Challenging EVAR’s: Long term optimization with Onyx

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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 1a Endoleak ("Gutter Effect")
2.7-14.2%  0-2.8%
12.5%       6.2%
10%         4.0%
10%         3.0%

The role of Liquid Embolization

- Type I Endoleaks
- Type II Endoleaks
- Gutters
Taking care of HIGH FLOW gutters (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
  - Iuxtarenal angioplasty 32 cases (84.2%)
  - Oversizing of the body (mean) 18% (range 8-32; SD ± 7.6)
  - Proximal aortic cuff extension 11 (28 %)
  - Chimney 19 (50 %)
  - Fenestration 3 (7.8 %)
  - RA Loss 1 (2.6 %)
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 benefit 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.

831 patients

EL – 1 : 13 % Visceral and Renal Arteries

EL-1 : 11 % Arch Vessels
Experience with the sandwich technique in endovascular thoracoabdominal aortic aneurysm repair

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The sandwich technique was introduced as an off-the-shelf technique to patients with thoracoabdominal aortic aneurysms (TAAA) 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 stent grafts (ASGs).

The aneurysm is either excluded in the visceral or non-aneurysmal aorta. In a sandwich procedure, the aneurysm oral end is placed between two aortic aneurysm grafts. The chimney graft connects the aorta only immediately above the orifice of the visceral artery over a very short distance, which maintains chimney graft motion and occlusion.

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METHODS

The study included 32 patients from February 2010 to January 2013. All patients presented with TAAAs. Patients were treated with a custom-made homologous Dacron aorta in a retrograde and antegrade fashion. The TAAAs were excluded in most cases by using ASGs. Patients with chronic renal failure and chronic renal failure with diabetes mellitus were not included. None of the patients had an endovascular aneurysm repair (EVAR) before. All patients underwent a combination of open and endovascular procedures. The patients were evaluated with a computed tomography angiography (CTA) and magnetic resonance angiography (MRA) to assess the outcomes. The data were collected from the patients' medical records.

The primary endpoint was the 30-day survival rate. The secondary endpoints included the 30-day and 1-year survival rates, the freedom from re-intervention, and the freedom from major adverse events. The primary endpoint was achieved in all patients. The 30-day survival rate was 93.8%, and the 1-year survival rate was 84.4%. The freedom from re-intervention was 92.1%, and the freedom from major adverse events was 89.3%.

EL-1: 15%
Watchful waiting?
Gutters are benign?

**Natural History of Type Ia Gutter Endoleaks After Snorkel/Chimney EVAR**

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**Objective:** Snorkel/chimney (so-EVAR) endografts have gained in popularity to address the lack of widespread availability and manufacturing limitations of branched/kosmotized devices in the treatment of complex abdominal aortic aneurysms. Despite high technical success and mid-term patency of snorkel-stent configurations, concerns remain regarding the high incidence of perceived early type Ia gutter endoleaks due to lack of circumferential seal. We sought to evaluate the incidence and natural history of gutter endoleaks following so-EVAR.

**Methods:** Review of medical records and available imaging studies, including completion angiography and serial CTA, was performed for all patients undergoing so-EVAR at our institution between September 2009 and January 2015. Only procedures involving ≥1 renal artery with or without several snorkel stents were included. Need for secondary intervention related to treatment of gutter endoleaks was also recorded.

**Results:** Sixty patients (mean age, 75.3 ± 7.6 years; male, 70.0%) underwent so-EVAR with a total of 108 snorkel stents (96 renal [16 iliac], 10 SMA, 2 celiac). A median of 2 (range, 1-4) snorkel stents were placed per patient. Type Ia gutter endoleaks were noted on completion angiography in 35.0% of patients. Follow-up CTA revealed spontaneous resolution of gutter endoleaks in 29.1%, 46.2%, 61.0%, and 80.4% of patients at 1-month, 6-months, 1-year, and 2-years postprocedure, respectively (Fig). Multivariate analysis revealed the presence of ≥2 snorkel stents to be protective

**Conclusions:** Type Ia gutter endoleaks represent a relatively frequent early occurrence following so-EVAR but appears to resolve spontaneously in the majority of cases. Given that few patients require intervention related to gutter endoleaks and the presence of such endoleak does not necessarily correlate to increased risk for aneurysm sac growth, the natural history of gutter endoleaks may be more benign than originally feared.
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 chimney 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 technique for use was a balloon-expandable covered stent. Main outcome measures were aneurysm size regression and chimney graft patency.

Results: A total of 63 stents/chimney grafts were successfully placed in 39 patients (mean age, 76.6 years). The technical success was 100%. The mean postoperative proximal neck length and aneurysm size were 4.7 mm and 94.8 mm (range, 3.5-135 mm), respectively. The mean postoperative neck length after use of chimney grafts was 12.7 ± 6.3 mm. The mean aneurysm size decreased significantly (48.8 mm; 95% confidence interval, 2.206-70.94; P = .001) after a mean follow-up of 36.6 ± 17.4 months. Thirty-day mortality and all-cause mortality were 6.4% and 17.7%, respectively. Two patients (16%) with single chimney grafts presented with late new onset of type Ib endoleak and underwent additional stent and chimney extension placement. Primary chimney graft patency was 95.7%. 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. (J Vasc Surg 2014;000:1-9.)

EL - 1 : 1,6 %
Gutters in the Arch
No Tolerance

Iliac Limb in Innominate Artery

Vibahnn Reinforced in left Common Carotid
Adjunct in High Flow Areas
Developments in parallel grafts for aortic arch lesions.

Kolvenbach RR, Rabin A, Karmeli R, Alpaslan A, Schwierz E.

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, to ensure an overlapping zone of more than 7 cm between the different grafts. Alternatively, sandwich configurations are used to avoid contact between the parallel graft and the aortic wall.

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 the 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% in all these cases. 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 almost 25% secondary interventions were required mainly to treat type I leaks, in those cases where the leak did not resolve spontaneously.

The overall mortality rate was 3.5%. The results of parallel grafts 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 \(\Rightarrow\) Active Gutter Elimination
Treatment of gutters: 2 Periscopes + 1 Chimney SMA
Sandwich TAAA II (#21) 3 months later
Single Chimney

The more curved the better
Gutters

Sandwich TAAA II 14 days later
Sandwich TAAA II  (#17)  8 weeks later
4 Barrel Endo Debranching
Prophylactic Use of Onyx
Gutter Reduction

Sandwich Technique

Direct Contact between Chimney graft and Stent Graft
Sandwich Bridging Stent
TAAA Sandwich Technique
Gutters TAAA
Onyx Immediate sealing
Sandwich TAAA II 14 days later
Onyx
Gutter Sealing

n = 14

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