Challenging EVAR’s: Long term optimization with Onyx

RALF R. KOLVENBACH
No Disclosures
Handling of Gutters

- Watchful waiting all gutters
- Pro active treatment of high flow gutters
- Pro active treatment of low flow gutters
- Watchful waiting low flow gutters
- Maximum overlap (ViaBahn)?
- Sandwich Grafts?
Classification of gutter type in parallel stenting during endovascular aortic aneurysm repair

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Ruptured Juxtarenal AAA 87 years

Off the shelf solutions: Chimney Grafts
Issues of Chimney-technique

Type Ia Endoleak („Gutter Effect“)

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<tr>
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</thead>
<tbody>
<tr>
<td>Endoleak</td>
<td>2.7-14.2 %</td>
<td>0-2.8%</td>
<td>12.5%</td>
<td>6.2%</td>
</tr>
<tr>
<td></td>
<td>10.5%</td>
<td>4.0%</td>
<td>10.0%</td>
<td>3.0%</td>
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<td></td>
<td>10.0%</td>
<td>3.0%</td>
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The role of Liquid Embolization

- Type I Endoleaks
- Type II Endoleaks
- Gutters
Taking care of HIGH FLOW gutters (Onyx™)
ONYX

Onyx is a liquid embolic agent ethylene vinyl alcohol (EVOH) copolymer dissolved in dimethyl sulfoxide (DMSO)

It comes in two formulations:

Onyx 18 (6% EVOH) and Onyx 34 (8% EVOH).

Onyx 18 has a lower viscosity and, therefore, may flow further in the endoleak cavity. Both formulas solidify within 5 minutes of injection.
Techniques (n = 38 / 170)

- Associated interventions

<table>
<thead>
<tr>
<th>Technique</th>
<th>Count</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Luxtrenal angioplasty</td>
<td>32 cases</td>
<td>84.2%</td>
</tr>
<tr>
<td>Oversizing of the body (mean)</td>
<td>18% (range 8-32; SD ± 7.6)</td>
<td></td>
</tr>
<tr>
<td>Proximal aortic cuff extension</td>
<td>11 (28%)</td>
<td></td>
</tr>
<tr>
<td>Chimney</td>
<td>19 (50%)</td>
<td></td>
</tr>
<tr>
<td>Fenestration</td>
<td>3 (7.8%)</td>
<td></td>
</tr>
<tr>
<td>RA Loss</td>
<td>1 (2.6%)</td>
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</tr>
</tbody>
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Transcatheter Embolisation of Type 1 Endoleaks after Endovascular Aortic Aneurysm Repair with Onyx: When No Other Treatment Option is Feasible

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Endoluminal treatment of type IA endoleak with Onyx

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The role of Onyx in Gutters after ChEVAR

Chimney Grafts in Aortic Stent Grafting: Hazardous or Useful Technique? Systematic Review of Current Data

**Background:** The chimney graft (CG) technique was introduced to rescue accidentally covered aortic branches during aortic endovascular repair. It extends the sealing zone. There is concern about “gutter” type I endoleak (EL-1) and about the durability of CGs. The aim of the present report was to analyze the rapidly increasing existing data.

**Methods:** A search was performed (PRISMA criteria) for all studies of visceral and thoracic/arch chimney grafts. Technical and clinical details and outcome were assessed.

**Results:** The present review includes 831 patients who underwent EVAR/TEVAR (endovascular aneurysm repair/thoracic endovascular aneurysm repair) with one or more chimney, periscope, or sandwich grafts. For aortic visceral vessels 517 patients received 911 visceral CGs and 314 patients received 364 arch CGs. Most procedures (81% visceral and 69% arch CGs) were elective. Thirty day mortality was 4% for both groups. The rate of early EL-1 was 13% (visceral CGs) and 11% (arch CGs). Most EL-1 were handled conservatively (observation: 70% for visceral CG and 45% for arch CG). Early CG patency was high (97%-99%) and remained high during follow up (median 17 months). Late (after 30 days) EL-1 was reported in nine visceral (2%) and 12 arch (4%) CG cases. Few other late complications were reported, but those losing a kidney at the initial repair seemed to have a high risk of requiring permanent hemodialysis.

