SHORT REPORT

Simultaneous Endovascular Exclusion of Thoracic Aortic Aneurysm with Open Abdominal Aortic Aneurysm Repair

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Background. The treatment of aneurysms at multiple sites within the aorta is problematic.

Methods. Between March 2002 and June 2003 in the Department of General, Vascular and Transplant Surgery, Medical University of Warsaw six patients with coexisting abdominal and descending thoracic aortic aneurysms underwent simultaneous open abdominal aortic aneurysm (AAA) repair and endoluminal thoracic aortic aneurysm (TAA) repair. The indication for a combined procedure was a diagnosed descending TAA and AAA with no significant risk factors for open aortic surgery or technical contraindications for endovascular treatment of TAA.

Results. One patient died in the peri-operative period while the other five patients all recovered well after surgery and were discharged with both aneurysms excluded.

Conclusion. Endovascular treatment of TAA combined with a simultaneous open AAA repair is an efficient and relatively safe treatment modality in patients with TAA and AAA disqualified from endovascular repair. The fact that thoracotomy is not a necessity significantly lowers the complication rate in these patients.

Key Words: Multilevel aortic aneurysm; Endovascular thoracic aortic aneurysm treatment; Open abdominal aortic aneurysm surgery.

Introduction

Multilevel aortic aneurysms poses a serious problem for vascular surgeons in the terms of choice of an adequate surgical method of treatment. Open surgery is still associated with significant morbidity and mortality especially in patients with thoracic aortic aneurysms (TAA).^1–3 Ten to 29% of patients with TAA have coexisting abdominal aortic aneurysms (AAA).^2,4 Historically, multilevel aortic surgery was performed in these patients simultaneously or subsequently. An alternative to open surgery could be stentgraft placement for TAA and AAA. AAA morphology is not always suitable for endovascular repair (short or conical neck, severe angulations of the neck or iliac tortuosity). Additionally, in some patients a good result of open aneurysm repair can be predicted. In such cases simultaneous stentgraft placement for TAA combined with open repair for AAA may be a viable method of treatment. It allows for a lower complication risk, than for a procedure associated with open thoracotomy and high aortic cross-clamping and excludes both aneurysms from circulation.

Patients and Methods

Between March 2002 and June 2003 in the Department of General, Vascular and Transplant Surgery, Medical University of Warsaw six patients with coexisting AAA and TAA underwent simultaneous open abdominal aneurysm repair and stentgraft placement through the implanted gelatin-coated Dacron abdominal vascular prosthesis side limb. This group of patients consisted of two females and four males with a mean age of 70 years, four of whom were heavy smokers. Four patients from this group suffered significant co-morbidities including hypertension (4), coronary artery disease (4), history of myocardial infarction (2), COPD (1) and diabetes (1). Two patients

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had also occlusive iliac disease. Patient characteristics are shown in Table 1.

The aneurysms were detected clinically (1), or incidentally on plain X-ray (2), abdominal ultrasound (1) or echocardiography (2). In all cases contrast-enhanced thoracoabdominal spiral computed tomography (3 mm slides) were performed to measure abdominal and thoracic aneurysm diameters with evaluation for stentgraft implantation. Three dimensional reconstruction and angio-CT were performed (Fig. 1). In addition in two cases digital subtraction angiography was performed to attain a clearer morphology of the aortic arch. The indication for a combined procedure was a diagnosed descending TAA and AAA with technical contraindications for endovascular treatment or no significant risk factors for open abdominal aortic surgery (patient nos. 1 and 5). All thoracic aneurysms began below the left subclavian artery ostium. All except one abdominal aneurysm were infrarenal, with one suprarenal aneurysm involving the celiac trunk and superior mesenteric artery. Preoperative measurements are shown in Table 2.

