ARCH ENDO REPAIR: THE BOLTON PERSPECTIVE

Piergiorgio Cao, MD, FRCS
Disclosure

Speaker name:

**Piergiorgio Cao**

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
Any repair of aortic arch remains demanding and exposes to not negligible mortality and stroke risks.

- Open repair: gold standard

- Hybrid and endovascular repair: valid alternative mostly in high risk patients
Debranching technique (Zone 2)

Car – Subcl BP

Chimney on LSA
Debranching technique (Zone 1)

- Car – Car – Subcl BP
- Car – Subcl BP (Bovine Arch)
- Bilateral Car – Subcl BP (aberrant RSA aneurysm)
Debranching technique (Zone 0)

Total Debranching

Single Branched + Car – car – subcl BP

Double Branched + Car – subcl BP
Perioperative results

<table>
<thead>
<tr>
<th></th>
<th>Endo</th>
<th>Open</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Death</td>
<td>8.5%</td>
<td>13.8%</td>
<td>0.47</td>
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<tr>
<td>Stroke</td>
<td>5.6%</td>
<td>3.4%</td>
<td>1</td>
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<tr>
<td>Spinal cord ischemia</td>
<td>2.8%</td>
<td>0%</td>
<td>0.50</td>
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</table>

5-year results

All cause Survival

Log Rank test: $p = 0.62$

Late reinterventions

Log Rank test: $p = 0.82$
Arch TEVAR issues

✓ Conformability
✓ Endoleak
✓ Retrograde dissection
✓ Stroke
Conformability
Deployment related issues
Conformability
Migration and type I endoleak
Patients’ selection

Shaggy” aorta
Retrograde dissection
Zone 1 repair

San Camillo Experience
2009 - 2015

TEVAR: 483
RAD: 7 (1.4%)
Zone 0-1: 109
RAD in Zone 1: 5.9%
Potential advantages of Arch Branched stentgrafts

- Straight landing zone
- No gutters endoleak
- Low risk of migration (?)
- Low risk of retrograde dissection (?)
BOLTON ARCH BRANCHED STENTGRAFT
Delivery System based on Relay NBS PLUS Thoracic Stent-Graft

Proximal Clasping mechanism to allow stent-graft repositioning and pre-curved guidewire lumen to allow self-orientation

Secondary sheath allows easy tracking to zone 0

Atraumatic Support Wires to control the expansion of the inferior portion of the graft
Bolton Arch Branched Device

- Based on Relay NBS (Non-Bare Stent) Plus platform
- Single or double inner branch
- Diameter: 30 mm, 35 mm
- Diameter of opening: Ø 11 mm
BOLTON ARCH BRANCHED STENTGRAFT
Main Body – Tunnel length and diameter

G: Posterior tunnel for BCT
H: Anterior tunnel for LCCA

<table>
<thead>
<tr>
<th>Tunnel Length</th>
<th>Tunnel Diameter</th>
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<tr>
<td><strong>Length</strong> D</td>
<td><strong>Diameter G</strong></td>
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<tr>
<td>60 mm</td>
<td>12 mm</td>
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<tr>
<td>45 mm</td>
<td>12 mm</td>
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<tr>
<td><strong>Length</strong> G</td>
<td><strong>Diameter H</strong></td>
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<tr>
<td>44 mm</td>
<td>12 mm</td>
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<tr>
<td>34 mm</td>
<td>12 mm</td>
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<tr>
<td><strong>Length</strong> H</td>
<td></td>
</tr>
<tr>
<td>40 mm</td>
<td></td>
</tr>
<tr>
<td>30 mm</td>
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</table>
BOLTON ARCH BRANCHED STENTGRAFT

- Specific tapering pattern
- Low profile graft
- "PRO" delivery system (24-25F)
- Redesigned size dedicated stents
- New Hemi Stents
BOLTON ARCH BRANCHED STENTGRAFT

Lock stent prevents modular disjunction

Dull barbs facing towards lumen of the tunnel preventing potential disconnection of the branches
• Introduction of dedicated bridging stents
  – 14F O.D. with 45cm long detachable sheath
  – 8-24mm of diameter; 70-140mm of length
  – Controlled deployment through “mechanical advantage”
  – Proximal capture
BOLTON ARCH BRANCHED STENTGRAFT

Branches optimization

Dedicated design

Proximal Clasping & short tip

14F delivery system
Intraoperative monitoring

rSO$_2$

Cerebral oximetry sensor
Prevention of air embolism

Stentgraft flushing with CO₂
(before flushing with saline)

- More effective de-airing (higher diffusion of CO₂)
- Lower risk of air embolism (higher solubility of CO₂ in the blood)
Limits of Arch Branched stentgrafts

- Time for customization

- Morphological criteria:
  - Asc Ao diameter
  - Asc Ao length
  - Prosthetic
## Bolton Arch Branched Device

<table>
<thead>
<tr>
<th>Center</th>
<th>Investigator</th>
<th>City</th>
<th>Country</th>
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<tbody>
<tr>
<td>Ospedale San Camillo Forlanini</td>
<td>Prof. Cao</td>
<td>Roma</td>
<td>Italy</td>
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<tr>
<td>Ospedale G. Brotzu</td>
<td>Dr. Camparini</td>
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<td>Prof. H. Rousseau</td>
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<td>Osaka University Hospital</td>
<td>Dr. Kuratani</td>
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<td>Prof. F. Moll – dr. Van Herwaarden</td>
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<td>Dr. M. Hamady</td>
<td>London</td>
<td>United Kingdom</td>
</tr>
<tr>
<td>Linköping University Hospital</td>
<td>dr. C. Forssell</td>
<td>Linköping</td>
<td>Sweden</td>
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<table>
<thead>
<tr>
<th>Total</th>
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<tbody>
<tr>
<td>N</td>
<td>26</td>
</tr>
<tr>
<td>Male</td>
<td>69,2%</td>
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<tr>
<td>Mean Age</td>
<td>72y</td>
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<tr>
<td>TAA</td>
<td>80,8%</td>
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<tr>
<td>PAU</td>
<td>3,8%</td>
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<tr>
<td>Type B Dissection</td>
<td>15,4%</td>
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<tr>
<td>Procedure completed</td>
<td>100%</td>
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<tr>
<td>Freedom from endoleak</td>
<td>92,3%</td>
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<tr>
<td>Perioperative overall death</td>
<td>11,5%</td>
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<tr>
<td>Perioperative procedure related death</td>
<td>3.8%</td>
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Conclusion

Endovascular approach is a valid alternative to open surgery for all patients when morphologically feasible.

Identification of a suitable proximal landing zone remains a major concern in TEVAR for arch disease.

The choice of a straight proximal landing zone, like ascending aorta, may prevent deployment related issues, type I endoleak and retrograde dissection.

Branched stentgrafts might be useful in avoiding arch manipulations and decreasing the risk of major adverse events and should be extended to the most “unstable” areas of the aortic arch (zone 1).