Evolving Concepts for Thoracic Endografting for Type B Aortic Dissection

New Cardiovascular Horizons
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Disclosures

Consultant
- Medtronic
- Bolton Medical
- Endologix

Ownership
- Ascyrus Medical
Acute Aortic Dissections

Type A
- Open Heart Surgery

Type B
- Complicated
  - TEVAR
- Uncomplicated
  - Medical Therapy
Type B Aortic Dissection

Acute non-complicated

Acute with malperfusion

Chronic with aneurysm
Medical management of Uncomplicated Acute Type B

1. Lower Blood Pressure
2. Reduce the left ventricle ejection force (dP/dt)
3. Transfer to Aortic Center
Acute Aortic Dissections

**Type A**
- Open Heart Surgery

**Type B**
- Complicated
  - TEVAR
- Uncomplicated Low Risk
  - Medical Therapy
- Uncomplicated High Risk
  - TEVAR

**Notes:**
- Entry tear >1cm
- Total aortic diameter >4cm
- False lumen size >3.5cm
- Partial false lumen thrombosis
- Etc.
Aortic Dissections are Classified by:

- Aortic Segment Involvement
  - **Type A:** Ascending aorta involvement
  - **Type B:** Ascending not involved

- Duration from Clinical Onset
  - **Acute:** Within first 14 days
  - **SubAcute:** Between 14 days and 3 months
  - **Chronic:** Greater than 3 months

- Complications (yes/no)
  - Uncomplicated
  - Complicated
Uncomplicated Type B Dissection

**STATE-OF-THE-ART PAPER**

Interdisciplinary Expert Consensus Document on Management of Type B Aortic Dissection

Rossella Fattori, MD,* Piergiorgio Cao, MD,† Paola De Rango, MD,‡ Martin Czerny, MD,§ Arturo Evangelista, MD,∥ Christoph Niemaber, MD,¶ Hervé Rousseau, MD,# Marc Schepens, MD** Pesaro, Rome, and Perugia, Italy; Berne, Switzerland; Barcelona, Spain; Rostock, Germany; Toulouse, France; and Brugge, Belgium

Patients with uncomplicated acute type B dissection should be treated with medical therapy. At present, there is no evidence of advantage with TEVAR or open surgery.
TEVAR for Type B Aortic Dissection

Entry Tear Management
Aims of Endovascular Treatment for Acute Aortic Dissection

1. Cover the entry tear
2. Treat or Prevent Rupture
3. Reestablish organ / limb perfusion
4. Restore flow in true lumen
5. Induce false lumen thrombosis
Long-term Follow-up

Pre  1yr  2 yrs  3 yrs  4yrs  5yrs

Rod White, M.D.
Complication directed procedures decrease mortality.

Operative mortality increased from 9% to 38% with malperfusion.
Understanding malperfusion: mechanism of branch compromise

Dynamic obstruction

Prolapsed septum into ostium during cardiac cycle

Static obstruction

Cleavage plane of dissection extends into ostium
Dynamic Malperfusion

Static Malperfusion

Complicated Management: Stepwise Approach

- Have the dynamics of the true lumen changed on IVUS?
INSTEAD and INSTEAD XL

Management of Uncomplicated Type B Aortic Dissection

2-Year and 5-Year Results of the Randomized Investigation of Stent Grafts in Aortic Dissection Trial

- Characterize short-term and long-term outcomes and vessel morphology of uncomplicated, TBAD patients treated with OMT vs OMT+TEVAR
- 7 European Centers
- N = 140 subjects, OMT = 68, OMT+TEVAR = 72. 2 year and 5 year follow-up
- Primary Endpoint: All-cause mortality
- Secondary Endpoints: Aorta-specific mortality and disease progression

Trial evaluated Talent Xcelerant; Talent no longer available in US
INSTEAD at 2 Years: Remodeling

After 2 years, 90% remodeling with TEVAR ($p \leq 0.001$)
### INSTEAD XL: 5 Year Analysis

