NEW INNOVATIONS IN ENDOLEAK MANAGEMENT
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DISCLOSURES
• Nothing to disclose

GOALS
• Background
• Surveillance Guidelines
• Type I endoleaks
• Chimney/snorkels
• FEVAR
• Endofixation
• Type II endoleaks
• Significance?
• Prevention?
• Type III endoleaks
• Reline
• “Other” fixes

BACKGROUND
• Majority of AAA repair is done endovascularly
• SVS practice guidelines (JVS 2009)
• CTA at one month post EVAR
  • If no endoleak/hone year
  • If endoleak or abnormality: 6 months
• Color duplex ultrasonography or noncontrast imaging in renal failure
• Lifelong Surveillance
  • Change in position of endograft?
  • Status of aneurysm sac?
  • Endoleak?

LIFELONG SURVEILLANCE
• Maldeployment
• Inadequate Sizing
• Graft Migration
• Anatomic remodeling
• Patients lost to followup have much poorer survival than patients who have in-person followup after EVAR
  • 85% versus 92%
  • Thought to be due strictly to surveillance postoperative scans
ENDOLEAKS: LIFELONG SURVEILLANCE

- 880 patients with EVAR 1999-2015
- Sac shrinkage/expansion
- Reintervention
- New endoleaks appeared during the entire follow-up of the study
- Endoleaks evolved to requiring reinterventions in nearly 1/3 of patients

- Type I
  - Presence limb stenosis/thrombosis
  - Age >65 years
  - Active smoking
  - Sac expansion
  - Freedom from reintervention
  - 95.6% 2 years
  - 94.1% 4 years
  - 90.5% 6 years
  - 87.5% 8 years
  - 86.4% 10 years
  - 83.5% 12 years
  - 80% 14 years
  - 6 deaths

- Type II
  - 2 sac rupture with type I endoleak
  - Overall survival 94.5% 2 years, 33.3% 14 years

TYPE IA ENDOLEAKS

- Incomplete/ineffective seal at proximal or distal end of graft
- Endograft migration downwards
- Aneurysm morphology/anatomy changes
- Goal of repair to improve proximal fixation
- Endograft cuff
- Suprarenal fixation
- Palmaz stenting
- Anchoring devices

TYPE IA ENDOLEAK: SAC ENLARGEMENT

- Treatment
  - Sac Enlargement
  - Open Ligation

TYPE IA ENDOLEAK: SNORKEL/CHIMNEYS

- Snorkel/Ch-EVAR
  - Attempt to increase proximal neck length through the use of stents into visceral vessels
  - 60 pts/111 snorkel stents
  - Gutter leaks as high as 30% in the early postoperative period
  - Spontaneous resolution
    - 65% within 1 year
    - 88% within 18 months
  - Reintervention rate of 3.3%

DEVICE SELECTION

- 20–30% oversizing of cuff based on max diameter at base of superior mesenteric artery
- Adequate neck to achieve a minimum of 1.5 cm of new seal
- 1-mm oversizing for renal vessels
- Access left brachial versus left axillary artery
- Preference for cuffs with suprarenal fixation based on distance of main body endograft from lowest renal artery

TYPE IA ENDOLEAK: SNORKEL/SNORKELS

- Time to presentation avg 6 years
- 19 patients with type I endoleak requiring Ch-EVAR as salvage procedure
- 18 cuff with parallel visceral stents
- 1 relining with parallel visceral stents
- 29 new total stent grafts placed
- Primary technical success 100%
- Reintervention in one patient for new type III endoleak
- 18month follow up with 100% snorkel patency
TYPE IA: PROTOCOL

Endovascular Options
- >13mm Below Renal Arteries
- <13mm Below Renal Arteries
- Proximal aortic or iliac aneurysm
- Structural Failure
- Adequate Suprarenal or Supra-Aortic
- Recanalized Type IA
- Recanalized Type IA with >150% Endograft Wall Apposition

Open Intervention
- Proximal Extension Cuff
- Aortic Conversion
- Aorta-Bifurc No-Sling
- Proximal Extension with Paired Sealing
- Open Aortic Neck Filtration
- Open Femoral Access

