The Natural History of Aortic Arch Aneurysms
When to Intervene

Aortic LIVE 2017
Bucerius Law School Hamburg
23 October 2017

Stephen W.K. Cheng
M58  
Ruptured while waiting For A-Br graft

M79  
Refused TEVAR  
Ruptured died 4 months

M80  
Refused TEVAR  
Ruptured died
Objectives

• Determine the natural history of isolated, non-dissecting aortic arch aneurysms

• Identify risk factors of arch aneurysm rupture
Hospital-wide database, n=45

EXCLUSION:

Dissections
Thoraco-abdominal
Ascending aneurysms
Marfan
<2 CT follow up
Patient Characteristics

Demographics
- Age
- Gender
- Smoking
- Hypertension
- Hyperlipidemia
- Chronic heart diseases
- COPD
- Chronic renal diseases
- Diabetes mellitus

Clinical course
- Surgery
- Rupture
- Death

Aneurysm
- Size
- Morphology

Serial CTs
- Aneurysam expansion rate
Size: Maximal Transverse Diameter
Aneurysms n=45

• Size:
  – Mean 5.6 cm
  – 3.9-9.9 cm

• Morphology:
  – 23 saccular (51%)
  – 22 fusiform (49%)

• Ascending aorta diameter
  – Mean 4.1 cm
  – 2.7-4.8 cm
Clinical Course

• Follow up: mean 36.6 months; (191 patient-years)

• 10 ruptures (22%)
  – 9 died; 1 survived

• 4 postponed elective surgery; 2 emergency surgery

• Total deaths= 23 (51%)
  – 9 ruptures; 14 others
### Demographics: Rupture vs No Rupture

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Total (n=45)</th>
<th>Rupture (n=10)</th>
<th>Rupture-Free (n=35)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (y)</td>
<td>77.0 ± .9</td>
<td>77.4 ± 1.9</td>
<td>76.9 ± 1.1</td>
<td>.817</td>
</tr>
<tr>
<td>Male</td>
<td>36 (80%)</td>
<td>8 (80%)</td>
<td>28 (80%)</td>
<td>1.000</td>
</tr>
<tr>
<td>Current smoker</td>
<td>11 (24.4%)</td>
<td>1 (10%)</td>
<td>10 (28.6%)</td>
<td>.409</td>
</tr>
<tr>
<td>Hypertension</td>
<td>32 (71.1%)</td>
<td>7 (70%)</td>
<td>25 (71.4%)</td>
<td>1.000</td>
</tr>
<tr>
<td>Hyperlipidemia</td>
<td>15 (33.3%)</td>
<td>3 (30%)</td>
<td>12 (34.3%)</td>
<td>1.000</td>
</tr>
<tr>
<td>Coronary artery diseases</td>
<td>27 (60.0%)</td>
<td>6 (60%)</td>
<td>21 (60%)</td>
<td>.721</td>
</tr>
<tr>
<td>COPD</td>
<td>13 (28.9%)</td>
<td>3 (30%)</td>
<td>10 (28.6%)</td>
<td>.704</td>
</tr>
<tr>
<td>Chronic renal diseases</td>
<td>13 (28.9%)</td>
<td>4 (40%)</td>
<td>9 (25.7%)</td>
<td>.704</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>14 (31.1%)</td>
<td>4 (40%)</td>
<td>10 (28.6%)</td>
<td>.428</td>
</tr>
</tbody>
</table>
Aneurysm Expansion Rates

Risk Factors

- Age
- Sex
- Smoking
- Hypertension
- Hyperlipidemia (P= .0321)
- Chronic heart diseases
- COPD
- Chronic renal diseases
- Diabetes mellitus
- Aneurysm size (>6.5cm; P= .001)
- Aneurysm morphology
- Ascending aortic diameter
Critical Size to Rupture: 5.5 cm

Critical Expansion rate to Rupture: 5.5 mm/yr
<table>
<thead>
<tr>
<th>Predictor</th>
<th>OR</th>
<th>95% CI</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>1.01</td>
<td>0.90-1.14</td>
<td>0.812</td>
</tr>
<tr>
<td>Male</td>
<td>1.00</td>
<td>0.17-5.79</td>
<td>1.000</td>
</tr>
<tr>
<td>Current smoker</td>
<td>0.28</td>
<td>0.03-2.49</td>
<td>0.252</td>
</tr>
<tr>
<td>Hypertension</td>
<td>0.933</td>
<td>0.20-4.35</td>
<td>0.930</td>
</tr>
<tr>
<td>Hyperlipidemia</td>
<td>0.82</td>
<td>0.18-3.76</td>
<td>0.800</td>
</tr>
<tr>
<td>Chronic heart diseases</td>
<td>1.00</td>
<td>0.24-4.20</td>
<td>1.000</td>
</tr>
<tr>
<td>COPD</td>
<td>1.07</td>
<td>0.23-4.99</td>
<td>0.930</td>
</tr>
<tr>
<td>Chronic renal diseases</td>
<td>1.93</td>
<td>0.44-8.42</td>
<td>0.384</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>1.67</td>
<td>0.39-7.19</td>
<td>0.494</td>
</tr>
<tr>
<td>Size</td>
<td>2.64</td>
<td>1.10-6.33</td>
<td>0.029*</td>
</tr>
<tr>
<td>Expansion rate</td>
<td>1.50</td>
<td>1.12-2.00</td>
<td>0.007*</td>
</tr>
<tr>
<td>Saccular morphology</td>
<td>0.94</td>
<td>0.23-3.85</td>
<td>0.936</td>
</tr>
<tr>
<td>Ascending Aorta Diameter</td>
<td>0.92</td>
<td>0.27-3.19</td>
<td>0.897</td>
</tr>
</tbody>
</table>
## Predictors of Rupture - Multiple Logistic Analysis

<table>
<thead>
<tr>
<th>Predictor</th>
<th>OR</th>
<th>95% CI</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size</td>
<td>2.33</td>
<td>.87-6.24</td>
<td>.091</td>
</tr>
<tr>
<td>Expansion rate</td>
<td>1.43</td>
<td>1.06-1.92</td>
<td>.018&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
</tbody>
</table>
Conclusion

- Expansion rate $>5.5$ mm/y is a significant supplementary predictor of rupture
- Aneurysm size $>5.5$ cm is critical to rupture of true arch aneurysms
- Aneurysm size $>6.5$ cm is associated with high expansion rate and indicate impending rupture
- Hyperlipidemia is associated with expansion rate $>5.5$ mm/y