The ongoing discussion about the definition of “complicated” and “uncomplicated” type B aortic dissection

Current Status

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Cardiology and Aortic Centre

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CN: No relevant financial relationships to disclose.
Evolution of Cardiovascular Conditions

Figure 2 Annual Survey of Thoracic Aortic Surgery [1984–2013] by Japanese Association for Thoracic Surgery. Modified from reference (2). DAA, Aortic dissection; A Acute, acute type A aortic dissection; B Acute, acute type B aortic dissection; A Chronic, chronic type A aortic dissection; B Chronic, chronic type B aortic dissection; non DAA, non dissecting aneurysm; non DAA ruptured, ruptured aneurysm.

Malperfusion syndromes
- Visceral ischemia (ALT, AST, lactate, bilirubin)
- Renal malperfusion (unilateral)
- Spinal cord ischemia (symptoms)
- Iliofemoral malperfusion (claudication)

Refractory hypertension (>3 drugs)

Uncontrolled (recurrent pain)

Impending aortic rupture
- Increasing periaortic hematoma
- Hypotension (RR syst<90 mmHg)
- Shock

Criteria* for “complicated” type B aortic dissection

*Current Guidelines 2017/2018
...why is the definition of “uncomplicated” so complicated?

Uncomplicated TBAD...

misnomer

*noun [C]*

/ˌmɪsˈnɒmər/ *US ˌmɪsˈnʌmər/

*a name that does not suit what it refers to, or the use of such a name:

*It was the scruffiest place I've ever stayed in, so "Grand Hotel" was a complete misnomer.*

*It's something of a misnomer to refer to these inexperienced boys as soldiers.*

(Definition of “misnomer” from the *Cambridge Advanced Learner’s Dictionary & Thesaurus* © Cambridge University Press)
High risk criteria for “uncomplicated” type B aortic dissection

Demographic criteria
• Age < 60 years of age
• Connective tissue diseases
• Family history of aortic conditions

Laboratory criteria
• Fibrinogen splits >20 mg/mL
• White blood cell count > 11.0 x 109 cells/L (p<0.05)*
• D-Dimer > 500ng/ml (maintaining)

Morphological criteria
• Total aortic diameter >42mm
• False lumen diameter >22mm
• False lumen partial thrombosis
• Single entry
• Entry diameter > 10mm
• True lumen diastolic compression
• False lumen at inner curvature of aorta

Functional criteria
• Perfused false lumen (Doppler flow)
• High false lumen volume flow (> 700 ml/min)
• Enhanced FDG-uptake on PET

*Chen ZR et al. J Geriat Card 2017
Initial management: In suspected acute aortic dissection

Suspected acute aortic dissection

- Unstable patient with systolic BP <100 mm Hg
  - BP monitoring, ventilation, resuscitation, echocardiogram
  - Aortic dissection confirmed
    - Immediate surgery
  - Other diagnosis
    - Management dependent on diagnosis

- Stable patient with systolic BP ≥100 mm Hg
  - Initial investigations:
    - Blood tests
    - ECG
    - Chest radiography
    - Titrate BP to 100–120 mm Hg with intravenous β blockers, nitroprusside, or calcium-channel blockers
    - Analgesia
  - Aorta dissection confirmed
    - Type A
      - Surgery
    - Type B
      - Continue medical treatment

Feasable: My 1st -TEVAR- In Type B Dissection

ENDOVASCULAR STENT–GRAFT PLACEMENT FOR THE TREATMENT OF ACUTE AORTIC DISSECTION

MICHAEL D. Dake, M.D., Noriyuki Kato, M.D., R. Scott Mitchell, M.D., Charles P. Semba, M.D.,"Mahmood K. Razavi, M.D., Takatsugu Shimono, M.D., Tadanori Hirano, M.D., Kan Takeda, M.D., Isao Yada, M.D., and D. Craig Miller, M.D.

ABSTRACT

Background

The standard treatment for acute aortic dissection is either surgical or medical therapy, which is associated with high morbidity and mortality. We report our initial experience with the use of endovascular stent-graft placement for the treatment of acute aortic dissection.

