Management of Endoleaks

Murray Shames, MD
Professor and Chief, Division of Vascular Surgery
Director Tampa General Hospital Aortic Program
Vice Chair of Research, Dept. of Surgery
Conflict of Interests:

• Speaker: Gore, Medtronic, Cook
• Consultant: Gore
• Medical Advisory Board: Medtronic
• Educational program support: Cook, Gore, Medtronic
• Research Study Investigator: Gore, Medtronic, Cook
• Off-label use of endovascular products
Types of Endoleaks

- **Type I:** leak at graft attachment site
  - Ia: proximal
  - Ib: distal
  - Ic: iliac occluder
  - Id: gutter leaks

- **Type II:** aneurysm sac filling via branch vessel (most common)
  - IIa: single vessel
  - IIb: two vessels or more

- **Type III:** leak through defect in graft
  - IIIa: junctional separation of the modular components
  - IIIb: fractures or holes involving the endograft
  - IIIc: Fen/brach – target leaks

- **Type IV:** leak through graft fabric as a result of graft porosity, often intraoperative and resolves with cessation of anticoagulants

- **Type V:** continued expansion of aneurysm sac without demonstrable leak on imaging
Evaluation of Endoleaks: Imaging

CT/CTA
- Gold Standard (?)
- With or without IV contrast
- Cons- Radiation, nephrotoxicity

Ultrasound
- Pros- No radiation, Widely available
- Can use contrast agents
- Con- highly operator dependent

MRI/MRA
- Time-Resolved MRA
- Pros- No radiation, No nephrotoxicity
- Cons- graft artifact, machine/operator variability, pacemakers, claustrophobia

Angiography
- Pros- Verifying type of endoleak concomitant tx
- Cons- Operator dependent, invasive, radiation, nephrotoxicity, expense
Type I Endoleaks

- Persistent Type Ia endoleak 0.5-13%
- Failing old grafts or EVAR outside of IFU
- May progress to loss of proximal fixation
  - All available devices prone to migration
  - Migration incidence 2% to 30% (definition, F/U length)
Type Ia Endoleak: Example
Available Interventions

- Bare Metal Stent
- Proximal Cuff
- Conversion with AUI/Bifurcated EVAR
- Aptus Endoanchors
- Coils/Glue/Onyx
- Snorkel + Cuff
- Fenestrated Cuff / (PMEG)
- Open Conversion
  - Plication
  - Graft explant
Type Ia Endoleak Treatment

Proximal Endurant Cuff
SMA icast
R Renal icast
Open Aortic Neck Plication

- Circumferential apposition > 50% endograft to aortic wall
- Adequate oversizing of original endograft
- Absence of significant aortic calcification, thrombus or intimal disease
- Overlap of all endograft components by > 20 mm
- Structural integrity of endograft and/or cuffs
USF Type Ia Endoleak Experience

Procedures for Proximal Fixation Loss
N= 106

- Type 1A leak
  N=26 (25%)
- Loss of Endograft fixation
  N=45 (42%)
- Type 1A leak and Fixation Loss
  N=35 (33%)

Years: 2001-2013

<table>
<thead>
<tr>
<th></th>
<th>AneuRx</th>
<th>Excluder</th>
<th>Ancure</th>
<th>Zenith</th>
<th>Endologix</th>
<th>Talent</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>63 (60%)</td>
<td>13 (12%)</td>
<td>11 (10%)</td>
<td>8 (8%)</td>
<td>5 (5%)</td>
<td>5 (5%)</td>
</tr>
</tbody>
</table>
RESULTS: Secondary Interventions

Secondary Interventions N=106

Endovascular Options

- <25mm below Renal Arteries
  - Proximal Extension Cuff N=49 (46.3%)

- >25mm below Renal Arteries
  - AUI Conversion N=19 (17.9%)

- Prox + Distal fixation loss or structural failure
  - Aorto-bi-iliac Re-lining N=8 (7.5%)

- Adequate Suprarenal Aorta with 1A
  - Proximal Extension with Renal Chimney N=14 (13.2%)

Open Salvage
- Recalcitrant Leaks >50% Wall Apposition N=5 (4.7%)