**Conclusion:** Increasing amounts of data support the benefits of visceral and arch chimney graft techniques. In particular, the low early mortality and complication rates and high long-term patency seem advantageous; however, the majority of case renal artery was sacrificed. The CG technique is valuable for complex urgent patients and needs further documentation for other patient groups.
Experience with the sandwich technique in endovascular thoracoabdominal aortic aneurysm repair

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Background The sandwich technique is an off-the-shelf solution for patients with thoracoabdominal aortic aneurysms (TAAA). In a sandwich configuration, the chimney must rest in the middle of a space created by two or three aortic endografts.

Methods All patients with TAAAs who were treated with the sandwich technique were included in the study. After expanding Viscograft grafts (S. L. Gore and Associates Inc., Flagstaff, Ariz), first, were used as parallel grafts in the renal arteries and visceral vessels. Coiled fasting chimney grafts were used for the visceral arteries and excluded fasting pressure grafts for the renal arteries.

Results During the study period, 32 patients with TAAAs were treated with sandwich grafts. Indications for the procedure in 83% was an acute event of aneurysm, including two patients with a ruptured and a stenopathtic branching lesion. Those patients required an additional stenting procedure. A total of 104 chimney grafts were implanted. Two patients died postoperatively because of the operation. Major adverse events were recorded in ten patients, including one patient with persistent paraplegia and two with permanent renal failure requiring dialysis. The incidence of chimney graft occlusion was higher in patients with their or their parallel grafts than in those with two chimney grafts only. Patients with chronic infections who had a 35%-higher incidence of chimney graft occlusion than asymptomatic patients. The number of patients with type I or III endoleaks was higher in the group with these or their parallel grafts.

Conclusions The sandwich technique is an off-the-shelf endovascular chimney to treat patients with TAAAs in an endograft setting. The combination of chimney grafts with a parallel configuration enables a rapid endovascular aneurysm exclusion with acceptable midterm results. (J Vasc Surg 2014;60:3562-6.)

The sandwich technique was introduced to offer an endovascular off-the-shelf solution to patients with thoracoabdominal aortic aneurysms (TAAAs) as an alternative to a custom-made device that can be applied in an emergent setting. It combines the principles of a chimney graft with aneurysm exclusion by using several aortic endografts.

A chimney graft can parallel to an aortic endograft into the visceral or renal vessels, and there is a direct contact between the chimney graft and the aortic wall. In a sandwich procedure, the chimney rest in a space created by two aortic endografts. The chimney graft connects the aorta only immediately above the origin of the visceral artery over a very short distance, which maintains chimney graft motion and incorporation.

The chimney grafts were originally introduced as an endovascular technique to salvage small arteries and to stably treat perianeurysmal arteries. The limitation in length of the chimney graft does not permit endovascular exclusion of thoracoabdominal aneurysms. This can be accomplished with the sandwich technique and long chimney grafts. After a description of our experience with the original Limbo technique, methods result with a modified procedure and a larger number of patients with thoracoabdominal aneurysms are presented.

METHODS

The study included 32 patients from February 2010 to January 2013. All patients presented with TAAAs. Active aneurysms were defined in patients presenting with a symptom of symptoms ≥6 weeks before admission. Patients with complications ≥6 weeks were considered as acute. The patients were classified at risk for open surgery on the basis of conventional criteria, including the American Society of Anesthesiologists (ASA) Physical Status Classification 3 or 4 criteria. Concomitantly, it did not permit an open, conventional procedure included compromised cardiac function, thoracic aortic surgery, an episode of ≥6 weeks' chronic obstructive pulmonary disease, and chronic renal failure. A contrast-enhanced 84-slice computed tomography angiogram (CTA) was performed. The Germany, Institute, New York, Brandeis, and Hawaii, Israel
Watchful waiting?
Gutters are benign?
From the Society for Vascular Surgery

The PROTAGORAS study to evaluate the performance of the Endurant stent graft for patients with pararenal pathologic processes treated by the chimney/snorkel endovascular technique

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Objectives: The chimney/snorkel endovascular aortic repair (ch-EVAR) is gaining ever greater acceptance in the treatment of pararenal pathologic processes. However, the published experience includes mostly short term clinical results with combinations of several abdominal devices and types of distal grafts. The aim of this study was the midterm evaluation of the Endurant stent graft (Medtronic, Santa Rosa, Calif) as a standard abdominal device for ch-EVAR.

