagnosed easily. Patients with acute or chronic dissection usually manifested with different symptoms and were diagnosed easily. In our study, EBCT found obvious entries in 52 patients and there was no obvious entry in the other 24 patients. DSA verified the results of EBCT and found another two entries. The implantation of stent-graft was usually easily performed in patients with obvious entries. While in patients without obvious entries, the exclusion of the TAD always became difficult and required a thorough consideration of the length of the aneurysm, the relationship with LSCA or renal artery, and also the experience of the operator. After the implantation, re-aortography was compulsory to detect any endoleaks or remaining entries.

According to the pre-operation precise evaluation of TAD, there are several crucial parameters that determine the results of the stent-graft technique. These parameters may include: the diameter of the normal aorta proximal to the aneurysm, the distance from the intimal entry to the orifice of the LSCA and the position, diameter and the length of the aneurysm etc. According to our experience, the diameter of the stent-graft should be 2–6 mm or 20% bigger than the diameter of the proximal normal aorta and the length of the stent-graft usually varies from 10–12 cm. We believe that a 10–12 cm long graft would be enough and it can fully cover the entry of the dissection and need not be as long as the whole dissected aorta or the aneurysm, because thrombus will soon form in the false lumen of the aneurysm after the stent-graft intervention. Excessive stent-graft may exclude many intercostal arteries from the true lumen and increase the possibility of paraplegia [8]. Another important consideration is the distance from the intimal entry to the orifice of the LSCA. In our study, the average distance from the intimal entry to the orifice of the LSCA is 5.6 cm (0 to 10 cm). LSCA was excluded in 10 patients (13%). There were two cases of brachial arteriovenous fistula related to the stent-graft technique. But none of them had the symptom of blood stealing or upper limb ischemia. So we believe that most LSCA can be excluded safely and without complications. But, in order to be safe, when LSCA is in great possibility to be excluded, it is routine that we assess the patency of the carotid artery, the vertebral artery and the situation of the Willis’ Circle before the interventions. In some special cases when the left common carotid artery was involved in the aneurysm and was in great possibility to be excluded, we would set up a carotid-carotid bypass in advance. The last important consideration in the patient’s preoperative profile requiring careful attention relates to renal dysfunction, because postoperative renal failure after stent-graft implantation continues to be a significant and potential lethal complication [9]. Moreover, the incidence of worsening renal function increases two- to three-fold in those patients with pre-existing renal insufficiency. In our study, one patient with pre-operative renal insufficiency got acute renal failure, and the patient gradually recovered after 7-day hemodialysis.

Endoleak and too big a diameter of the stent-graft remain the shortcomings of the technology [2,10]. Endoleak after stent-graft implantation can cause progressively enlargement of the TAD and even rupture. While applying the stent-graft, endoleak usually takes place between the graft and the aortic wall (Type I or II). If endoleak was found before the end of the operation, additional stent should be needed. The additional stent should be of the same size as, or a little bigger than, the original one. Once it fails

4. Discussion

Although dramatic improvement in operative techniques, anesthesiologic methods, and medical therapy has been gained in recent years, TAD still remains a therapeutic dilemma. Thanks to the pioneering work of Dake and colleagues in Stanford, endovascular technology now represents a potential alternative to open surgery and medical preservative therapy in selected TAD patients [1]. One of the major advantages of this technique lies in the fact that extracorporeal circulation and deep hypothermic circulatory arrest with their inherent risks can be avoided. Vascular stent-graft technology can maintain blood flow to vital arteries while excluding the aneurysm from the circulation. In addition, stent-graft placement over the intimal tear can prevent the development of the aneurysm by facilitating complete thrombosis of the false lumen [6,7].

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again, open surgery of thoracic aorta replacement should be compulsory.

In our study, 30 patients underwent the stent-graft implantation in epidural anesthesia and 46 patients in local anesthesia. Firstly, we used epidural anesthesia on all patients. With the accumulation of experience and being more familiar with the anatomy and pathology of the disease, we tried more local anesthesia on patients. From January 2004 onwards, we used local anesthesia instead of epidural anesthesia in most patients. Local anesthesia had the advantages of being easier to handle, having less effect on the blood pressure, heart rates and being less invasive and became our first choice. All patients in local anesthesia were transported to the general ward immediately after the interventional procedure and were discharged from hospital in <1 week.

In conclusion, our preliminary experience shows that the endovascular stent-graft technology offered good perioperative morbidity and mortality rates, especially in an emergency situation. Stent-graft placement over TAD produced a low incidence of spinal cord ischemia, cardiac and pulmonary complications, less hospital stay, less blood transfusion and has become the first choice of TAD patients in our department.

References