Endovascular Treatment of Ruptured Abdominal Aortic Aneurysms

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Aortic aneurysms, especially when ruptured, constitute a direct life threat. Mortality in emergency surgical procedures has been estimated at 50 to 90%. In the recent years great advances have been achieved in the form of endovascular techniques, which offer effective treatment and are associated with a lower risk of complications and death.

The aim of the study was to evaluate endovascular treatment in patients with hypovolaemic shock due to aortic rupture in the infrarenal segment.

Material and methods. 19 patients with ruptured aortic aneurysms were treated by stentgraft implantation in our department from 2001 to 2006. Bifurcated stentgrafts were used in 6, while aortouniiliac stentgrafts were used in the remaining 13 with consecutive femoro-femoral by-pass grafting.

Results. Good results were obtained in 14 (73.7%) patients operated on while in hypovolaemic shock caused by aortic aneurysm rupture.
5 patients died in the perioperative period (26.3%). The deaths were caused by shock and multiple organ failure.

Conclusions. 1. Advances in vascular surgery offer an effective treatment for patients in hypovolaemic shock due to abdominal aortic aneurysm rupture. 2. New treatment modalities do not lift the surgeon’s responsibility to manage shock, which remains the main cause of death in patients with ruptured aortic aneurysms. 3. If the technical conditions for stentgraft implantation are met, endovascular procedures should be the method of choice in cases of ruptured abdominal aortic aneurysm.

Key words: abdominal aortic aneurysm, ruptured aneurysm, stentgraft, shock

Despite the enormous progress of medicine, made in the last 60 years, abdominal aortic aneurysms continue to pose a serious threat to the life of the patient. The only way to prevent fatal consequences of aneurysm rupture is surgical operation. In the case of aneurysm rupture, the chances of saving the patient, despite intensive treatment and operations, does not exceed 10-40%.

Endovascular techniques has been introduced several years ago, and allow treatment of patients with abdominal aortic aneurysms with fewer complications in the circulatory respiratory and kidney systems. Also an increase in the level of cytokines is smaller, which appear in the development of multiorgan failure. It is a major cause of perioperative deaths of patients with ruptured aortic aneurysms.

Endovascular operations eliminate the risk of damage to sidings, or vein plexuses in hematoma. Conflicts with these vessels occur in almost 2/3 of being operated due to ruptured abdominal aortic aneurysms and can cause further aggravating the shock. The open laparotomy leads to hypothermia, which could have consequences in blood clotting.

We claim that from the fact, that there was a lower number of complications in elective
stentgraft placement then in a classical approach, it is reasonable to expect that this trend will be sustained for ruptured one.

MATERIAL AND METHODS

During the period 2001-2006 in the Department of General and Thoracic Surgery 252 patients were treated by stentgraft implantation because of abdominal aortic aneurysm. With this group of 19 (7.5%) were operated urgently because of aortic rupture. Men accounted for a majority of 17 (89%), women 2 (11%). The age of patients ranged from 56 to 81 years, on average 68.2 years. Only 5 patients knew about existence of aneurysm before admission to the hospital, with the remaining 14 rupture was its first symptom (tab. 1).

On admission patients complained of a strong pain in the lumbar area 18 (94.7%), weakness 15 (78.9%), shortness of breath 13 (68.4%). On examination hypovolemic shock symptoms were dominating: systolic pressure <90 mm Hg 17 (89.5%), tachycardia HR > 100 18 (94.7%), paleness 19 (100%), oliguria 9 (47.4%) lost of consciousness 2 (10.5%).

All patients received colloids to suplement blood lost as early as possible.

Angio-CT have been performed in all cases to confirm diagnosis and to determine the place of rupture and if there is appropriate anatomic conditions for stentgraft placement. It was also essential to select the right type and size of stentgraft.

All patients had rupture into retroperitoneal area. The volume of hematoma evaluated in CT ranged from 1000 to 2500 ml, in 14 patients active bleeding were exposed in the form of contrast medium leakage outside aorta (fig. 1, 2).

The operations were performed mostly in local anesthesia (lignocain 1%) in 10 (52.6%), subdural anesthesia in 3 (15.7%), epidural anesthesia in 2 (10.5%) and only in 4 (21.1%) under general anesthesia.

