Open Surgical Repair Can Be One Option for the Treatment of Persistent Type II Endoleak after EVAR

Mitsutomo Yamada, MD, Hideki Takahashi, MD, PhD, Yuya Tauchi, MD, Hisashi Satoh, MD, PhD, and Hikaru Matsuda, MD, PhD

**Purposes:** Endovascular abdominal aortic aneurysm repair (EVAR) is an increasingly used method of repairing abdominal aortic aneurysm (AAA). However, the treatment of persistent type II endoleak is still a controversial issue. Five cases are reported here in which we performed open surgical repair of growing aneurysm due to persistent type II endoleak.

**Method:** Totally 128 EVAR cases were retrospectively reviewed, which were operated in our hospital from April 2008 to October 2013. These cases were followed by periodic contrast-enhanced computed tomography (CT) after EVAR. When persistent type II endoleak caused aneurysm sac growth, we performed surgical repair method for the first line treatment. In the operation, we incised the aneurysm sac by abdominal small median incision approach and sutured lumbar arteries from inside of aneurysm sac and tied inferior mesenteric artery (IMA) in addition to aneurysmorhaphy. Contrast-enhanced CT scanning was performed a week after open repair for the confirmation of complete treatment.

**Results:** Five of 128 cases (3.9%) were needed to be surgically repaired because of aneurysm sac growth (>5 mm), including two ruptured AAA cases. All patients recovered uneventfully. Contrast-enhanced CT scanning performed a week after these operations showed no endoleak and intact stent grafts and reduction of the aneurysm size.

**Conclusion:** We believe open surgical repair method of persistent type II endoleak with aneurysm expansion is secure method, and can be one of the preferable options for this life threatening complication after EVAR.

**Keywords:** EVAR, AAA, type II endoleak, surgical repair

**Introduction**

Endovascular abdominal aneurysm repair (EVAR) has been performed for more than a decade worldwide. This less invasive method of abdominal aortic aneurysm (AAA) repair continues to gain popularity. Studies that compared the outcome of EVAR with open graft replacement have consistently demonstrated a significant reduction in morbidity with endovascular repair.1–4 However, new type complications have plagued the stent graft approach, and importantly the failure to totally exclude the AAA by persistent perfusion and pressurization, defined as endoleak is one of the adverse outcomes.5,6 Despite consensus on the treatment of type I and type III endoleak, controversy remains about the optimal strategy for the treatment of type II endoleak because each strategy has their own advantages and disadvantages. Although previous studies have shown that most type II endoleaks are benign and are rarely associated with adverse of events,7 there are increasing reports of expanding aneurysm in the presence of type II endoleak eventually leading to aneurysm rupture.8,9

A variety of treatment or prevention methods have been advocated. These days, the most popular approach for the treatment of type II endoleak is transarterial coil embolization or translumbar embolization. Transarterial or translumbar embolization often needs second interventions and close surveillances. In addition, intervention to treat endoleaks also has some risks of complications. In this point, there is a question if these methods are truly minimally invasive, especially for the patients who suffer from chronic renal failure because of the frequent use of contrast medium.

After informing about merits and demerits of these each treatment, we obtained informed consent about open surgical repair from patients. We report five cases in which open surgical approach, transperitoneal sacotomy and ligation of endoleaks, was performed for the first line treatment of persistent type II endoleaks.

**Method**

Our institutional ethic committee approved our open surgical treatment method.
Open Surgical Repair Can Be One Option for the Treatment of Persistent Type II Endoleak after EVAR