For TAA exclusion, Talent (Medtronic) straight tube devices were used. The graft length exceeded the aneurysm length by approximately 3–4 cm and diameter oversizing was 10–15% (4–6 mm). In two patients low molecular weight heparin was administered for 5 days preoperatively. Prior to surgery, informed consent was obtained from all patients for thoracotomy. The patients were prepared and draped as for thoracoabdominal surgery. All procedures were performed in the operative theatre under general anesthesia. In all cases a transperitoneal abdominal midline approach was used. After heparinization (70 IU/kg), aortic cross-clamping was performed in the infrarenal aortic segment except in the patient with a suprarenal aneurysm. In all patients a bifurcated gelatin-coated Dacron prosthesis (Uni-graft; Braun) was used. After the upper and contralateral limb anastomosis was completed, the aorta was declamped and through the ipsilateral limb of the vascular prosthesis a Talent straight tube graft was placed under fluoroscopic guidance (Fig. 2). Final angiography revealed complete exclusion of thoracic aneurysm with no endoleak (Fig. 3). After all catheters were removed the ipsilateral limb was completed. Abdominal wall closure completed surgery and the patient was transferred to intensive care unit.

Results

In one case the AAA involving the celiac trunk,
superior mesenteric artery and renal arteries. In this patient an intraoperative coagulopathy developed which required plasma and blood transfusion and recombinant human coagulation factor VIIa. Two hours after primary abdominal closure a relaparotomy was performed due to persistent intra-abdominal hemorrhage. Intensive management with blood transfusion, recombinant human coagulation factor VIIa and abdominal packing was ineffective and the patient died 1 h after the second operation.

In all remaining cases, after a one day ICU stay the patient returned to the Department ward. Pre-discharge CT-scan revealed complete thoracic aneurysm exclusion and no endoleak (Fig. 4). No other early postoperative complications occurred, in particular there were no cases of spinal cord ischemia. In the follow-up period (8–23 months) CT-scans were performed on the third, sixth and 12th months postoperatively. We detected one type I endoleak due to thoracic stentgraft migration in a 6 months CT scan, which was treated by implanting an additional proximal stentgraft segment. No other types of endoleak were observed. There were no migration, aneurysm expansion, and any other complications associated with thoracic stentgraft placement or abdominal aneurysmectomy. No neurological defects were observed in this follow-up time. Detailed results are shown in Table 3.

Discussion

Since the first endovascular repair of a thoracic aortic aneurysm in 1992 there has been a significant increase in the numbers and indications for stentgraft implantation for diseases of the descending aorta. This procedure has rapidly become a valuable alternative for thoracic aneurysm treatment. If the patient is considered to be a candidate for endovascular treatment, careful assessment of TAA morphology should be performed. The aneurysm should not exceed the left subclavian artery proximally and there should be an adequate landing zone distally without involvement of major aortic branches. However,
multifenestrated devices may allow for a more widespread use of stentgrafts in aneurysms involving collateral vessels.4

There is very little data available for combined thoracic and abdominal aneurysm repair. According to Moon et al., historically, there were several ways of surgical treatment of multilevel aortic aneurysms.2 Simultaneous thoracic and abdominal aneurysm repair is a challenging surgical procedure, which can also be performed through separate incisions. The operation can be staged in time, and the order should be determined in accordance to aneurysm size and

Table 2. Preoperative measurements of AAA and TAA according to CT-scan

<table>
<thead>
<tr>
<th>Patient</th>
<th>Diameter</th>
<th>Renal a. involvement</th>
<th>Proximal neck</th>
<th>Significant iliac tortuosity</th>
<th>Feasible for endovasc repair</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>48</td>
<td>No</td>
<td>26</td>
<td>Yes (60°)</td>
<td>Yes (60°)</td>
</tr>
<tr>
<td>2</td>
<td>65</td>
<td>No</td>
<td>21</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>3</td>
<td>51</td>
<td>No</td>
<td>24</td>
<td>Yes (90°)</td>
<td>No</td>
</tr>
<tr>
<td>4</td>
<td>74</td>
<td>No</td>
<td>26</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>5</td>
<td>69</td>
<td>No</td>
<td>21</td>
<td>Yes (90°)</td>
<td>No</td>
</tr>
<tr>
<td>6</td>
<td>71</td>
<td>No</td>
<td>26</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