TYPE IA: FEVAR

- Salvage with FEVAR
- Length often prohibitive to reline depending on level of migration
- Solution— FEVAR (Renu) cuff
- Case reports—3 patients
  - 6 renals
  - 3 SMAs
  - 1 celiac
- 12 month follow up demonstrated 100% patency with no endoleak

TYPE IA: FEVAR II

- 26 pts Netherlands/Germany
  - 2002-2012
  - 23 fenestrated cuff
  - 3 bifurcated stent graft
  - Mean follow up 26.8 mos
  - Technical success 92%
  - No Type IA endoleak on first CTA

TYPE IA: FEVAR III

- Target vessel patency 100% (70)
- 4 required reintervention
  - Rupture, iliac limb occlusion, type IB and type II endoleak
- Increased technical challenges secondary to previously placed stent graft (11 cases with catheterization difficulties)
- Outcome seemed related to initial technical success
- Device availability in USA—??

TYPE IA ENDOLEAKS: ENDOFIXATION

- ANCHOR registry
  - 319 patients, 43 dies, 23months
  - EndoAnchors implanted proximally
  - 242 pts at time of initial procedure
  - Revision arm: 77 patients
  - Existing endograft with proximal aortic neck complications
  - 7 pts (9%) in revision arm required secondary intervention for residual type IA endoleak
  - 2 technical device failures in total
  - Fractured or incomplete penetration of screw

Table IV Endografts in the primary and revision arms

<table>
<thead>
<tr>
<th>Endograft</th>
<th>Primary arm (n = 242)</th>
<th>Revision arm (n = 77)</th>
<th>All (N = 319)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gore Excluder</td>
<td>86 (35.5)</td>
<td>16 (20.8)</td>
<td>102 (32.0)</td>
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<tr>
<td>Cook Zenith</td>
<td>40 (16.5)</td>
<td>11 (14.3)</td>
<td>51 (16.0)</td>
</tr>
<tr>
<td>Medtronic Endurant</td>
<td>112 (46.3)</td>
<td>10 (13.0)</td>
<td>122 (38.2)</td>
</tr>
<tr>
<td>Medtronic AneuRx</td>
<td>0</td>
<td>18 (23.4)</td>
<td>18 (5.6)</td>
</tr>
<tr>
<td>Medtronic Talent</td>
<td>0</td>
<td>14 (18.2)</td>
<td>14 (4.4)</td>
</tr>
<tr>
<td>Other</td>
<td>4 (1.7)</td>
<td>8 (10.4)</td>
<td>12 (3.8)</td>
</tr>
</tbody>
</table>

Table IV Endografts in the primary and revision arms
Table VI Secondary procedures

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Primary arm (n = 242)</th>
<th>No. (%)</th>
<th>Revision arm (n = 77)</th>
<th>No. (%)</th>
<th>All (N = 319)</th>
<th>No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open surgical conversion</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Repair of type Ia endoleak</td>
<td>1 (0.4)</td>
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<td>7 (9.1)</td>
<td></td>
<td>8 (2.5)</td>
<td></td>
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<tr>
<td>Treatment of type II endoleak</td>
<td>1 (0.4)</td>
<td></td>
<td>4 (5.2)</td>
<td></td>
<td>5 (1.6)</td>
<td></td>
</tr>
<tr>
<td>Treatment of migration</td>
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<td></td>
<td>0</td>
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<tr>
<td>Treatment of graft limb kinking</td>
<td>1 (0.4)</td>
<td></td>
<td>1 (1.3)</td>
<td></td>
<td>2 (0.6)</td>
<td></td>
</tr>
<tr>
<td>Treatment of graft limb occlusion</td>
<td>2 (0.8)</td>
<td></td>
<td>1 (1.3)</td>
<td></td>
<td>3 (0.9)</td>
<td></td>
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<tr>
<td>Treatment of access vessel injury</td>
<td>1 (0.4)</td>
<td></td>
<td>0</td>
<td>0</td>
<td>1 (0.3)</td>
<td></td>
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<tr>
<td>Lower extremity revascularization</td>
<td>2 (0.8)</td>
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<td>1 (1.3)</td>
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<td>3 (0.9)</td>
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<td><strong>Total secondary procedures</strong></td>
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ENDO FIXATION DEVICES

- Conclusions:
  - Couldn’t hurt (low complication rate, user-friendly)
  - Might help
  - Should we be placing these on every EVAR as prophylaxis?

