Long-Term Results of Standard EVAR in Angulated Necks

Hence JM Verhagen, MD PhD

Professor and Chief of Vascular Surgery
Erasmus University Medical Center, Rotterdam, The Netherlands

Nelson F. G. Oliveira, Frederico Bastos Gonçalves, Sanne E. Hoeks, Marie Josee van Rijn, Klaas Ultee, Sander Ten Raa, Joost A. van Herwaarden, Jean -Paul P. M. de Vries
Disclosure

Medtronic
WL Gore
Philips
Abbott
Endologix
Arsenal AAA
Proximal aneurysm neck

- Achilles heel of EVAR
- Essential for proper fixation and sealing
- Most frequent constraint for EVAR
EVAR in Angulated Proximal Necks

• Patients with highly angulated neck anatomy may account for up to a fifth of all EVAR patients

• Highly angulated neck anatomy is associated with worse outcomes.

• Consequently, this anatomy is excluded from the IFU and therefore poorly studied.

• Do contemporary grafts perform better?
Angle = trouble?
Angle = trouble ?
Hypothesis

Severe proximal neck angulation does *not* influence early and mid-term results when using the Endurant Stentgraft System.
Prospective database
3 high-volume centers

<table>
<thead>
<tr>
<th>Study</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>45</td>
<td>65</td>
</tr>
</tbody>
</table>

Outside IFU  
Inside IFU

30 day technical & clinical success
Deployment accuracy
Operative details
Long-term Follow-up
### 30-day technical and clinical success

<table>
<thead>
<tr>
<th></th>
<th>ANGULATED</th>
<th>NON-ANGULATED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary success</td>
<td>100% (1 prox. cuff)</td>
<td>100%</td>
</tr>
<tr>
<td>Mortality</td>
<td>2.2%</td>
<td>3.1%</td>
</tr>
<tr>
<td>Major complic.</td>
<td>6.7%</td>
<td>6.2%</td>
</tr>
<tr>
<td>Early Type I EL</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Migration</td>
<td>0%</td>
<td>0%</td>
</tr>
</tbody>
</table>
## Deployment accuracy

### Operative details

<table>
<thead>
<tr>
<th></th>
<th>ANGULATED</th>
<th>NON-ANGULATED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance renal-graft</td>
<td>2,3mm</td>
<td>2,4mm</td>
</tr>
<tr>
<td>Duration of procedure</td>
<td>105min</td>
<td>104min</td>
</tr>
<tr>
<td>Contrast</td>
<td>87ml</td>
<td>88ml</td>
</tr>
<tr>
<td>Gy time</td>
<td>12min</td>
<td>13min</td>
</tr>
</tbody>
</table>
So, in the short term it works
Techniques

- Take stiff part of wire out
- Push-Up Technique
- Reversed Slider technique
Long-term FU
What Do We Know?

50 publications on EVAR outcome in **challenging anatomy** w/ new generation SG devices

36 publications specifically focusing on **neck-related** challenging anatomical factors

10 publications specifically focusing on **severe neck angulation**

2 publications w/ **data >4 yrs** on severe neck angulation
Study Design

• Retrospective case-control study from a prospective multicenter database:
  
  • 2008-2009
  • 3 high-volume centers
  • Endurant stent graft
  • Angulated Study Group
  • Non-Angulated Matched Control Group
## Baseline Patient Characteristics