All dimensions are in mm. aSymptomatic AAA. bFeasible for endovasc repair.
symptoms. Crawford suggested an initial repair of the thoracic aneurysm in asymptomatic patients.\textsuperscript{10,11} On the other hand 30\% of deaths after descending thoracic aneurysm repair is associated with coexisting untreated infrarenal aneurysm rupture.\textsuperscript{12} In accordance with this data, Crawford performed simultaneous surgery in patients who continued to do well in the operating room after the first replacement. The mortality rate for such a procedure was 10\%.\textsuperscript{11} It is also possible to exclude coexisting TAA and AAA by means of thoracic and abdominal stent grafts. This can be performed simultaneously or subsequently and is a viable alternative for high risk patients.\textsuperscript{4} According to many authors there is no reason for endovascular AAA repair in patients without significant risk factors. In our opinion in patients with multilevel aneurysmal aortic disease the choice of treatment of the concomitant AAA should be the same as in patients with AAA only. The presence of TAA should not modify the treatment method of the AAA.

Eton reports a case of thoracic stent graft implantation two weeks after open abdominal aneurysmectomy in a patient with a suspected mycotic thoracic aneurysm.\textsuperscript{8} Nevertheless if there is no contraindication, both aneurysms should be excluded simultaneously. This seems a much simpler approach, with the straight tube thoracic graft inserted through the limb of the abdominal prosthesis, with no additional groin incision.

When considering patients with thoracoabdominal aneurysms it is obligatory to evaluate the patient’s cardiopulmonary status. Many patients because of their poor cardiopulmonary reserve can still be considered for a combined procedure where they would be otherwise unfit for open thoracotomy. In our series at least in two patients open thoracotomy could not be performed due to poor cardiopulmonary status.

A serious problem following endovascular and open repair of thoracic aortic aneurysms is spinal cord ischemia. According to current literature the complication rates are equal in both methods of treatment. Steroids, hypothermia, cerebrospinal fluid drainage and prevention of hypertension may be offered to lower the risk of this complication. Overall, the rate of this complication has been shown to range between 0 and 21\%.\textsuperscript{3,4,13–15}

The spinal cord is predominantly supplied with...
Table 3. Operative data and results

<table>
<thead>
<tr>
<th>Patient Number</th>
<th>Number of thoracic stentgraft segments used</th>
<th>Intraoper. Type of abdominal distal anastomosis</th>
<th>Duration of procedure (min)</th>
<th>Blood lost (ml)</th>
<th>Neurologic deficit</th>
<th>30-days Follow-up</th>
<th>Neurologic deficit in follow-up</th>
<th>Complications in follow-up</th>
<th>Follow-up (months)</th>
<th>Duration of procedure (min)</th>
<th>Blood lost (ml)</th>
<th>Neurologic deficit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>No.Comm. iliac</td>
<td>170</td>
<td>800</td>
<td>No</td>
<td>Yes</td>
<td>None</td>
<td>None</td>
<td>8</td>
<td>19</td>
<td>2300</td>
<td>None</td>
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<tr>
<td>2</td>
<td>2</td>
<td>No.Comm. iliac</td>
<td>240</td>
<td>700</td>
<td>No</td>
<td>Yes</td>
<td>None</td>
<td>None</td>
<td>6</td>
<td>24</td>
<td>3000</td>
<td>None</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>No.Comm. iliac</td>
<td>330</td>
<td>5000</td>
<td>–</td>
<td>–</td>
<td>Died</td>
<td>Cured</td>
<td>5</td>
<td>1</td>
<td>150</td>
<td>None</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>No.Comm. iliac</td>
<td>180</td>
<td>1200</td>
<td>No</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>2</td>
<td>1</td>
<td>1200</td>
<td>None</td>
</tr>
</tbody>
</table>

a) Due to severe atherosclerosis. b) Died during reoperation due to persistent hemorrhage. c) Treated by additional stent-graft segment placement. d) Due to aneurysmal common iliac arteries.

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In conclusion, endovascular treatment of thoracic aortic aneurysm combined with a simultaneous open abdominal aneurysmectomy is an efficient and relatively safe treatment modality in patients with TAA and AAA disqualified from endovascular repair. The fact that thoracotomy is not a necessity significantly lowers the complication rate after this procedure. However, long-term follow-up on a larger group of patients is necessary to assess the durability and effectiveness of this method of therapy.

References

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