Methods

A total of 15 patients with acute aortic dissection were treated with endovascular stent-graft placement. The stents were deployed in the descending thoracic aorta in 10 patients, in the abdominal aorta in 3, and in both the thoracic and abdominal aorta in 2.

Results

All patients were alive at 1-year follow-up. Eight patients had no evidence of intimal flap, which was confirmed by computed tomographic angiography or magnetic resonance imaging. Three patients had persistenttype B dissection, which resolved completely in one patient and partially in two.

Conclusion

Endovascular stent-graft placement is a feasible, safe, and quick method of treatment for acute aortic dissection. Open surgery should be abandoned.

- Feasible
- Safe
- Quick recovery
- Open surgery abandoned

Potential...induced aortic remodeling after TEVAR + F/U

Completely reconstructed acute dissection

Progressive shrinkage of false lumen thrombus mass

Relief of infrarenal true lumen collapse
Remodeling with TEVAR...

Complete false lumen thrombosis in the descending thoracic aorta

Pre-procedure  Post-procedure  24 months
Uncomplicated type B dissection on drugs!
Type B aortic dissection: Survival and predictors

Survival with acute type B aortic dissection on drugs....

INSTEAD: 2 yrs outcomes after TEVAR in uncomplicated patients

@ 1 year crossover rate 14% (p=0.02)
@ 2 years crossover rate 20% (p=0.02)

The initial RCT showed a long-term advantage of an intervention (stent-grafting the TL), with two large registry-based analyses confirming the signal from the RCT; findings are supported by short-term F/U of an independent RCT. **On aggregate, all data are consistent! Very strong signal!**
late advantage also supported by MGH Cohort study

**TEVAR for uncomplicated TBAD**

**Natural history of uncomplicated TBAD**

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*Fig 3. Kaplan-Meier curve for survival of 298 patients with uncomplicated, acute type B dissection, from the time of presentation, stratified by those undergoing intervention (green) and those remaining medically managed throughout the operative period (red) (P = .018). SE, Standard error.*
Survival after TEVAR in complicated TBAD

Remodelling is key to success; long-term surveillance still recommended!

N = 51

Fig 3. Kaplan-Meier survival curve in patients with acute type B aortic dissection who were treated with thoracic endovascular aortic repair.

TEVAR in Complicated and "uncomplicated" TBAD is backed-up by Guidelines...

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**Recommendations for treatment of aortic dissection**

<table>
<thead>
<tr>
<th>Recommendations</th>
<th>Class</th>
<th>Level</th>
<th>Ref.</th>
</tr>
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<tbody>
<tr>
<td>In all patients with AD, medical therapy including pain relief and blood pressure control is recommended.</td>
<td>I</td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>In patients with Type A AD, urgent surgery is recommended.</td>
<td>I</td>
<td>B</td>
<td>1,2</td>
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<tr>
<td>In patients with acute Type A AD and organ malperfusion, a hybrid approach (i.e. ascending aorta and/or arch replacement associated with any percutaneous aortic or branch artery procedure) should be considered.</td>
<td>IIa</td>
<td>B</td>
<td>2,118, 202–204, 227</td>
</tr>
<tr>
<td>In uncomplicated Type B AD, medical therapy should always be recommended.</td>
<td>I</td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>In uncomplicated Type B AD, TEVAR should be considered.</td>
<td>IIa</td>
<td>B</td>
<td>218,219</td>
</tr>
<tr>
<td>In complicated Type B AD, TEVAR is recommended.</td>
<td>I</td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>In complicated Type B AD, surgery may be considered.</td>
<td>IIb</td>
<td>C</td>
<td></td>
</tr>
</tbody>
</table>

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**Legend**

- **Class of recommendation.**
- **Level of evidence.**
- **Reference(s) supporting recommendations.**

AD = aortic dissection; TEVAR = thoracic endovascular aortic repair.

ESC Guidelines 2014
Current recommendations...