Table 1  Patients’ characteristic

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Open surgical repair (n = 5)</th>
<th>Other cases (n = 123)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>78.8 ± 9</td>
<td>75.1 ± 8.7</td>
<td>0.54</td>
</tr>
<tr>
<td>Male, n (%)</td>
<td>4 (80)</td>
<td>119 (96.7)</td>
<td>0.90</td>
</tr>
<tr>
<td>BMI</td>
<td>21.0 ± 5.0</td>
<td>22.2 ± 3.6</td>
<td>0.84</td>
</tr>
<tr>
<td>Hypertension, n (%)</td>
<td>4 (80)</td>
<td>53 (43.1)</td>
<td>0.10</td>
</tr>
<tr>
<td>Diabetes mellitus, n (%)</td>
<td>0 (0)</td>
<td>13 (10.6)</td>
<td>0.44</td>
</tr>
<tr>
<td>Chronic renal failure, n (%)</td>
<td>4 (80)</td>
<td>12 (9.8)</td>
<td>0.00</td>
</tr>
<tr>
<td>History of ACS, n (%)</td>
<td>1 (20)</td>
<td>23 (18.7)</td>
<td>0.94</td>
</tr>
<tr>
<td>Anticoagulation, n (%)</td>
<td>0 (0)</td>
<td>34 (27.6)</td>
<td>0.17</td>
</tr>
<tr>
<td>Diameter of aneurysm at EVAR (mm)</td>
<td>53.6 ± 15</td>
<td>50.9 ± 11.5</td>
<td>0.55</td>
</tr>
</tbody>
</table>

BMI: body mass index; ACS: acute coronary syndrome; EVAR: endovascular aneurysm repair

Totally 128 cases were retrospectively reviewed. There were 127 cases of EVAR procedure for AAA or iliac aneurysm in our hospital from April 2008 to October 2013 and one case was referred to our hospital for the treatment of expanding aneurysm after EVAR. Patients’ characteristics of open surgical repairs and other EVAR cases demonstrated in Table 1.

After EVAR procedure, follow up was made by thin-slice (1–3 mm) contrast enhanced computed tomography (CT) after a week and 3, 6, 9, 12 months and annually thereafter. In our facility, “Aquilion One” of Toshiba Co.Ltd was used. We injected Iopamiron300 of Bayer Co. Ltd into patients’ venous at 16 mgI/kg/s speed. When the CT value of descending aorta at the pulmonary artery level reached 200–250, we started scanning. Reconstruction parameter was 10 mm and 1 mm. When type I or type III endoleak was detected, second intervention was made by adding stent grafts or ballooning. When type II endoleak was suspected, serial observations with CT scanning were performed. The maximum minor diameter of the aneurysm was measured with electronic calipers and compared with the diameter from previous study. Aneurysm sac growth (>5 mm) or persistent endoleak (>6 months) was thought to need a second procedure.10)

Forty-five of 128 cases (35.2%) had early type II endoleak and 15 of 128 cases (11.7%) had persistent type II endoleak and 5 of 128 cases (3.9%) were needed to be surgically repaired because of aneurysm sac growth (>5 mm) or rupture. Among these five cases, four cases were men. Average age was 78.8 ± 9.0 years old. The mean interval between EVAR procedure and open surgical repair was 17.6 ± 7.3 months. The maximum minor diameter of aneurysm at open repair was 62.2 ± 13.5 mm and 8.6 ± 2.8 mm larger than the diameter at previous EVAR procedure (Table 2). Data was analyzed by using SPSS14.0 software using t-test or Chi-square test. Statistical significance was assessed by using 95% confidence intervals, and P <.05 was considered significant.

Devices used in the 128 cases include Excluder (W.L. Gore & Associates, Flagstaff, AZ, USA) and Zenith (Cook Inc, Bloomington, IN, USA) and Powerlink (Endologix, Irvine, Calif).

All open surgical repairs were performed under general anesthesia on the spine position. We performed abdominal small median incision and transperitoneal sacotomy and ligated side branch endoleaks responsible for aneurysm sac expansion. In all cases, cross clamping of the stent grafts were avoided. Opening the aneurysm sac, the endovascular devices were intact and inflow bleedings from multiple lumber arteries on the posterior wall of the aneurysm were identified (Fig. 1). The lumber arteries were over sewn with 3-0 polypropylene suture and inferior mesenteric arteries were tied with 1-0 silk. Confirming no other source of bleeding by the direct inspection, the aneurysm wall was partial resected and down sized closing with absorbable sutures (Fig. 2). Two of five patients demonstrated the ruptured aneurysm.

Results

There was no significant complication and no hospital death. The mean operation time was 99.8 ± 41.7 min and the mean anesthesia time was 156.4 ± 40.7 min. Bleeding during operation was less than 200 ml in four of five cases. In all cases, we detected type II endoleak by lumber arteries and inferior mesenteric artery (IMA). No type I or type III endoleak was detected. In one case type IV endoleak was identified.