In all cases both femoral arteries were exposed after that arteriography were performed, in order to show the level of renal arteries, aortic bifurcation and the place of rupture. Then patients were given from 20 to 30 mg of heparin. We perform arteriotomy and on a stiff leader stentgraft body was introduced. Successively extension parts were introduced. 13 (68.4%) patients received aortouniliac stent-
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graft (UNI-ILIAC). After stentgraft deployment the occluder was introduced into contralateral side to prevent from endoleak. Blood supply for contralateral leg was obtained by femoro-femoral extranatomical PTFE by-pass. 6 (31.6%) patients received bifurcated stentgraft which legs ended in the common iliac arteries.

Arteries were primary sutured with wound drainage.

Because it took about 3 minutes from arteriography to deployment of main body of stentgraft intraaortic balloons had not been used. The duration of the operation counted from skin incision to last skin suture ranged from 50 to 95 minutes (average 70). Rupture closure were done after about 20 minutes duration of the operation (from 15 to 30 minutes).

During the postoperative patients were monitored in the postoperative ward where intensive treatment for hypowolemic shock were continued.

RESULTS

In all patients qualified for endovascular procedure we successfully implanted stentgraft and stopped blood loss. At the same time in all patients, it was possible to preserve blood supply in the lower limbs.

In all 19 patients (100%) we achieved a very good direct results. In postoperative period 5 (26.3%) patients died. One died because of myocardial infarction in 2 postoperative day. The remaining 4 patients died because of multi organ failure.

The remaining 14 (73.7%) were discharged home in good general condition in average 8 postoperative day. They remain in good condition and are under permanent control of our outpatient ward (fig. 3, 4).

DISCUSSION

In 1994, Yusuf et al. described the case of a successful endovascular repair of ruptured abdominal aortic aneurysm (1). Since then many other cases of aortic rupture treated with stentgrafts were described e.g. to vena cava inferior, to the digestive tract. Open procedure in case of ruptured abdominal aortic aneurysms requires general anesthesia. It is a well-described phenomenon that the blood pressure drops after the application of this type of anesthesia, which leads to the aggravation of hypotension. Local anesthesia makes circulating system more stable during and after operation (2, 3).

Peppelenbosch et al. (4) and Reichart et al. (5) recommend the use of uniiliac stentgrafts due to easier and faster implantation and closing the rupture. In its studies Lachat et al. Orend et al., used bifurcated stentgrafts, getting an equally good results.

Results of treatment of ruptured abdominal aortic aneurysms with stentgrafts presents tab. 2. They are far more favourable than the classic approach. We can observe very low mor-

Fig. 3. Angio-CT. Follow-up examination after 3 months. Stentgraft in aortic lumen. Thrombosed aneurysmal sac

Fig. 4. Angio-CT. Follow-up examination after 3 months. Uniliac stentgraft and femoro-femoral bypass. 3D reconstruction
tality rate compared with traditional operations, where perioperative mortality ranges from 50% to 90% (6, 7, 8).

We used Uniiliac stentgraft in 13 patients, of whom 10 survived. Bifurcated stentgrafts were used in 6 patients, 2 of them died. In the protocol we agreed that Uniiliac system as technically easier and faster in use should be a standard. We used bifurcated stentgrafts only if all experienced team was available and if uniiliac system was not available.

We used stentgrafts available on the market, and it was 1 Talent Medtronic stentgraft and in remaining 18 Zenith COOK.

It seems that the crucial factor affecting the survival of patients with ruptured abdominal aortic aneurysm the duration of hypovolemic shock (9). In specialized centers, transport, diagnostics and organization of operations is shorter than 20 minutes. In our centre diagnostics itself lasts from 30 to 60 minutes. Unfortunately, in Poland during transport to hospital patients is unpredictable. Hence, the death rate among our patients is slightly higher than those cited in the text. It remains, however, much lower than in conventional operations.

We start treating of hypovolemic shock during on admission with colloids transfusion. More intensive treatment of hypotension and blood transfusions started after rupture had been sealed.

Another very important factor affecting the effectiveness of this method is the experience of the team. Reports in the literature says about several or a dozen or so of cases.

In our clinic endovascular procedures are carried out since 2000 and their total number has exceeded 600 (4, 8). Due to that experience and good cooperation with companies supplying with stentgrafts, patient in an emergency can get an immediate and effective aid.

**CONCLUSIONS**

1. Advances in vascular surgery offer an effective treatment for patients in hypovolaemic shock due to abdominal aortic aneurysm rupture.
2. New treatment modalities do not lift the surgeon’s responsibility to manage shock, which remains the main cause of death in patients with ruptured aortic aneurysms.
3. If the technical conditions for stentgraft implantation are met, endovascular procedures should be the method of choice in cases of ruptured abdominal aortic aneurysm.

