Institutional report - Aortic and aneurysmal

Major complications following endovascular surgery of descending thoracic aorta

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Abstract

We evaluated the impact of major complications on clinical outcome in a series of patients undergoing endovascular repair (EVAR) of descending thoracic aorta. From March 2001 to June 2005, 51 patients underwent EVAR for descending aortic diseases. Thirty-five were treated in emergency (60.7%) and 41 (80.4%) were in III–IV ASA class. There were no deaths, surgical conversion or paraplegia. A neurologic complication occurred in one patient (1.9%). Eleven major systemic complications occurred in 5 patients. One patient showed a primary type I endoleak at discharge, resolved spontaneously after 9 months. Three (5.9%) vascular injuries occurred during the endovascular procedure, requiring an emergency rescue iliac-femoral artery bypass. At follow-up (29 ± 14 months), there was an overall mortality rate of 5.1% (3/51); 2 deaths (3.9%) were procedure related. Two secondary EVARs (3.9%) were successfully performed, one for a late type I endoleak six months after EVAR in a traumatic patient, and a second for a late rupture distally to the stent-graft implanted 36 months before in an acute type-B dissected patient. EVAR for descending aortic diseases is associated with decreased mortality and complications, however, long-term follow-up and additional studies are mandatory to detect late failure and to confirm clinical safety of this procedure.

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Keywords: Descending aortic diseases; Endovascular surgery; Stent-graft

1. Introduction

Despite improvements in surgical management, conventional surgery of the descending thoracic aorta is still associated with a significant risk of mortality and morbidity, a rate that increases under emergency conditions and in the presence of severe comorbid medical illness [1]. Since the initial reports from Stanford [2], endovascular surgery to treat diseases of the thoracic aorta has been used with growing enthusiasm and technical feasibility and the clinical safety of thoracic EVAR is now well recognized. Such notwithstanding, this growing enthusiasm is tempered by procedure-related complications appearing at early and long-term follow-up.

We evaluate the impact of these major complications on clinical outcome in a series of patients undergoing endovascular aortic repair (EVAR) of descending thoracic aorta.

2. Materials and methods

From March 2001 to June 2005, 51 consecutive patients with severe comorbid medical illness, that makes them not suitable for conventional surgery, underwent EVAR for descending aortic diseases. Indications were: acute type-B dissection in 26 patients (51.0%), thoracic aortic aneurysm (TAA) in 18 (35.3%) and traumatic rupture in 7 (13.7%): 35 patients were treated in emergency (60.7%) and 41 (80.4%) were in III–IV class, according to the American Society of Anesthesiologists (ASA) classification. Patient characteristics are indicated in Table 1.

A spiral computed tomographic (CT) scan, a conventional angiography of the thoracic and abdominal aorta with a calibrated catheter, and a coronary artery angiography were performed preoperatively to assess suitability for EVAR, for measuring and localizing purposes and determin-
ing the size of the implanting stent grafts. The diameter of the selected stent graft exceeded the diameter of the aorta by a minimum of 10% for traumatic rupture to a maximum of 20% for aortic aneurysm and acute type B dissection. The excess diameter was required to increase the radial force of the device as a result of self-expansion of the endoprosthesis, thus allowing for improved sealing of the graft in the aorta.

Stent-graft placement was performed in the catheterization laboratory or in the operating room. Patients received general anesthesia and mechanical ventilation. The procedure began by introducing a 6F pigtail catheter (Cordis, Hamburg, Germany) through the radial artery for precise localization of the left subclavian artery (LSA), intra-procedural aortography, and direct monitoring of invasive arterial pressure. Antibiotic prophylaxis with cefotaxime (2 g twice daily for 5 days) and heparin 5000 IU was given intravenously. In all cases, vascular access was achieved by surgical dissection of one of the femoral or iliac arteries chosen, after contrast injection of the distal abdominal aorta to select the most appropriate side for access and the onset of the celiac axis (landing zone). In the two patients with previous aortobifemoral bypass, access was obtained through a prosthetic branch. The delivery system was inserted through the femoral or iliac artery and loaded onto the 300-cm-long 0.035-inch Back-up Meier wire (Boston Scientific, Boston, MA) to the level of the thoracic aorta. Hypotension (mean arterial pressure approximately 60 mmHg) was induced by sodium nitroprusside just before the placement of the stent(s). Subsequent aortography confirmed the adequacy of treatment.