Every patient could start drinking and walking within 2 days after operation. Contrast-enhanced CT scanning performed 7 days following the operations demonstrated patent stent grafts without evidence of any endoleaks and shrinkage of aneurysms (44.7 ± 3.5 mm). All patients were followed 16.2 ± 8.1 months after surgical repair and had not suffered any complications including endoleak (Table 3).
Although endovascular aneurysm repair (EVAR) was introduced more than 15 years ago, type II endoleak development after EVAR is still a debated issue. The incidence of type II endoleak varies from 6% to 30%.\(^7,11,12\) The relationship between persistent endoleak and the risk of aneurysm growth or rupture has been described. In a series from the Albany Medical Center group, 64% of patients with persistent sac flow demonstrated sac enlargement, and 26% ruptured. It is also reported that persistent endoleak without aneurysm growth can cause aneurysm rupture.\(^13\) We limited the treatment of type II endoleak to those associated with the aneurysm sac growth of >5 mm or persistent endoleak >6 months.\(^10\) Close observations should be kept to the persistent type II endoleaks which were not treated this time and might be considered more aggressive treatment.

Regarding the type of graft and the occurrence of endoleak has been well described. Eric et al. reported that
Open Surgical Repair Can Be One Option for the Treatment of Persistent Type II Endoleak after EVAR

Table 3  Postoperative outcome of 5 cases

<table>
<thead>
<tr>
<th>Case</th>
<th>Operation time (min)</th>
<th>Hemorrhage volume (ml)</th>
<th>Persistent IMA</th>
<th>Ligation arteries</th>
<th>Stay days</th>
<th>Follow up term (months)</th>
<th>Prognosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>100</td>
<td>100</td>
<td>-</td>
<td>lumber</td>
<td>18</td>
<td>17</td>
<td>alive</td>
</tr>
<tr>
<td>2</td>
<td>81</td>
<td>200</td>
<td>+</td>
<td>IMA, lumber</td>
<td>15</td>
<td>22</td>
<td>alive</td>
</tr>
<tr>
<td>3</td>
<td>67</td>
<td>trivial</td>
<td>+</td>
<td>IMA</td>
<td>20</td>
<td>9</td>
<td>alive</td>
</tr>
<tr>
<td>4</td>
<td>180</td>
<td>600</td>
<td>+</td>
<td>IMA, lumber</td>
<td>55</td>
<td>22</td>
<td>alive</td>
</tr>
<tr>
<td>5</td>
<td>71</td>
<td>trivial</td>
<td>-</td>
<td>lumber</td>
<td>10</td>
<td>1</td>
<td>alive</td>
</tr>
</tbody>
</table>

Case numbers are consistent with those of Table 2. IMA: inferior mesenteric artery

Recently the treatment of type II endoleak by using liquid embolization agents (Onyx, glue, thrombin, polymers) has been gaining popularity. In this method, liquid embolization agents are directly injected into IMA, lumber arteries or aneurysm sac itself. However, liquid embolization agents are relatively expensive and it is also reported that unintended spill can cause a variety of complications.

The technique of laparoscopic branch ligation either via the trans- or retroperitoneal route has been suggested as an alternative for the treatment of type II endoleak by some experienced investigators. Laparoscopic surgery has also technical difficulties. In addition, peri-aortic inflammation subsequent to endovascular aneurysm repair or multiple endoleaks may increase the technical demands of the procedure.

Despite the limitations of retrospective design, small patient population and short follow-up, it seems reasonable to bring a message that direct transperitoneal sacotomy and endoleak ligation can be a feasible and reliable method of treating patients with persistent type II endoleaks. Although it is not still clear if this method is really less invasive for the patients the point it requires abdominal incision, open surgical method is safe and secure. Even when the possibility of type I or type III endoleak cannot be excluded preoperatively, direct examination of the entire aneurysm and endovascular makes it possible to treat by rapping felt around the endovascular.

Open surgical repair is free from missed or incompletely treated endoleak and this means that patients will not need subsequent interventions and hospital attendings. Our surgical repair method needs comparatively less operation time and is also safe and less invasive to use for patients who are previously regarded as unfit for conventional AAA repair. In conclusion, open repair of persistent type II endoleak causing aneurysm growth can be the feasible option for the treatment.

Conflict of Interest Statement

Mitsutomo Yamada and other co-authors have no conflict of interest.
References