TYPE II ENDOLEAKS

- Retrograde blood flow from an aortic branch vessel
  - IMA
  - Lumbar
  - Middle sacral
  - Accessory renal arteries
- Report incidence vary widely in literature
  - 3-40%
  - Most commonly between 10-20%
- Increased chance of developing type II
  - Mural thrombus
  - Patent aortic branch vessels

693 pts 2009-2013 Australia
- 225 pts developed type II endoleaks
- 133 spontaneously resolved
- 37 untreated unresolved
- 16 underwent intervention
- Smoking and warfarin protective
- Age, R iliac artery tortuosity, and large external iliac artery diameters were risk factors

TYPE II ENDOLEAKS CAN/SHOULD WE PREVENT THEM?

- Preemptive embolization of sac
  - Coils, fibrin glue
- 72 pts 2011-2014
  - 36 with, 36 without
  - Group without embolization
    - 9 type II, 1 type Ia
  - Group without embolization
    - 2 type II, 1 type Ib
  - Average cost 7500 euro more
  - Avg exposure time 13 min more
TYPE III ENDOLEAKS

- Relining the graft
  - Cuff or limb
  - Sometimes the whole graft!
  - Pros: morbidity minimal with endovascular repair
  - Pitfalls: contrast usage

- Conversion to AUI and plug

- Contributing factors (thin graft material):
  - Guidewire/catheter manipulation and aggressive balloon molding
  - Off-label use in highly calcified anatomy
  - Lateral movement (changes in implant stability)
  - Other device proximal extensions

TYPE III ENDOLEAKS

- Incidence is fairly rare with most endografts
  - 965 EVAR procedures over 20 years (France/Belgium)
  - 20 type III leaks identified (2.1%)
  - Median interval between EVAR and diagnosis was 5.5 years (0-13 years)
  - 88% managed endovascularly
  - AUI: 5 (20%)
  - Limb extension: 7 (28%)
  - Covered stent placement: 8 (32%)
  - Aortic cuff: 1 (4%)
  - 25% recurring

- Variety of stent grafts
  - Stentor
  - Vanguard
  - Zilver
  - Excluder
  - Talent
  - AneuRx
  - Endurant
  - Ovation
  - Anaceva

- Independent risk factors:
  - 1st and 2nd generation endografts

TYPE IIIA ENDOLEAKS:

- Contributing factors (modular disconnect)
  - Inadequate component overlap at index procedure
  - Lateral movement in large or tortuous aortas leading to reduction or loss of component overlap
  - Excessively oversized proximal extension relative to bifurcated main body device.

- Preventative: better device selection with emphasis on maximizing overlap

TYPE IIB ENDOLEAKS: AFX

- Contributing factors (thin graft material):
  - Guidewire/catheter manipulation and aggressive balloon molding
  - Off-label use in highly calcified anatomy
  - Lateral movement (changes in implant stability)
  - Other devices proximal extensions


SCVS 2016: Endosalvage Techniques – Relining of Infrarenal EVAR as a solution for High-Pressure Endoleak. Inui et al.
OTHER SOLUTIONS TO TYPE IIIb...

- 4 year old fenestrated Cook graft
- Aneurysm growth 5.3→6.7cm
- Angiography with selective catheterization revealed type IIIb endoleak in proximal graft
- Not considered for open repair given comorbidities.
- Endovascular relining difficult given fenestrations of SMA/RRA
- Defect sized with balloon, then amplatz plug "fills" the hole.

CONCLUSIONS

- Endoleak management is continually evolving with new technology and new challenges
- Old standbys still work...
- Innovative techniques demand a critical eye
- (and randomized controlled trials)
- "Newest" doesn’t always mean "best"