Conformability is key in treating complex iliac anatomies

A Millon
MD, PhD
Vascular and Endovascular Surgery
Lyon, France
EVAR - TEVAR

Long term results depend on aortoiliac morphology:

Aneurysm size
Proximal and distal neck morphology
(Length, diameter, thrombus, calcification, angulation)

Aortoiliac tortuosity / Stent graft conformability

Anatomical fit between patient and stent graft = important factor for success
Context

- **Definition of Arterial tortuosity?**
  - Methods of measurement

- **Definition of Stent-graft conformability?**
  - Respect of arterial tortuosity, length ...
  - Wall apposition
  - Kinking, endoleaks ...
Arterial Tortuosity

Thoracic aorta  Abdominal aorta  Iliac arteries
Arterial Tortuosity
Methods of measurement

• Double Iliac Sign

• Angle

• Tortuosity Index
Arterial tortuosity
Tortuosity Index TI


Distance along the centerline
Straightline distance

Aortic TI
CIA TI
Pelvic artery TI
Stent Graft Conformability

Respect of native arterial anatomy
Respect of arterial **length**
Centerline distance pre and post implantation
Stent Graft Conformability

Respect of native arterial anatomy
Respect of arterial tortuosity
Tortuosity Index pre and post implantation
Stent Graft Conformability

Wall Apposition

Bench test

Stent Graft Conformability

Good wall apposition in tortuous anatomy

Lack of apposition = Bird’s beak

- Length of unapposed stent-grafts
- Distance between proximal end of the covered SG and inner curvature

Ueda et al. Radiology 2010
Stent Graft Conformability

Stent graft composition and design

Stent nature: nitinol, stainless steel

Stent configuration: continuous spiral, sinusoidal or discontinuous

Stent to graft attachment: suture, bonding film...

Graft material: ePTFE, Polyester
Stent Graft Conformability

- EVAR: Similar conformability for Endurant, Zenith Flex, Zenith LP, Spiral Z
  
  *Lee et al. J Endovasc Ther 2014*

- EVAR: Excluder > Endurant > Zenith Flex
  
  *Coulston et al. J Vasc Surg 2014*

- TEVAR: C TAG = Relay > Zenith
  
  *Canaud et al. J Vasc Surg 2013*

- Iliac Branched device: IBE > Zbis
Clinical Research

Conformability of GORE Excluder Iliac Branch Endoprosthesis and COOK Zenith Bifurcated Iliac Side Branched Iliac Stent Grafts

Nellie Della Schiava, Matthieu Arsicot, Tarek Boudjelit, Patrick Feugier, Patrick Lermusiaux, and Antoine Millon, Lyon, France

Ann Vasc Surg 2016

Z BIS 9 patients
IBE 13 patients

Arterial lengths and tortuosity index assessed pre and post Implantation
### Table III. Influence of stents ZBIS and IBE and the tortuosity index and the lengths of the ipsilateral iliac axes and iliac bifurcated graft

<table>
<thead>
<tr>
<th></th>
<th>Preoperative</th>
<th>Postoperative</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IBE Excluder</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CIA</td>
<td>1.19 (1.03–1.69)</td>
<td>1.10 (1.00–1.49)</td>
<td>0.16</td>
</tr>
<tr>
<td>PIA</td>
<td>1.48 (1.16–2.09)</td>
<td>1.40 (1.10–1.81)</td>
<td>0.23</td>
</tr>
<tr>
<td>DIS</td>
<td>3</td>
<td>0</td>
<td>0.03</td>
</tr>
<tr>
<td>Total length on centerline (mm)</td>
<td>197.9 (162–159)</td>
<td>188.1 (161–223)</td>
<td>0.17</td>
</tr>
<tr>
<td><strong>ZBIS Zenith</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CIA</td>
<td>1.01 (0.56–1.24)</td>
<td>1.02 (1.0–1.07)</td>
<td>0.44</td>
</tr>
<tr>
<td>PIA</td>
<td>1.37 (1.24–1.77)</td>
<td>1.22 (1.13–1.48)</td>
<td>0.02</td>
</tr>
<tr>
<td>DIS</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Total length on centerline (mm)</td>
<td>186 (149–211)</td>
<td>165 (140–196)</td>
<td>0.02</td>
</tr>
</tbody>
</table>

### Table IV. Influence of IBE and ZBIS stent grafts on the modifications of the indices of tortuosity and of the length of the iliac axes and the internal iliac arteries

<table>
<thead>
<tr>
<th></th>
<th>IBE Excluder</th>
<th>ZBIS Zenith</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Postoperative modifications</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CIA</td>
<td>0.08 (0.00; 0.47)</td>
<td>-0.01 (-0.46; 0.17)</td>
<td>0.08</td>
</tr>
<tr>
<td>PIA</td>
<td>0.08 (-0.07; 0.33)</td>
<td>0.14 (-0.04; 0.36)</td>
<td>0.07</td>
</tr>
<tr>
<td>Postoperative modifications (mm) of the total iliac length</td>
<td>9.77 ± 11.06</td>
<td>20.56 ± 12.96</td>
<td>0.02</td>
</tr>
<tr>
<td>Postoperative modifications (mm) of the IIA length</td>
<td>2.54 (-25; 41)</td>
<td>3.56 (-7; 20)</td>
<td>0.42</td>
</tr>
</tbody>
</table>
Product Features of Gore Devices

- **ePTFE & Nitinol**
  - Biocompatible, highly durable, long term performance

- **Sutureless Construction**
  - Stent is heat bonded to graft
  - Optimized for stent nesting

- **Stent design**
  - Sinusoidal pattern
  - Provides nitinol stent support with fewer unsupported gaps, better wall apposition, and limiting kinking and occlusion
Clinical implications

- Type Ia Endoleak (Bird’s beak)

- Device collapse
Clinical implications

- Kinking
- Limb occlusion
- Type Ib endoleaks
- Limb dislocation...
Clinical implications

Aortic neck angulation and iliac tortuosity are associated with occurrence of complications after EVAR

Conclusions

Conformability probably matters to get good long term outcomes
Conformability is key in treating complex iliac anatomies

A Millon
MD, PhD
Vascular and Endovascular Surgery
Lyon, France