**REFERENCES**


**Table 2. Results of endovascular treatment for ruptured abdominal aortic aneurysms**

<table>
<thead>
<tr>
<th></th>
<th>Year</th>
<th>Patients</th>
<th>Deaths (%)</th>
<th>Hospitalization (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lachat</td>
<td>2002</td>
<td>21</td>
<td>2 (9,5%)</td>
<td>6</td>
</tr>
<tr>
<td>Reichart (5)</td>
<td>2003</td>
<td>6</td>
<td>1 (16,7%)</td>
<td>8</td>
</tr>
<tr>
<td>Peppelenbosch (4)</td>
<td>2003</td>
<td>26</td>
<td>4 (15,4%)</td>
<td>bd. / –</td>
</tr>
<tr>
<td>Our clinic</td>
<td>2001-2006</td>
<td>19</td>
<td>5 (26,3%)</td>
<td>8</td>
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COMMENTARY

Data published during the 14th International Workshop on Endovascular Therapy, which took place in June 2007 in Corsica demonstrated more than 600 patients with ruptured abdominal aneurysms documented by means of endovascular methods. The presented results were obtained from 43 centers worldwide, and the cumulated perioperative mortality considering the above-mentioned method amounted to less than 20%. Thus, I read with great interest the study of the Polish Authors who shared their experience considering minimally invasive methods in the treatment of ruptured abdominal aortic aneurysms.

The use of stentgrafts in patients with ruptured abdominal aneurysms indicates the technological progress which took place during the past half century. The open method described and introduced by Creech during the fifties of the past century was mastered by most vascular surgeons and applied in practice. During the past fifteen years we have observed the development of novel, minimally invasive operative methods, which have also gained application in vascular surgery. However, not all confirm the efficacy of stentgrafts as the method of choice considering ruptured abdominal aneurysms. The Authors cited the study by N. Pellenbosch from the Catharina Hospital in Eindhoven: “Endograft treatment of ruptured abdominal aortic aneurysms using the Talent aortouniliac system: an international multicenter study” (Journal of Vascular Surgery 2006; 43(6): 1111-1123), who compared 49 patients subjected to endovascular intervention with 51 patients operated by means of the open method. The perioperative mortality was similar in both groups amounting to 35% and 37%, respectively. In both groups the percentage of complications 90 days after surgery was high, amounting to 59%. Similar conclusions were noted in the study: “A randomised trial of endovascular and open surgery for ruptured abdominal aortic aneurysm – results of a pilot study and lessons learned for future studies” published by RJ Hinchliff in the European Journal of Vascular Surgery, 2006; 32(5): 506-13. Data presented by the Nottingham center demonstrated that the 30-day perioperative mortality in both groups was similar, amounting to 53%, and that postoperative complications occurred in 77% of patients subjected to endovascular interventions, and 80% in case of open surgery. I mentioned the cited studies in order to demonstrate that not all are so enthusiastic towards novel, minimally invasive methods considering management of ruptured abdominal aneurysms.

In my opinion, the above-mentioned method enables survival of many patients directed to specialist centers in Poland. Based on my own experience computer tomography should not be performed in every case, in order to qualify patients towards endovascular operations. The examination often prolongs the decision concerning the beginning of surgery. Prolonged diagnostic examinations and the transportation of the patient delay surgery, irrespectively of the planned method of aneurysm management. The operative room should be equipped with the C arm, which enables to perform aortography and begin immediate surgery in case of patients qualified towards stentgraft implantation. In case of hypovolemic shock the C arm renders possible the introduction of the balloon catheter by means of the femoral artery into the aorta, and prevent further extravasation. The Authors of the study did not mention the names of the systems used, as well as the decision concerning the type of stentgrafts applied, Uniliac or bifurcated.

Based on literature data the most difficult condition to fulfill is to assure proper organization of work and a 24-hour standby of an experienced team of surgeons and/or radiologists experienced in performing endovascular procedures.
Centers which aspire towards performing such complicated operations should have at their disposal a wide range of endovascular prostheses placed on shelves and ready-to-use. Considering the Health Care System in Poland logistics seems to be the weakest point, which has been confirmed by statistics demonstrating mortality in the above-mentioned group. Thus, I would like to congratulate the Authors on the obtained good results, and wish they continue, considering the development of endovascular methods in the treatment of ruptured abdominal aneurysms.

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