<table>
<thead>
<tr>
<th></th>
<th>Angulated (n=45)</th>
<th>Non-angulated (n=65)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yrs), mean (SD)</td>
<td>75.6 (6.5)</td>
<td>72.7 (8.5)</td>
<td>0.49</td>
</tr>
<tr>
<td>Male</td>
<td>36 (80.0)</td>
<td>59 (90.8)</td>
<td>0.11</td>
</tr>
<tr>
<td>Smoking</td>
<td>32 (71.1)</td>
<td>51 (78.5)</td>
<td>0.38</td>
</tr>
<tr>
<td>Hypertension</td>
<td>25 (55.6)</td>
<td>35 (53.8)</td>
<td>0.70</td>
</tr>
<tr>
<td>Cardiac disease</td>
<td>22 (48.9)</td>
<td>27 (41.5)</td>
<td>0.45</td>
</tr>
<tr>
<td>DM</td>
<td>6 (13.3)</td>
<td>15 (23.1)</td>
<td>0.20</td>
</tr>
<tr>
<td>COPD</td>
<td>14 (31.1)</td>
<td>13 (20.0)</td>
<td>0.18</td>
</tr>
<tr>
<td>Creatinine clearance &lt;60 mL/min/1.73 m²</td>
<td>16 (35.6)</td>
<td>20 (30.8)</td>
<td>0.60</td>
</tr>
<tr>
<td>CVD</td>
<td>4 (8.9)</td>
<td>12 (18.5)</td>
<td>0.16</td>
</tr>
<tr>
<td>PAD</td>
<td>11 (24.4)</td>
<td>15 (23.1)</td>
<td>0.87</td>
</tr>
<tr>
<td>ASA class III/IV</td>
<td>33 (73.3)</td>
<td>43 (66.2)</td>
<td>0.42</td>
</tr>
<tr>
<td>AAA diameter (mm), mean (SD)</td>
<td>68.6 (14.2)</td>
<td>58.8 (7.6)</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>AAA volume (cc), mean (SD)</td>
<td>309.5 (30.1)</td>
<td>187.4 (8.2)</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Prox neck diameter (mm), mean (SD)</td>
<td>25.2 (4.2)</td>
<td>25.5 (4.5)</td>
<td>0.71</td>
</tr>
<tr>
<td>Prox neck length (mm), mean (SD)</td>
<td>27.2 (14.8)</td>
<td>32.6 (13.1)</td>
<td>0.05</td>
</tr>
<tr>
<td>Neck thrombus &gt;25% of circumference</td>
<td>8 (17.8)</td>
<td>10 (15.4)</td>
<td>0.74</td>
</tr>
<tr>
<td>Neck calcification &gt;25% of circumference</td>
<td>3 (6.7)</td>
<td>1 (1.5)</td>
<td>0.16</td>
</tr>
<tr>
<td>Suprarenal neck angle (°), mean (SD)</td>
<td>51.4 (21.1)</td>
<td>17.9 (17.0)</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Infrarenal neck angle (°), mean (SD)</td>
<td>80.8 (15.6)</td>
<td>35.4 (20.0)</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>
Summary @ 4Y

Severe proximal neck angulation did not affect:

- Primary clinical success
- Risk of rupture
- Type 1A endoleak
- Neck-related reinterventions
- AAA-related adverse events
- Stent fractures
Primary Clinical Success @ 7.4 Y

Corrected for baseline differences
(AAA diameter, neck length, oversizing)
Survival @ 7.4 Y

Corrected for baseline differences
(AAA diameter, neck length, oversizing, gender)
Severe proximal neck angulation did not affect:

- AAA sac growth
- Neck dilatation
- Migration (> 5 mm)
- Rupture
- Stent fractures (0)
- Neck-related adverse events or reinterventions
- Barb detachment (never multiple)
Morphological Outcomes

No remodeling after first post-op CT scan
Type 1A endoleak

- Difference in type 1A endoleak rate ($p=0.016$):
  - Angulated group: 11.4%
  - Control group: 1.6%

- All needed open conversion
Conclusions

• We report the longest-term outcomes of standard EVAR in patients with severely angulated proximal necks

• Despite long proximal seal lengths, a worrisome increased rate of type 1A endoleak was found

• No difference was found in
  – Primary clinical success
  – Overall survival
  – Aneurysm related survival
Conclusions

• 7-Year FF type1A rate was 86 %.

• Consequently, angulated-neck patients with sufficient neck-length can benefit from standard EVAR.

• Lifelong surveillance with CT-imaging should be maintained.

• Loss of proximal seal was due to progressive neck dilatation, not to migration. The primary use of endoanchors to prevent this may improve future outcomes.
Thank you