Cardiac- and Respiratory-Induced Motion of Renal Arteries and Stents in Snorkel Endovascular Aneurysm Sealing

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Disclosure

Speaker name: Christopher Cheng

I have the following potential conflicts of interest to report:

- Consulting
- Employment in industry
- Stockholder of a healthcare company
- Owner of a healthcare company
- Other(s)

- I do not have any potential conflict of interest
Objective and Imaging

Quantify cardiac- and respiratory-induced renal artery and stent deformation in AAA patients treated with Sn-EVAS

10 patients underwent cardiac-resolved CTA during inspiration and expiration breath-holds
Modeling and Quantification

- Branch angle
- End-stent angle
- Stent arc length
- Curvature
### Results – Renal Snorkel Stent

<table>
<thead>
<tr>
<th>(Values in Mean±SD)</th>
<th>Cardiac Deformation (Diastole to Systole)</th>
<th>Respiratory Deformation (Inspiration to Expiration)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Right</td>
<td>Left</td>
</tr>
<tr>
<td>ΔArclength (%)</td>
<td>0.1±0.8</td>
<td>-0.4±1.2</td>
</tr>
<tr>
<td>ΔAvg C (cm⁻¹)</td>
<td>0.02±0.03</td>
<td>0.01±0.03</td>
</tr>
<tr>
<td>ΔPeak C (cm⁻¹)</td>
<td>0.04±0.07</td>
<td>0.02±0.07</td>
</tr>
<tr>
<td></td>
<td><strong>0.13±0.09</strong></td>
<td><strong>0.15±0.11</strong></td>
</tr>
<tr>
<td></td>
<td><strong>0.20±0.10</strong></td>
<td><strong>0.18±0.09</strong></td>
</tr>
</tbody>
</table>

- Significant cardiac-induced bending of the snorkel stent
- Significant respiratory-induced bending of the snorkel stent
- No significant difference between cardiac vs. respiratory deformation

![Diagram showing branch and end-stent angles](image1.png)

![Diagram showing stent arc length and curvature](image2.png)
## Results – Renal Artery

<table>
<thead>
<tr>
<th>(Values in Mean±SD)</th>
<th>Cardiac Deformation (Diastole to Systole)</th>
<th>Respiratory Deformation (Inspiration to Expiration)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ΔBranch Angle (°)</td>
<td>Right 0±1</td>
<td>Left 0±1</td>
</tr>
<tr>
<td>ΔEnd-Stent Angle (°)</td>
<td>-1±2</td>
<td>0±2</td>
</tr>
<tr>
<td>ΔAvg C (cm⁻¹)</td>
<td>-0.02±0.02</td>
<td>0.03±0.02</td>
</tr>
<tr>
<td></td>
<td>0.21±0.18</td>
<td>0.28±0.17</td>
</tr>
</tbody>
</table>

- End-stent angle change greater for respiration vs. cardiac
- Maximum curvature change greater for respiration vs. cardiac
- End-stent angle change greater for LRA vs. RRA for respiratory
- Larger variation in respiratory-induced deformations vs. cardiac
Conclusions

- Balloon-expanded snorkel renal stents used for Sn-EVAS undergo similar magnitude of bending deformations due to cardiac pulsatility and respiration.

- The renal artery itself bends significantly more at the distal end of the stent with respiration as compared to cardiac by a factor of 2x.

- The left renal artery experiences greater bending while the right renal is relatively stabilized by the IVC.

- Renal arteries exhibit larger population variance for respiratory vs. cardiac deformations.

- Cardiac and respiratory influences may challenge the mechanical durability of snorkel stents of Sn-EVAS similarly, however, respiration may be the primary culprit for tissue irritation, potentially increasing risk for end-stent thrombosis, especially in the left renal artery.
Thank You
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