Technical and anatomical considerations to optimize clinical success with EndoAnchor implants

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LINC
24-01-2019
Disclosures

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Advisory board member: Medtronic

Research grants: Cardionovum, Stichting Lijf & Leven
Heli-FX EndoAnchor System

- Provide fixation and seal in aortic necks
- Prevent/resolve migration or endoleaks

- Even spacing around aortic circumference - Increase endograft fixation

- Resolve type Ia endoleak

- Successful deployment of EndoAchors

- Adequate penetration into aortic wall

Objectives

1) Quantify EndoAnchor penetration into the aortic wall in patients underdoing EVAR

2) Assess predictors of successful penetration and association to postprocedural type Ia endoleak
Methods – ANCHOR database

- **Inclusion criteria**
  - Treat type Ia endoleak
  - First postprocedure contrast-enhanced CT scan

- **Exclusion criteria**
  - CT artifacts due to metal or glue
  - CT slice thickness >3 mm
  - Implantation of adjuvant aortic extension cuffs

- **Patients from two cohorts (primary and revision)**
  - Successful: no type Ia endoleak after EndoAnchors
  - Unsuccessful: persisting type Ia endoleak after EndoAnchors
EndoAnchor analysis

- Penetration and circumferential location

Good penetration ≥2 mm

Borderline penetration <2 mm or gap between endograft and aortic wall

No penetration
EndoAnchor analysis

- Penetration and circumferential location

Good penetration ≥2 mm

Borderline penetration <2 mm or gap between endograft and aortic wall

No penetration
Results (anatomical criteria)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Type Ia endoleak (n=28)</th>
<th>No-endoleak (n=52)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Endograft size, mm</td>
<td>28 (26-30.8)</td>
<td>28 (25-32)</td>
<td>.839</td>
</tr>
<tr>
<td>Oversizing, %</td>
<td>4.8 (-2.6-18.2)</td>
<td>13.9 (-1.8-23)</td>
<td>.101</td>
</tr>
<tr>
<td>Suprarenal aortic diameter, mm</td>
<td>26.6 (25.5-29.5)</td>
<td>26 (23.4-28.4)</td>
<td>.153</td>
</tr>
<tr>
<td>Aortic diameter at lowest renal, mm</td>
<td>26.6 (24.5-28.9)</td>
<td>26 (23.0-28.4)</td>
<td>.188</td>
</tr>
<tr>
<td>Aortic diameter 5-mm below lowest renal, mm</td>
<td>27.6 (25.8-31.3)</td>
<td>26.0 (22.7-29.8)</td>
<td>.053</td>
</tr>
<tr>
<td>Aortic diameter 10-mm below lowest renal, mm</td>
<td>30.1 (26.8-33.8)</td>
<td>26.7 (24.1-32.1)</td>
<td>.020</td>
</tr>
<tr>
<td>Proximal neck length, mm</td>
<td>9.6 (7.0-16.8)</td>
<td>15.1 (8.7-27.0)</td>
<td>.039</td>
</tr>
<tr>
<td>Neck tortuosity index, –</td>
<td>1.1 (1.0-1.1)</td>
<td>1.1 (1.0-1.1)</td>
<td>.408</td>
</tr>
<tr>
<td>Maximum sac diameter, mm</td>
<td>60.1 (52.1-74.6)</td>
<td>59.1 (53.7-69.3)</td>
<td>.610</td>
</tr>
<tr>
<td>Suprarenal angulation, °</td>
<td>11.5 (4.3-21.3)</td>
<td>16 (10-23)</td>
<td>.080</td>
</tr>
<tr>
<td>Infrarenal angulation, °</td>
<td>18.5 (12.3-34.8)</td>
<td>20 (11.5-29)</td>
<td>.920</td>
</tr>
<tr>
<td>Infrarenal angulation to bifurcation, °</td>
<td>37.5 (23.3-43.8)</td>
<td>37.5 (27.3-47)</td>
<td>.565</td>
</tr>
<tr>
<td>Neck thrombus average thickness, mm</td>
<td>0 (0-0)</td>
<td>0 (0-1)</td>
<td>.392</td>
</tr>
<tr>
<td>Neck thrombus circumference, mm</td>
<td>0 (0-0)</td>
<td>0 (0-49.3)</td>
<td>.312</td>
</tr>
<tr>
<td>Neck calcium average thickness, mm</td>
<td>0 (0-2)</td>
<td>0 (0-1.8)</td>
<td>.821</td>
</tr>
<tr>
<td>Neck calcium circumference, mm</td>
<td>0 (0-40.0)</td>
<td>0 (0-18.4)</td>
<td>.693</td>
</tr>
</tbody>
</table>