Complications were classified as major, when life-threatening or prompting major therapeutic consequences (e.g., access complications requiring surgical revision), whereas complications that did not require further treatment (e.g., transient renal failure not requiring dialysis) were defined as minor. Complications were considered as early when occurring within 30 days postoperatively. Any complication that occurred unexpectedly, or could not be related to other causes, was classified as due to endovascular procedure. Primary procedural success was defined as absence of death or surgical conversion, exclusion of aneurysm or transected tract and occlusion of thoracic tear; technically successful deployment of the endoprosthesis at the intended target location. Early mortality and morbidity were considered as events occurring either upon hospital admission or within 30 days of the procedure. Late mortality included aortic related deaths after 30 days. Any death that occurred suddenly or could not be related to other causes was classified as due to aortic disease. The persistence of a double lumen in the abdominal aorta was not considered as an indication of failure if the thoracic intimal tear was covered and there was no blood flow in the false lumen. Re-intervention was defined as the need for any open surgical treatment or additional endovascular stent-graft procedures.

All patients underwent a CT-scan at discharge. Follow-up included a clinical examination and a serial CT-scan at 3, 6 and 12 months, and yearly thereafter.

3. Results

There were no deaths or surgical conversion. Primary procedural success was obtained in 50 patients (98.1%). There was no paraplegia despite the fact that the entire descending aorta was covered from LSA to the celiac axis in 20 patients (39.2%), with multiple stent grafts of increasing diameters inserted in the previous stent (‘telescope technique’). The number of stent-grafts implanted ranged from 1 to 4: 1.3±0.5 grafts/patient with traumatic aortic rupture, 2.1±1.1 in patients with atherosclerotic aneurysm and 2.4±0.8 in patients with acute type-B dissection.

In accordance with the Criado classification [3], denoting four zones for proximal endograft attachment, we landed in zone 1, from the brachiophecalic trunk to the left common carotid artery, in 3 patients (5.9%) without overstenting of left common carotid artery originating from the brachiophecalic trunk; in zone 2 from the left common carotid artery to the LSA in 7 (13.7%), and in zone 4 in the other 41 patients (80.4%). The LSA overstenting, without surgical revascularization, required in 10 (19.6%) patients, with LSA origin included in the aneurysm or dissection, was not complicated by subclavian steal phenomena. A hybrid approach was needed in a TAA patient with aortic bifurcation obstruction, treated with an aorto-bifemoral bypass as main vascular access.

In one patient (1.9%), without carotid diseases and not requiring LSA overstenting, a neurologic complication occurred, displaying amaurosis resulting from cerebral embolism in the left occipital lobe, due to guidewire or device manipulation [1]. In-hospital major complications classified as systemic or procedure related are listed in Table 2. Eleven major systemic complications occurred in 5 patients: 2 patients with traumatic aortic rupture, suffering from crush syndrome at hospital admission, developed acute renal failure, requiring a temporary renal substitutive therapy. Three (5.9%) vascular injuries occurred during the endovascular procedure, requiring an emergency rescue iliac-femoral artery bypass. In 2 patients the injuries were due to severe calcified atherosclerosis and tortuosity of iliofemoral axis and in a 19-year-old woman with traumatic rupture of the aorta and multitrauma (head injury and leg fractures), a laceration of the right iliac artery occurred, resulting from the discrepancy between the diameter of the artery (<8 mm) and the size of the device (25 Fr). A CT scan at discharge on the sixth

<table>
<thead>
<tr>
<th>Variable</th>
<th>Number of patients</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Systemic</strong></td>
<td></td>
</tr>
<tr>
<td>Dialysis</td>
<td>4 (7.8%)</td>
</tr>
<tr>
<td>Temporary</td>
<td>3 (5.9%)</td>
</tr>
<tr>
<td>Prolonged intubation</td>
<td>4 (7.8%)</td>
</tr>
<tr>
<td>Myocardial infarction</td>
<td>1 (1.9%)</td>
</tr>
<tr>
<td>Crush syndrome</td>
<td>2 (3.9%)</td>
</tr>
<tr>
<td><strong>Procedure related</strong></td>
<td></td>
</tr>
<tr>
<td>Mortality</td>
<td>0</td>
</tr>
<tr>
<td>Primary endoleak</td>
<td>1 (1.9%)</td>
</tr>
<tr>
<td>Surgical conversion</td>
<td>0</td>
</tr>
<tr>
<td>Vascular complications</td>
<td>3 (5.9%)</td>
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</tbody>
</table>
postoperative day revealed a primary type I endoleak in one patient with atherosclerotic aortic aneurysm: a close follow-up was planned with serial 3-month CT-scans. After 9 months the endoleak resolved spontaneously.