Methods: Between January 2009 and January 2013, prospectively collected data of high-risk patients with pararenal pathologic processes who underwent ch-EVAR with placement of the Endurant abdominal device were analyzed. The chimney graft intended for use was a balloon-expandable covered stent. Main outcome measures were aneurysm size regression and chimney graft patency.

Results: A total of 188 thoracoabdominal aortic aneurysm grafts were successfully placed in 126 patients (mean age, 76.5 years). The technical success was 100%. The mean postoperative proximal neck length and aneurysm site size were 4.7 mm and 94.8 mm (range, 3.6-135 mm), respectively. The postoperative mean neck length after use of chimney grafts was 18.2 ± 6.3 mm. The mean aneurysm size decreased significantly (48.8 mm, 95% confidence interval, 2.5-75.0; P = .001) after a mean radiologic follow-up of 36.6 ± 17.4 months. Thirty-day mortality and midterm mortality were 0.8% and 17.7%, respectively. Two patients (1.6%) with single chimney grafts presented with late new onset of type I endoleak and underwent additional tube and multiple chimney placement. Primary chimney graft patency was 98.7%. Freedom from chimney graft-related reinterventions was 95.7%.

Conclusions: Standard use of the Endurant abdominal device for ch-EVAR in >120 patients is associated with high technical success, significant aneurysm size regression, and low incidence of secondary procedures after 3-year radiologic follow-up. These results will give significant impetus to device selection, facilitating the standardization of technique.

![Image](https://via.placeholder.com/150)

**EL – 1 : 1.6 %**
Adjunct in High Flow Areas
Real World Experience

Due to the shortage of commercially available off-the-shelf aortic arch grafts since the last years parallel grafts or chimney grafts have played an increasing role in the treatment of patients with aortic arch lesions. Although there are still issues with type endoleaks and gutters between the chimney graft and the aortic stent-graft remaining, we report our results with the Medtronic thoracic graft in combination with long self-expanding parallel grafts. Alternatively, sandwich configurations are used where a direct contact between the parallel graft and the aortic wall is avoided. We have placed a total of 65 parallel grafts into supra-aortic branches. In 21 cases chimney grafts were placed into the carotid artery, in most cases into the left common carotid artery. In 36 cases chimney grafts were placed into left subclavian artery. A maximum number of 4 parallel grafts were placed for total endovascular debranching. In addition, in 8 patients a parallel graft had to be placed into the innominate artery. There was a patency of 69% for all subclavian artery chimney grafts versus 73% for carotid artery parallel grafts. Of note is a stroke rate of 5.2%. Only 2 of the patients with an occluded left subclavian artery chimney graft required a bypass procedure for arm claudication or ischemia. We had a primary type I endoleak rate of 28%. In those cases where the leak did not resolve spontaneously, secondary interventions were required. The overall mortality rate was 3.5%. The results of parallel graft in the aortic arch are promising, but of major concern is still the high rate of type I endoleaks as well as the neurological complication rate, most probably due to catheter manipulation in patients with severe atherosclerotic arch lesions.
Symptomatic Aneurysm
Active Gutter Sealing

Indication for Chimneys +
Chimney + Polymer Sealing  =>  Active Gutter Elimination
Sandwich TAAA II  (#21)  3 months later
Single Chimney

The more curved the better
Sandwich TAAA II

14 days later

Gutters
4 Barrel Endo Debranching
Prophylactic Use of Onyx
Sandwich Bridging Stent
Gutters TAAA
Onyx Immediate sealing
Onyx
Gutter Sealing

n = 14

- Juxtarenal Aneurysms: 9
- TAAA: 3
- Aortic Arch: 2
- Type I Leak: 0
- Type III Leak: 0
Alternative Techniques

- Endo Bags
- Polymer Rings
- Endo Staplers
Minimizing Gutters
The Future

- Polymer Sealing prophylactically of all Chimney Gutters

- Results with ChEVAR and Onyx similar to Fenestrated and Branched grafts
Challenging EVAR’s: Long term optimization with Onyx

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