#### Table 3. Causes of Death Since Randomization

<table>
<thead>
<tr>
<th>Time Interval</th>
<th>OMT</th>
<th>OMT+TEVAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–12 mo</td>
<td>#01 (AR-73) MPS #02 (AR-244) R</td>
<td>#01 (AR-6) type A #02 (AR-15) R</td>
</tr>
<tr>
<td>12–24 mo</td>
<td>#03 (AR-722) R #04 (AR-745) R #05 (AR-900) type A #06 (AR-1000) SD</td>
<td>#07 (AR-1101) R #08 (AR-1110) R #09 (AR-1344) SD #10 (AR-1349) R #11 (AR-1401) R</td>
</tr>
<tr>
<td>24–36 mo</td>
<td>#12 (AR-1629) SD #13 (AR-1650) R</td>
<td>#14 (AR-2075) SD #15 (AR-2421) cancer</td>
</tr>
<tr>
<td>36–48 mo</td>
<td>#07 (AR-1110) R #08 (AR-1110) R #09 (AR-1344) SD #10 (AR-1349) R #11 (AR-1401) R</td>
<td></td>
</tr>
<tr>
<td>48–60 mo</td>
<td>#12 (AR-1629) SD #13 (AR-1650) R</td>
<td>#14 (AR-2075) SD #15 (AR-2421) cancer</td>
</tr>
<tr>
<td>60–72 mo</td>
<td>#14 (AR-2075) SD #15 (AR-2421) cancer</td>
<td></td>
</tr>
</tbody>
</table>

Numbers with AR or NR denote days from randomization to death. AMI indicates acute myocardial infarction; AR, aorta-related death; MPS, malperfusion syndrome; NR, not aorta-related death; OMT, optimal medical treatment; PN, pneumonia; R, aortic rupture; SD, sudden death (death within 1 hour in patients with known absence of coronary or structural heart disease); TEVAR, thoracic endovascular aortic repair; and Type A, type A aortic dissection.
INSTEAD XL: Key Results

TEVAR FOR AORTIC DISSECTION PREVENTS LATE EXPANSION; ENCOURAGES AORTIC REMODELING

Cumulative Clinical Results: Year 0 through Year 5

- All-Cause Mortality: 19.3% vs. 11.1% (p=0.13)
- Aorta-Specific Mortality: 19.3% vs. 6.9% (p=0.04)
- Disease Progression: 46.1% vs. 27.0% (p=0.04)

19.1% Absolute Risk Reduction

Clinical Evidence
Uncomplicated TBAD: Does it Exist?
Acute Aortic Dissections

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**
Entry tear >1cm
Total aortic diameter >4cm
False lumen size >3.5cm
Partial false lumen thrombosis
Etc.
Refractory Pain/HTN are Predictors of Mortality

- In-hospital mortality significantly higher with medical management
  - 2/3 medical rx deaths due to rupture
- Refractory pain/HTN independent predictor of in-hospital mortality
- Intervention associated with improved outcomes over medical management for refractory pain/HTN

Medical Management: In-hospital mortality

Circulation 2010; 122:1283-9
Aortic Diameter at Presentation

A Prospective Study of Medically Treated Acute Type B Aortic Dissection

A. Winnerkvist, U. Lockowandt, E. Rasmussen and K. Rådegran

Department of Cardiothoracic Surgery and Anesthesiology, Karolinska University Hospital and Department of Molecular Medicine and Surgery Karolinska Institutet, Stockholm, Sweden

- Freedom from aortic event (dissection-related death, aneurysm formation >6cm, new Type A dissection) 75% @ 5yrs & 67% @ 10yrs

- Significant predictors of aortic event
  - Maximal aortic diameter >4.0 cm at first CT scan (hazard ratio 3.5; 95% CI 1.2-9.7; p=0.018)
  - IMH with localized PAU (hazard ratio 14.5; 95% CI 1.8-13.1; p=0.0018)
Overall Aortic Diameter at Presentation

- Aortic event (dissection-related death, aneurysm formation >6cm, new Type A dissection)

- Significant predictors of aortic event

  Maximal aortic diameter >4.0 cm at first CT scan (hazard ratio 3.5; 95% CI 1.2-9.7; p=0.018)

    - IMH with localized PAU (hazard ratio 14.5; 95% CI 1.8-13.1; p=0.0018)
False Lumen Diameter ≥ 22mm at Time of Initial Acute Type B Dissection Predictive of Late Death

Song et al. JACC, 50:799-804, 2007
**False Lumen Diameter at Presentation**

- **Incidence of Distal Aorta Aneurysm**
  - 51 Type 1, 49 type 3
  - 31 ± 27 mo.

**Figure 1**

- Incidences of aneurysm at the aortic arch, upper, mid, and lower descending thoracic aorta and abdominal aorta in patients with type 1 and type 3 aortic dissection.

**Graph**

- False Lumen Diameter Area Under Curve: 0.91 (95% CI: 0.83 – 0.98)
- Aorta Diameter Area Under Curve: 0.71 (95% CI: 0.55 – 0.87)

**False lumen at UT aorta >22 mm is 100% sensitivity & 76% specificity for predicting late aneurysm formation**

*(J Am Coll Cardiol 2007;50:799-804)*
Size and Location of Entry Tear

Long-Term Outcome of Aortic Dissection With Patent False Lumen

184 consecutive patients

Type A  108 Surgically treated
Type B  76  Medically treated

Discharged with patent false lumen
Median Follow-up 6.42 years

Background —
To assess the natural evolution of uncomplicated acute Type B dissection.