Three patients died during follow-ups ranging from 8 to 58 months (29 ± 14 months), with an overall mortality rate of 5.1%; 2 deaths (3.9%) were procedure related. Of these, one occurred in an acute type-B dissection patient, 13 months after EVAR, due to a late retrograde endoleak, just before a new planned treatment and the other in an atherosclerotic patient who suddenly died two months after the procedure. The third patient died because of complications of a lung cancer after 38 months. Two secondary EVARs were successfully performed: one in a chronic traumatic rupture patient with a descending aorta pseudoaneurysm for a late proximal endoleak, noted at 6-month CT-scan; the other in a type-B dissection patient, treated 2 years prior, because of a contained rupture of the descending thoracic aorta distally to the previously implanted stent-graft. Late major complications are listed in Table 3.

4. Discussion

Although the favorable survival and the low incidence of reported complications appear to be somewhat encouraging in this first decade of thoracic EVAR experience, it should be noted that major complications are encountered in 8–25% of cases [4–7]. In our series, the early and late mortality compares favorably with other authors who report a hospital and late mortality ranging between 1.4% and 3.8%, and 3% and 17.3%, respectively [4–6].

Vascular access to the thoracic aorta continues to be a main source of complications and is generally poorly tolerat-ed by the patients. As reported in literature, vascular injury can occur in 6–15% of patients undergoing EVAR [7–9]. The size, ranging from 20–25F, and relative stiffness of the devices are not safe in calcified, atherosclerotic and tortuous vessels or in small size arteries of women and young people with traumatic aortic rupture. Careful pre-operative planning limits and prevents introducing vascular access injuries. We highly recommend using a vascular access larger than 8 mm to avoid unfortunate complications during introduction of the device.

Although the incidence of neurologic complications and paraplegia was minimal and less than that reported with open repair [1,6], they do occur with thoracic endograft repair. The risk of a cerebrovascular accident ranges between 0% and 4.4% [4,5,7]. It is commonly believed that stroke occurs because of manipulation of guidewire or stent delivery system within the aortic arch [1].

Spinal ischemic injury remains the most dreaded potential complication. An incidence ranging from 0–6% is reported [1,4,9–11]. At present the exact mechanism of paraplegia is not completely understood. Simultaneous abdominal and thoracic aortic repair and coverage of long segments of the aorta have been reported to portend a higher risk of paraplegia [1,7,12]. No paraplegia occurred in our series despite the extensive covering of the entire descending aorta between T9 and T12 in 24 patients (47.1%).

Overstenting of the left subclavian artery with or without revascularization is still controversial. In our series, 10 (19.6%) patients requiring the overstenting of the LSA underwent no primary surgical revascularization, without any signs of vascular arm ischemia and/or subclavian steal phenomena. Recent reports emphasized the need for a primary surgical revascularization when the left vertebral artery is dominant or there is a marked stenosis of the right vertebral artery and/or occlusion of an internal carotid artery, avoiding the surgery procedure when there is a satisfactory and equal caliber of both vertebral and carotid arteries [13,14].

EVAR for thoracic aortic diseases is associated with decreased mortality and complications and improved early and mid-term outcome, particularly if compared with open conventional surgery for high risk patients [10,11,15]. According to our experience, a secondary EVAR is a safe procedure for the treatment of early and late complications, as well as significant endoleaks or late contained rupture. However, long-term follow-up and additional studies are mandatory to detect late failure and to confirm the clinical safety of this procedure.

Table 3
Late results

<table>
<thead>
<tr>
<th>Variable</th>
<th>Number of patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortality</td>
<td>3 (5.9%)</td>
</tr>
<tr>
<td>Aortic related</td>
<td>2 (3.9%)</td>
</tr>
<tr>
<td>Endoleak + late rupture</td>
<td>1 (1.9%)</td>
</tr>
<tr>
<td>Endoleak + secondary EVAR</td>
<td>1 (1.9%)</td>
</tr>
<tr>
<td>Late rupture + secondary EVAR</td>
<td>1 (1.9%)</td>
</tr>
</tbody>
</table>

References


