INFLUENCE OF RESPIRATORY AND CARDIAC INDUCED MOVEMENT ON PRECISE AORTIC ARCH ENDOGRAFT DEPLOYMENT

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DIFFICULTIES FOR PRECISE DEPLOYMENT IN AORTIC ARCH

Anatomy:
- Arch curvature
- Tortuosity
- Side branch localisation

Physiology:
- Blood flow (Windsock effect)
- Cardiac contraction
- Respiratory movement

DEPLOYMENT WITH:
- Lowering blood pressure
- Adenosine
- Rapid pacing
- Inferior Caval Vein Balloon

WINDSOCK- EFFECT

Aortic root 6,1mm
Innominate art 1,9mm
LCCA 2,4 mm
LSA 1,9 mm
(van Prehn, J., et al. JEVT 2007)

RESPIRATORY MISMATCH

DISCLOSURE OF SPEAKER

Proctor and speaker for COOK
HOW FUSION SHOULD WORK

- 11 healthy nonsmoking volunteers
- Ascending aorta: 24.3 mm (left anterior)
- Descending aorta: 18.2 mm (right anterior)

CLINICAL STUDY

Aortic Arch Vessel Geometries and Deformations in Patients with Thoracic Aortic Aneurysms and Dissections
Ga-Young Suh, PhD, Ramin E. Barsegi, MD, Dominik Fleischmann, MD, and Christopher P. Cheng, PhD

- 15 pt with asc aortic aneurysma and chron dissections
- 3D LCCA movement:
  - Cardiac-induced: 2.9 mm
  - Respiratory-induced: 6.3 mm
- Resp movement > Cardiac movement

CLINICAL STUDY

- 60 patients
- Regular clinical CTs
- Contrast enhanced and non-contract enhanced
- Breath-hold expiration and inspiration
- Quantitative three-dimensional subtraction analysis
- Dataset overlay was checked in all three dimensions and adjusted manually when necessary using table as reference points

CLINICAL STUDY

Patient Characteristics N %

<table>
<thead>
<tr>
<th>Sex</th>
<th>Male</th>
<th>42</th>
<th>70</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>18</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>Mean age ± SD (range) in years</td>
<td>70 ± 7 (45 - 84)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean Body Mass Index ± SD (range) in kg/m²</td>
<td>26 ± 4 (15 - 34)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>COPD</td>
<td>16</td>
<td>27</td>
<td></td>
</tr>
</tbody>
</table>

Aortic aneurysma 36 60
Intimal calcifica 8 13
Thoracic 18 27
Thoracoabdominal 10 17
Aortic dissection 16 27
Pseudoaneurysm after endo procedure 4 13

CLINICAL STUDY

Quantification of Respiratory Movement of the Aorta and Side Branches

Respiratory Displacement of the Thoracic Aortic Physiological Phenomena With Potential Implications for Thoracic Endovascular Repair

- 11 healthy nonsmoking volunteers
- Ascending aorta: 24.3 mm (left anterior)
- Descending aorta: 18.2 mm (right anterior)

RESPIRATORY DISPLACEMENT

Displacement (mean ± standard deviation in mm)

<table>
<thead>
<tr>
<th>Anatomical level</th>
<th>Aorta Control</th>
<th>Left Right</th>
<th>Control Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thoracic</td>
<td>57 ± 36 (0-96)</td>
<td>0</td>
<td>262 ± 125 (0-77)</td>
</tr>
<tr>
<td>&gt;TCA 16 ± 33 (0-15)</td>
<td>33 ± 25 (0-10)</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>TCO 16 ± 32 (0-15)</td>
<td>31 ± 12 (0-14)</td>
<td>148 ± 32 (0-14)</td>
<td></td>
</tr>
<tr>
<td>LCCO 74 ± 37 (0-15)</td>
<td>38 ± 18 (0-10)</td>
<td>61 ± 27 (0-15)</td>
<td></td>
</tr>
<tr>
<td>LAC 74 ± 37 (0-16)</td>
<td>35 ± 18 (0-10)</td>
<td>63 ± 26 (0-15)</td>
<td></td>
</tr>
<tr>
<td>DA 53 ± 19 (0-10)</td>
<td>34 ± 20 (1-8)</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>TO 0</td>
<td>11 ± 5 (0-4)</td>
<td>11 ± 5 (0-4)</td>
<td></td>
</tr>
<tr>
<td>RMO 0</td>
<td>13 ± 12 (0-15)</td>
<td>13 ± 12 (0-15)</td>
<td></td>
</tr>
<tr>
<td>LCO 0</td>
<td>15 ± 12 (0-6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RCO 0</td>
<td>15 ± 12 (0-6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LUCO 156 ± 13 (0-55)</td>
<td>55</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NECO 216 ± 145 (0-54)</td>
<td>54</td>
<td></td>
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</tbody>
</table>
INFLUENCE OF PATIENT CHARACTERISTICS ON AORTIC MOVEMENT AT LEVEL LSA

<table>
<thead>
<tr>
<th>Patient characteristics</th>
<th>p_value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male vs. Female</td>
<td>0.01</td>
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<tr>
<td>COPD yes vs. no</td>
<td>0.54</td>
</tr>
<tr>
<td>Age &gt; 65 vs. &lt; 65 years</td>
<td>0.71</td>
</tr>
<tr>
<td>Age &gt; 85 vs. &lt; 85 years</td>
<td>0.16</td>
</tr>
<tr>
<td>BMI &gt; 25 vs. ≤ 25 kg/m²</td>
<td>0.14</td>
</tr>
<tr>
<td>Endograft yes vs. no</td>
<td>0.11</td>
</tr>
</tbody>
</table>

Endograft ≤ 5 cm distal to LSA vs. > 5 cm distal to LSA or no endograft 0.11

Breath hold deployment:

Expiration → Inspiration

LSA origin:
- Anterior: 7.4 mm (1-14)
- Medial: 3.8 mm (0-10)
- Caudal: 6.2 mm (0-12)

3D vector: 11.1 (2-18) mm

AORTIC ARCH DURING RESPIRATION

BREATH HOLD DEPLOYMENT

CONCLUSIONS

➢ There is more than windsock-effect influencing precise stent-graft deployment in the aortic arch
➢ Respiratory-induced arch movement is significantly more than cardiac-induced, and easier to counteract.
➢ During inspiration, the thoracic aorta and arch side branches moved in anterior, medial and caudal direction.

➢ Advice:
➢ Not only breath hold during angio, but also during stent-graft deployment
➢ Liberal use of rapid-pacing during deployment