*aDenominators are smaller than the group size due to missing values. Data is represented as median (IQR).*
## EndoAnchor penetration

- 580 EndoAnchors

<table>
<thead>
<tr>
<th>Variable&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Type Ia endoleak</th>
<th>No-endoleak</th>
<th>Total</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>EndoAnchors, N</td>
<td>247 (42.6)</td>
<td>333 (57.4)</td>
<td>580 (100)</td>
<td>.060</td>
</tr>
<tr>
<td>Good penetration</td>
<td>98 (39.7)</td>
<td>235 (70.6)</td>
<td>333 (57.4)</td>
<td>.002</td>
</tr>
<tr>
<td>Borderline penetration</td>
<td>43 (17.4)</td>
<td>32 (9.6)</td>
<td>75 (12.9)</td>
<td>.003</td>
</tr>
<tr>
<td>No penetration</td>
<td>106 (42.9)</td>
<td>66 (19.8)</td>
<td>172 (29.7)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Distance from LRA, mm</td>
<td>9 (6-13)</td>
<td>8 (4-13)</td>
<td></td>
<td>.006</td>
</tr>
<tr>
<td>Fabric distance, mm&lt;sup&gt;b&lt;/sup&gt;</td>
<td>7.5 (4.5-11.8)&lt;sup&gt;b&lt;/sup&gt;</td>
<td>7.3 (4.3-10.3)&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
<td>.118</td>
</tr>
<tr>
<td>Location, °</td>
<td>158 (90-278)</td>
<td>188 (98-285)</td>
<td></td>
<td>.273</td>
</tr>
</tbody>
</table>

LRA, lowest renal artery.

<sup>a</sup>Data is represented as number (%) and median (IQR).

<sup>b</sup>Seven EndoAnchors were deployed above the fabric; 4 in the persistent type Ia endoleak group and 3 in the no-endoleak group.
Predictors successful EndoAnchor penetration

- Independent protective factors
  - Oversizing, %
  - Endurant stent

- Independent risk factors
  - Aortic diameter at lowest renal artery, 5 mm, 10 mm
  - Neck thrombus and calcium circumference and thickness

<table>
<thead>
<tr>
<th>Multivariate Logistic Regression</th>
<th>OR</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Endurant stent</td>
<td>3.724</td>
<td>.001</td>
</tr>
<tr>
<td>Aortic diameter 10-mm below lowest renal artery, mm</td>
<td>0.894</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Neck calcium average thickness, mm</td>
<td>0.562</td>
<td>.004</td>
</tr>
</tbody>
</table>
Predictors of type Ia endoleak

- **Independent protective factors**
  - Proximal neck length
  - Good penetrating EndoAnchors

- **Independent risk factors**
  - Aortic diameter 5 mm below lowest renal artery
  - Borderline EndoAnchors
  - Non-penetrating EndoAnchors

<table>
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<tr>
<th>Multivariate Logistic Regression</th>
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<th>P-Value</th>
</tr>
</thead>
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<tr>
<td>No penetration</td>
<td>1.714</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>
Successful deployment

Endograft: Gore Excluder
Misdeployment and incorrect indication
Incorrect indication
Misdeployment (calcium and thrombus)

Endograft: Endurant
7 EndoAnchors
Don’t undersize the endoguide

Support of the Applier at the opposite wall
Pushing the endograft towards the aortic wall
Prevent wiggling of EndoAnchors
C-arm perpendicular to tip of endoguide

Example of C-arm orientations for implanting 4 EndoAnchors:

1. C-Arm at 45° RAO for implantation at 1:30 and 7:30
2. C-Arm at 45° LAO for implantation at 4:30 and 10:30
EA distribution in successfully treated type IA endoleaks

EA distribution in successfully treated type IA endoleak with exclusion of those beyond recommended use.
EA distribution in persistent type IA endoleak

EA distribution in persistent type IA endoleak with exclusion of those beyond recommended use

**Legend**
- Red: No penetration
- Orange: Borderline penetration
- Green: Good penetration
- Blue: Postprocedural type IA endoleak width

**Diagram A**
- Red: 43%
- Orange: 17%
- Green: 40%

**Diagram B**
- Red: 20%
- Orange: 10%
- Green: 70%


Conclusions

- Good EndoAnchor penetration less likely when
  - Larger aortic neck diameter
  - Significant mural calcium and thrombus in neck
  - EndoAnchor is not perpendicular vs stentgraft
  - Beyond recommended use

- Bordeling or no EndoAnchor penetration
  - Predictive of postprocedural type Ia endoleak
Conclusions

- Essentials for successful EndoAnchor deployment
  - Within recommended use
  - Pre-operative planning
  - C-arm position during implantation
  - EndoAnchors only in proximal 5 – 10 mm of endograft