Methods and Patient Population —
184 consecutive patients with uncomplicated acute Type B dissection were included. Type A dissection was surgically treated; Type B dissection was medically treated with angiography and aortic wall stabilization surgery if needed. Median follow-up was 6.42 years.

Results —
Survival rates at 3, 5, and 10 years were 98%, 95%, and 93%, respectively. Time to dissection-related adverse events, whereas mortality was predicted by baseline maximum descending aorta diameter (HR: 1.36 [1.08–1.70]; \( P \)=0.008), entry tear size (HR: 1.1 [1.04–1.16]; \( P \)=0.001), and Marfan syndrome (HR: 3.66 [1.65–8.13]; \( P \)=0.001).

Conclusions — Aortic dissection with persistent patent false lumen carries a high risk of complications. In addition to Marfan syndrome and aorta diameter, a large entry tear located in the proximal part of the dissection identifies a high-risk subgroup of patients who may benefit from earlier and more aggressive therapy. (Circulation. 2012;125:3133-3141.)
Size and Location of Entry Tear

Size + Entry location

(Circulation. 2012;125:3133-3141.)
Size and Location of Entry Tear

(Circulation. 2012;125:3133-3141.)
Patent or Partially Thrombosed False Lumen

201 patients (false lumen status)

- 114 Patent
- 68 Partial Thrombosis
- 19 Complete Thrombosis
Additional High-Risk Group

- Partial thrombosis of FL
- Large entry tear (>10mm)
- FL diameter > 22mm
- Uncontrolled hypertension
Mortality by Status of False Lumen

P values
Overall, 0.003
*Partial thrombosis vs. patent, < 0.0001*
Complete thrombosis vs. patent, 0.17
Partial thrombosis vs complete thrombosis, 0.41

Figure 1. Kaplan–Meier Mortality Curve Stratified According to the Status of the False Lumen.
P values were calculated by the log-rank test. Overall denotes comparison of all three curves.
Morphology of the True and False Lumen

- Saccular configuration of the false lumen is a positive predictor for aortic growth

- Circular configuration of the true lumen is a negative predictor for aortic growth

(Uncomplicated Acute Type B Dissection

(J Vasc Surg 2013;58:1220-5.)
Influence of Multiple risk factors

### TABLE 3. Statistical analysis of predictors for late aortic events

<table>
<thead>
<tr>
<th>Predictive factor</th>
<th>Univariate</th>
<th>Multivariate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\chi^2$</td>
<td>$P$</td>
</tr>
<tr>
<td>Sex</td>
<td>0.27</td>
<td>.60</td>
</tr>
<tr>
<td>Age $\geq$ 70 y</td>
<td>0.66</td>
<td>.42</td>
</tr>
<tr>
<td>Hypertension</td>
<td>1.83</td>
<td>.18</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>2.40</td>
<td>.12</td>
</tr>
<tr>
<td>Ischemic heart disease</td>
<td>4.38</td>
<td>.036</td>
</tr>
<tr>
<td>Cerebrovascular disease</td>
<td>4.10</td>
<td>.043</td>
</tr>
<tr>
<td>COPD</td>
<td>0.61</td>
<td>.44</td>
</tr>
<tr>
<td>Hemodialysis</td>
<td>1.46</td>
<td>.23</td>
</tr>
<tr>
<td>LVEF $\geq$ 70%</td>
<td>2.61</td>
<td>.11</td>
</tr>
<tr>
<td>Type (DeBakey IIIa/b)</td>
<td>0.19</td>
<td>.66</td>
</tr>
<tr>
<td>Patent false lumen</td>
<td>9.70</td>
<td>.0018</td>
</tr>
<tr>
<td>Aortic diameter $\geq$ 40 mm</td>
<td>15.2</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>$Fl \geq$ 0.64</td>
<td>10.9</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Mean systolic blood pressure during follow-up ($\geq$140 mm Hg)</td>
<td>1.75</td>
<td>.19</td>
</tr>
</tbody>
</table>

CI, Confidence interval; COPD, chronic obstructive pulmonary disease; LVEF, left ventricular ejection fraction; Fl, fusiform index.

Degree of fusiform dilatation of the proximal descending aorta in type B acute aortic dissection can predict late aortic events

Influence of Multiple risk factors

M: Maximum diameter
   > 40 mm

P: Patent False Lumen

F: Fusiform index (FI)
   > 0.64

N: Normal

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Acute Aortic Dissections

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    - Medical Therapy
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