Aortic Root Dilatation in Young Stroke Patients with Patent Foramen Ovale

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No conflicts of interest
Case

- 48 year old male
- No cardiovascular risk factors
- Right middle cerebral artery infarct
- Echocardiogram performed
An observation

• In PFO / ASA patients who are referred for device closure after CVA:
  – The aortic root is not uncommonly dilated
  – The mitral valve may be dystrophic.
A question

• Could PFO / ASA represent a form of connective tissue disorder?

• This question has never been assessed in a prospective or systematic manner.
Hypothesis

• Aortic size is larger in patients with symptomatic PFO.

Aim

• To prospectively compare aortic size in patients with symptomatic (CVA) PFO with healthy controls.
Subjects

• Consecutive patients who:
  – presented with CVA
  – PFO on bubble study
  – neurologist assessed PFO as likely CVA aetiology
  – under 50 years
  – underwent percutaneous PFO closure

• Age-, sex- and BSA-matched healthy controls.
Methods

• TTE
• Comprehensive echo
  – Standardised dimensions of aortic root (2D)
    • Aortic annulus
    • Sinuses of Valsalva
    • Ascending aorta
  – LV dimensions
Aortic annulus

Ascending aorta

Sinuses of Valsalva
<table>
<thead>
<tr>
<th></th>
<th>PFO + CVA</th>
<th>Control</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number</td>
<td>47</td>
<td>47</td>
<td></td>
</tr>
<tr>
<td>Age, years</td>
<td>37 ± 7</td>
<td>35 ± 12</td>
<td>0.3</td>
</tr>
<tr>
<td>Male</td>
<td>28 (60%)</td>
<td>27 (57%)</td>
<td>0.8</td>
</tr>
<tr>
<td>Height, m</td>
<td>1.72 ± 0.10</td>
<td>1.72 ± 0.09</td>
<td>0.9</td>
</tr>
<tr>
<td>Weight, kg</td>
<td>74.1 ± 13.5</td>
<td>71.9 ± 10.6</td>
<td>0.4</td>
</tr>
<tr>
<td>BSA, kg/m²</td>
<td>1.88 ± 0.21</td>
<td>1.85 ± 0.16</td>
<td>0.5</td>
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</tbody>
</table>
PFO patients (n=47)

- Migraine: 9 (19%)
- ASA: 35 (74%)
- Highly permeable PFO: 23 (49%)
<table>
<thead>
<tr>
<th>Aorta, mm</th>
<th>PFO + CVA</th>
<th>Control</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aortic Annulus</td>
<td>23 ± 3</td>
<td>22 ± 2</td>
<td>0.2</td>
</tr>
<tr>
<td>Sinuses of Valsalva</td>
<td>34 ± 4</td>
<td>31 ± 3</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Ascending Aorta</td>
<td>32 ± 4</td>
<td>29 ± 3</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>
Aortic Diameters

Aortic Annulus  Sinuses of Valsalva  Ascending Aorta
<table>
<thead>
<tr>
<th></th>
<th>PFO + CVA</th>
<th>Control</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Left Ventricle, mm</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LVEDV</td>
<td>48 ± 5</td>
<td>50 ± 4</td>
<td>0.1</td>
</tr>
<tr>
<td>LVESV</td>
<td>30 ± 4</td>
<td>32 ± 5</td>
<td>&lt;0.05</td>
</tr>
</tbody>
</table>
Why are aortic roots bigger in patients with PFO + CVA?

- **Suggested explanations:**
  1. Association because common aetiology i.e. underlying connective tissue disease.
  2. Mechanistic association.
  3. Confounding.
1. Common aetiology

- Connective tissue disorder
- Aortic dilatation is a feature of connective tissue disorders such as Marfan syndrome.
- The aetiology of PFO / ASA is unknown, but other cardiac lesions with redundant tissue e.g. MVP are more common in Marfan / Ehlers-Danlos.
- The incidence of ASA is 3x higher in Marfans.
- PFO has never been studied in this cohort.

2. Mechanistic Association

• Aortic enlargement has been implicated as a cause of right-to-left shunting in the platypnoea-orthodeoxia syndrome (POS)
• ‘Unfolded aorta’
  – Angulation leads to IVC flow towards fossa ovalis.
• Dilated aorta
  – Atrial septum is ‘smaller’, under less tension and more mobile.
Smaller, more mobile septum

Dilated aortic root

Normal aortic root

3. Confounding?

• Excluded older patients (>50y) as vascular risk factors might explain CVA and dilated aorta.
• In particular, no patient or control was hypertensive.
• Potentially unidentified factors?
Conclusion

• Aortic diameter is increased in young PFO patients who have sustained a CVA.

• Two suggested aetiologies:
  1. Common underlying connective tissue disorder.
  2. Mechanistic effect – less likely.

• Our results support further research in this area.
Acknowledgements

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