How Does Aortic Neck Morphology And Thrombus Burden Influence AAA Sac Behavior After EVAR

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DISCLOSURES
• NONE

The Hostile Neck?
- Short
- Calcification
- Angulation
- Conical
- Thrombus

Thrombus is particularly controversial
- Increased thromboembolic events (Shintani et al)
- Decreased sac regression (Yeung et al)
- No difference in secondary intervention, sac growth, peripheral embolization (Van Herwaarden et al)

GOAL
To evaluate infrarenal aortic neck morphology, its influence on patient outcomes as well as neck/sac behavior following EVAR.

Quantifying Neck Thrombus
- Most clinical studies have used percentages of thrombus-covered neck diameter:
  - Subjective?
- Volumetrics: perhaps more accurate estimation of thrombus measured over aortic distance (aortic neck health)
  - Less descriptive of thrombus?
    (thickness at particular location/circumferential involvement)
Methods

Single institution retrospective review from 2009-2013

Inclusion criteria:
- elective EVARs for infra renal AAA
- Pre operative thin cut (1-4mm) contrast CT scan available
- Post operative CT scan available

Exclusion criteria
- FEVAR, TEVAR, isolated iliac aneurysms

Image post processing
- Volumetrics and all other aortic measurements conducted by 2 independent radiologists using TeraRecon
- Measurements were verified by independent surgeons with good correlation
- Thrombus volume of aortic neck: calculated at 5-mm, 10-mm, and 15-mm below the renal arteries by subtracting the inner wall volume from the outer wall volume.
- Neck Shape was determined qualitatively into 3 categories: Funnel, Conical, and Cylindrical

Aortic Neck Thrombus Volume using Volumetrics

Volume Thrombus = Difference between outer wall (entire aortic volume) and inner wall volume (lumen)

Percent thrombus = Volume thrombus / Outer wall volume
Methods

Outcomes

• Aortic aneurysm sac growth (>5mm)
• Neck dilatation >5mm: at 0,5,10mm below lowest renal artery
• Type I leaks

Statistics:
Chi square for categorical and T test for continuous variables. (P<0.05 considered statistically significant)

Results

Baseline Characteristics

<table>
<thead>
<tr>
<th>Variable</th>
<th>All Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td>146</td>
</tr>
<tr>
<td>Male</td>
<td>115 (78.8%)</td>
</tr>
<tr>
<td>Female</td>
<td>31 (21.2%)</td>
</tr>
<tr>
<td>Age</td>
<td>74.7 (+/- 8.2)</td>
</tr>
<tr>
<td>Race</td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>138/146 (95%)</td>
</tr>
<tr>
<td>African American</td>
<td>4/146 (3%)</td>
</tr>
<tr>
<td>Other</td>
<td>8/146 (8%)</td>
</tr>
<tr>
<td>Baseline Profile</td>
<td></td>
</tr>
<tr>
<td>HTN</td>
<td>106/146 (72.6%)</td>
</tr>
<tr>
<td>CAD/CHF</td>
<td>57/146 (39%)</td>
</tr>
<tr>
<td>COPD</td>
<td>24/146 (16%)</td>
</tr>
<tr>
<td>HLD</td>
<td>71/146 (48%)</td>
</tr>
<tr>
<td>ESRD</td>
<td>3/146 (2%)</td>
</tr>
<tr>
<td>Atrial fibrillation</td>
<td>14/146 (10%)</td>
</tr>
<tr>
<td>TIA/CVA</td>
<td>4/146 (3%)</td>
</tr>
<tr>
<td>PVD</td>
<td>15/146 (10%)</td>
</tr>
<tr>
<td>Diabetes type II</td>
<td>20/146 (14%)</td>
</tr>
<tr>
<td>History of tobacco use</td>
<td>88/146 (60%)</td>
</tr>
<tr>
<td>Symptoms</td>
<td>8/146 (6%)</td>
</tr>
</tbody>
</table>

Mean follow-up 24 months (Range 1–118 months)

Neck Dilatation

Mean follow-up 24 months (Range 1–118 months)

Neck Shape

Cylindrical 78 (54%)
Conical 51 (35%)
Conical Funnel 16 (11%)
Cylindrical 51 (35%)

Aortic Neck Shape

Conical
Funnel
Cylindrical
Sac Growth
19/146 patients (13%)

No significant difference in sac growth based on neck morphology

<table>
<thead>
<tr>
<th>Neck Morphology</th>
<th>% Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Funnel (n=2)</td>
<td>10.5%</td>
</tr>
<tr>
<td>Conical (n=7)</td>
<td>36.8%</td>
</tr>
<tr>
<td>Cylindrical (n=10)</td>
<td>52.6%</td>
</tr>
</tbody>
</table>

Neck Thrombus

<table>
<thead>
<tr>
<th>% Thrombus</th>
<th>0mm</th>
<th>10mm</th>
<th>15mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>None: 0-25%</td>
<td>25.3% (37)</td>
<td>19.9% (29)</td>
<td>22.6% (33)</td>
</tr>
<tr>
<td>Mid: 25-50%</td>
<td>65.8% (96)</td>
<td>74.7% (109)</td>
<td>74.0% (108)</td>
</tr>
<tr>
<td>Moderate: 50-75%</td>
<td>6.2% (9)</td>
<td>3.4% (5)</td>
<td>2.7% (4)</td>
</tr>
<tr>
<td>Severe: &gt;75%</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Aortic Neck Dilatation is Associated With Conical Necks

Neck Thrombus

<table>
<thead>
<tr>
<th>Type</th>
<th>0mm</th>
<th>5mm</th>
<th>10mm</th>
<th>15mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type 1</td>
<td>No Thrombus</td>
<td>Thrombus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type 2</td>
<td>No Thrombus</td>
<td>Thrombus</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Results

Gender Analysis

The percent thrombus of the aortic neck was greater in female patients at 35.7% vs 30% (P=0.02).
Preoperative AAA diameter was 5.8cm in women and 5.5cm in males (p=0.348).
Abdominal aneurysm sacs were smaller in women at 1 year follow up (4.2cm vs 5.1cm, P<0.002)
Men had more type I leaks (3.5% vs 0%), 0 women (0%) p=NS
Conclusions

Neck morphology has no impact on sac behavior (growth).
• Conical aortic necks appear to be associated with increased neck dilatation.

Aortic neck thrombus is not statistically significant for type 1 leaks, aneurysm sac growth, or increased neck dilatation.

But... Trend towards neck dilatation with increased neck thrombus (by volumetric analysis)

Volumetric Analysis of thrombus may provide more accurate description of the health of the aortic neck than axial % diameter measurements

Larger sample size and longer follow-up needed

References


Results

Sac Growth: No correlation with thrombus burden, neck shape, Type I leaks: No correlation with thrombus burden, neck shape, or percent oversize.

Neck dilatation: was associated with conical neck, however there was no association with percent oversizing or thrombus burden.

Pre Operative CTA

Pre Operative CTA with Volumetrics thrombus evaluation

50%

CTA 4 years post EVAR