Hybrid
- Open Partial Explant N=11 (10.4%)
RESULTS: AAA Sac Remodeling

Overall Cohort

- Stabilization: 45%
- Regression: 34%
- Growth: 18%
- Regression: 3%

Aneurysm Sac Behavior By Intervention

- Prox Cuff:
  - Regression: 21.2%
  - Growth: 23.8%
  - Stabilization: 14.3%
  - Relining: 3%
  - Plication: unclassified

- AUI:
  - Regression: 23.8%
  - Growth: 18%
  - Stabilization: 20%
  - Relining: 5%

- Prox Ext+ Renal:
  - Regression: 14.3%
  - Growth: 17%
  - Stabilization: 30%
  - Relining: 10%

- Relining:
  - Regression: 14.3%
  - Growth: 17%
  - Stabilization: 30%
  - Relining: 5%

- Plication:
  - Regression: 3%
  - Growth: 17%
  - Stabilization: 30%
  - Relining: 5%
  - Unk: 10%

Division of Vascular Surgery
RESULTS: Primary Endpoints

Freedom from Re-Intervention, Rupture and Explantation

<table>
<thead>
<tr>
<th># At Risk</th>
<th>106</th>
<th>91</th>
<th>76</th>
<th>71</th>
<th>60</th>
<th>54</th>
<th>45</th>
</tr>
</thead>
</table>

88%
Aptus Endoanchors
Type II Endoleak

- Sac filling via branch vessel (e.g. lumbar or inferior mesenteric artery)
- Most common EL (80%)
- Subtypes:
  - Simple (2a) – one vessel
  - Complex (2b) – two or more vessels
Type II Endoleak Treatment Guidelines

SVS PRACTICE GUIDELINES

From the Society for Vascular Surgery

SVS practice guidelines for the care of patients with an abdominal aortic aneurysm: Executive summary

Elliot L. Chaikof, MD, PhD,a David C. Brewster, MD,b Ronald L. Dalman, MD,c Michel S. Makaroun, MD,d Karl A. Illig, MD,e Gregorio A. Sicard, MD,f Carlos H. Timaran, MD,g Gilbert R. Upchurch Jr, MD,h and Frank J. Veith, MD,i Atlanta, Ga; Boston, Mass; Palo Alto, Calif; Pittsburgh, Pa; Rochester, NY; St. Louis, Mo; Dallas, Tex; Ann Arbor, Mich; and Cleveland, Ohio

Type II Endoleaks:

“For those (Type IIs) detected at the time of EVAR, further treatment is not indicated, since spontaneous resolution is possible”
Natural History of Type II Endoleaks

- Postop occurrence 9-30%
  - Higher incidence with increased # of patent lumbar arteries and IMA
  - Possibly higher incidence w/large AAAs and little mural thrombus

- Most are transient
  - 50-80% resolve w/in 6 months spontaneously

- Persistent (>6 months) in 3-8%
  - Usually don’t spontaneously resolve

- Delayed - unusual
  - Seen during f/u; ? Missed due to scan quality/protocol
Clinical Significance of Type II Endoleak

Some studies demonstrate sac growth with Type II endoleak

- Retrospective analysis of VSGNE database
  - 46% pts w/persistent or new Type II endoleak had sac growth vs 6% with no/transient Type II endoleak
  - Sac growth >5mm in 40.3% w/Type II endoleak vs 16.8% w/o
  - Freedom from sac expansion at 1, 3 and 5 yrs
    - No Type II endoleak- 99.2%, 97.6% and 94.9%
    - With Type II endoleak- 88.1%, 48.0% and 28.0%

Size of Type II endoleak may have effect on sac growth

- Nidus >15mm has 10X increase risk of sac growth

---

Clinical Significance of Type II Endoleak

Benign Course

EUROSTAR data (2,463 pts.)
- No increased rupture risk associated with Type II endoleak
  - Late rupture rate 0.52% in pts with Type II endoleak
- Recommended tx only in pts. with Type II endoleak and sac growth

Retrospective review of 10 trials (2,617 pts), 2000-2004\(^1\)
- No reported ruptures related to Type II endoleak

Clinical Significance of Type II Endoleak

Not Benign Course

EVAR I and II - 22/823 with late rupture (2.7%)\(^1\)
- at least 5 (0.6%) had Type II endoleak and sac growth