Eur J Vasc Endovasc Surg (2017) 53, 1–3

EDITORIAL

Management of Descending Thoracic Aorta Disease: Evolving Treatment Paradigms in the TEVAR Era

The ESVS guidelines are reflective of a recent, dramatic change in the management of descending thoracic aorta disease marked by the steady adoption of endovascular repair as standard of care.\textsuperscript{5,6} When repair is indicated, thoracic endovascular aneurysm repair (TEVAR) is now the first-line recommended treatment for intact and ruptured descending thoracic aneurysm (DTAA), blunt traumatic thoracic aortic injury, acute Stanford type B aortic dissection (TBAD), intramural hematoma, and penetrating aortic ulcer. For each of these processes, the ESVS guidelines offer a type I or IIA recommendation for endovascular therapy first. Taken together, this is a powerful statement supporting the broad applicability and growing preference for TEVAR.

Importantly, the primacy of open surgical repair is emphasized in certain instances. For chronic TBAD with persistent symptoms or aneurysmal degeneration, open repair is recommended in patients with appropriate surgical risk. Owing to aortic membrane thickening and consequent poor plasticity in the chronic phase, TEVAR is less likely to offer durable benefit owing to persistent pressurization of the false lumen through distal fenestrations. Adjunctive endovascular techniques, such as false lumen embolization, may aid in causing false lumen thrombosis.\textsuperscript{15} However, open aortic repair is currently the only reliable way to treat chronic TBAD when repair is indicated.
# Improved technology - TEVAR (R)Evolution

<table>
<thead>
<tr>
<th>Gore Tag</th>
<th>Zenith TX2</th>
<th>Medtronic Talent Captivia</th>
<th>Medtronic Valiant Captivia</th>
<th>Gore Conformable TAG</th>
<th>Bolton’s Relay Plus</th>
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<td><img src="image5.png" alt="Image" /></td>
<td><img src="image6.png" alt="Image" /></td>
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</tbody>
</table>

![Image](image7.png)  ![Image](image8.png)  ![Image](image9.png)  ![Image](image10.png)  ![Image](image11.png)  ![Image](image12.png)
Zone 2 TBE (12 mm Portal) in “Residual” Type A Dissection (Downstream Aorta) 10 days

3 cm Dacron LZ previously constructed with Zone 2 Arch (10 days earlier)

Side branch sheath positioned in LSA
Note nice horizontal access
Remodeling and Outcomes

"P = 0.0031 (Adjusted = 0.037)"
Cases: 3D CT guided reintervention in type B dissection

1st attempt

2nd attempt
## Predictors of long-term stability

<table>
<thead>
<tr>
<th></th>
<th>B</th>
<th>SE</th>
<th>p-value</th>
<th>OR</th>
<th>95.0% CI for Hazard Ratio</th>
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<tbody>
<tr>
<td><strong>Age</strong></td>
<td>.030</td>
<td>.020</td>
<td>.134</td>
<td>1.031</td>
<td>.991-1.072</td>
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<tr>
<td><strong>Female</strong></td>
<td>-1.097</td>
<td>.649</td>
<td>.091</td>
<td>.334</td>
<td>.094-1.193</td>
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<tr>
<td><strong>STJ diameter</strong></td>
<td>-1.880</td>
<td>.637</td>
<td>.003</td>
<td>.153</td>
<td>.044-.532</td>
</tr>
<tr>
<td><strong>Complete FLT</strong></td>
<td>1.678</td>
<td>.751</td>
<td>.025</td>
<td>5.354</td>
<td>1.229-23.329</td>
</tr>
</tbody>
</table>
TIMING...remodeling is best in the acute and subacute phase of dissection!

Mid-term outcomes and aortic remodelling after thoracic endovascular repair for acute, subacute, and chronic aortic dissection: The VIRTUE Registry

Midterm outcomes and morphology are similar in acute and subacute type B dissection undergoing stent-graft treatment; the window of plasticity and for remodelling is open until 3 months.
Estimation of risk in type B aortic dissection