MGH group experience\(^2\)
- 164/873 pts (18.8%) with early Type II endoleak
  - 4/164 (2.4%) ruptured
- 33/873 pts (3.8%) with persistent Type II endoleak
  - 2/33 (6.1%) ruptured

Review of 32 retrospective studies (21,744 pts)\(^3\)
- 1515 (10.2%) Type II endoleak (35.4% resolved spontaneously)
- 14 ruptures (0.9%) - 6 known to not have sac growth

\(^1\)Wyss TR et al, Ann Surg 2010; 252: 805-812
\(^3\)Sidloff DA et al, Br J Surg 2013; 100(10):1262-1270
When to Treat Type II Endoleaks

- AAA enlargement >5 mm in 6 month interval
- Persistent Type II endoleak with pain or tender aneurysm
- AAA > 6 cm
- Change in AAA morphology
- Change in stent-graft position
Type II Endoleak Treatment Options

• Embolization
  – Transarterial
  – Translumbar
  – Peri-graft **

• Laparoscopic ligation of feeding arteries
  – Technically difficult, complications, poor results

• Open sacotomy and ligation of feeding vessels (usually a last resort)
Tampa General Hospital/USF Experience

252 Type II endoleaks treated (2008-May 2015)
  – Type IIa- 38%
  – Type IIb- 62%

- Associated Type I endoleak - 15%
- Expanding Aneurysm Sac - 89%
- Time to treatment 3.7 yrs

Access
  ▪ Transarterial- 85%
  ▪ Translumbar- 15%

Agents
  ▪ Liquid Embolic only- 33%
  ▪ Liquid Embolic and Coils- 22%
  ▪ Coils only- 17%

Source
  ▪ Lumbar artery- 77%
  ▪ IMA- 41%
Results

• Complication Rate
  – 43 (17%)

• Residual Endoleaks
  – 88% endoleak resolution
  – 2 Patients with AAA Rupture post-treatment

• Deaths
  – 6 (2%)
Type II Endoleak Summary

- CT not always predictive of endoleak type
- Type II may masquerade a Type I or III endoleak
- Persistent / late Type II endoleaks have the greatest clinical significance
- Type II endoleaks can lead to sac growth
- Type II endoleaks can cause aneurysm rupture
- Ideal outcome for embolization is occlusion of all feeding vessels and nidus
- Perigraft access preferred for Type IIb endoleaks and Transarterial access for Type IIa endoleaks
- No ideal embolic agent
Type III Endoleaks

- IIIa: junctional separation of the modular components
- IIIb: fractures or holes involving the endograft
- IIIc: fen/branch to target vessel leaks

- Suspected on CTA or MRA if endoleak is closely apposed to the graft and not at top or bottom
- High pressure leaks that should be fixed urgently
Type III Endoleaks

• Proper preoperative planning and intraoperative technique should prevent all of those
  – Minimize the number of components
  – Deploy the contralateral gate in straight aortas
  – Maximize overlap between components
  – Avoid junctions in angulated vessels
  – Follow the IFU for overlap
Type III Endoleaks

Endoleak at L renal fenestration

Endoleak resolved with Extension stent
Type III Endoleaks

Branched TAAA with L renal endoleak

Endoleak resolved with stent extension
Type III Endoleaks: Treatment Options

• Prevent
  – Minimum Overlap required but maximize as much as possible
  – Next-gen devices allow for overlap flexibility
  – Do not plan Extension as limb

• Repeat balloon molding

• Reline the overlap with endograft

• Add a bare-metal stent to provide more radial force

• Place Endoanchors between the proximal components – ensure penetration into aortic wall

• Role for sac filling technology?
Type IV Endoleaks

- Decreasing prevalence because of improvement in stent graft fabric porosity
- Relation to over anticoagulation & over pressurization of the power injector?? Lack of outflow
- Always suspect a more serious cause of endoleak such as Type I or III
- Treated by observation, anticoagulation reversal, sac embolization, relining
Type V (endotension)

2013 Preop 6.5cm AAA

2017 10.5cm AAA
Type V Interventions

- Look for other endoleaks
- Graft relining
- Explant
- Observation?