Stanford Aortic Dissection Risk Calculator

Patient Data
1. Connective tissue disease:
   - No
   - Yes

2. Maximum aortic diameter in the area of the dissected aorta:
   - 40 mm

3. Circumference of false lumen:
   - 240 deg.

4. Identifiable aortic intercostal arteries in the area of the dissected aorta:
   - 7

5. False lumen outflow:
   - 700 ml

Risk Score

Please tick supplying lumina (true lumen (TL) or false lumen (FL), or none) for every artery:
- Left subclavian artery (375)
- Celiac trunk (550)
- Superior mesenteric artery (550)
- Left renal artery (500)
- Right renal artery (500)
- Inferior mesenteric artery (190)
- Left common iliac artery (400)
- Right common iliac artery (400)

Result

Linear predictor (LP):
- Low risk (LP < 6.05)
- Intermediate risk (LP 6.06 to 7.00)
- High risk (LP > 7.00)

Risk of adverse event before 2 years:
- 20.6%
Latest case & standard procedure from last week...

SOP in distal dissection

LSA bypass/single branch
LSA occuder
Proximal Stentgraft
Open extension (PETTICOAT)
Distal management
Management 2017

High risk features:
Exclude all high risk features to justify medical management alone

- Patient with chest pain
- Blood biomarkers, ECG
- Urgent CT scan
  - Negative initial imaging, high clinical suspicion—add TTE
  - Pulmonary embolus
  - Aortic dissection
  - Acute coronary syndrome
    - Stanford type A
    - Stanford type B

Complications
- Aortic rupture
- End-organ ischaemia
- Continuing pain and hypertension despite full medical therapy
- Early false lumen expansion
- Large single entry

Open surgery after initial risk assessment
Uncomplicated: Medical treatment
Complicated: Endovascular treatment

Nienaber CA, Clough RA, Lancet 2015
Royal Brompton Aortic Centre 2017

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cardiac surgeon

Cesare Quarto

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vascular surgeon

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Mike Rubens
Imaging
Future management scheme for aortic dissection?
Chronic type B dissection: Classic surgical repair
DISSECT consortium

"... Dissection is an ever changing disease and a continuum of anatomic involvement and risk constellation ... essentially nobody is at no risk! “

Mortality

- uncomplicated 10%
- complicated 58%

**IRAD temporal classification:** Survival in B dissection by acuity

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**Kaplan-Meier Survival Curve**

**Dissection Type: B**

- **Log Rank Chi-Sq p<0.001 between management types**

- **Endovascular Management**
- **Medical Management**
- **Surgical Management**

- **0-24 hours (hyperacute)**
- **2-7 days (acute)**
- **8-30 days (subacute)**
- **greater than 30 days (chronic)**

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**Time from Symptom Onset (days)**

**Survival**

Booher M et al., Am J Med 2013
Aortic Dissection revised...

Mortality

- uncomplicated 10%
- complicated 58%

DISSECT consortium

“... Dissection is an ever changing disease and a continuum of anatomic involvement and risk constellation ... essentially nobody is at no risk! “

Mortality

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"... Dissection is an ever changing disease and a continuum of anatomic involvement and risk constellation ... essentially nobody is at no risk! “

Malperfusion syndrome treated with endovascular stent-graft and PETTICOAT; a) angiography of lower body malperfusion; b) reperfusion after proximal stent-graft; c) 3D CT reconstruction of acute complicated dissection with malperfusion; d) reconstructed aorta and abolished malperfusion after stent-graft and PETTICOAT.
Interventional Repair of type a aortic dissection

2- and 3-dimensional images of proximal aortic dissection before (A) and after stent-graft (B) with successful remodelling, but later total erosion of distal stent-edge at 16 months (C).
Interventional Repair of type a aortic dissection

pre procedure (FLIRT)

CT and echo images pre-procedure (A), at discharge (B) and 6-month follow-up (C) showing entry closure false lumen thrombus and shrinkage with true lumen expansion (remodelling) (patient no.2). Star shows the ASD occluder.

At discharge

6 months F/U

Yuan X et al under review 2017
Trends in Aortic Dissection over 17 years

Increasing percentage of type A repair

Fewer rejection from surgery

Increasing endovascular management for type B dissection

Decreasing surgical repair of type B aortic dissection

Pape L., et al. JACC 2015
Regionalized care offering all treatment options from ascending aorta to distal malperfusion

**Figure 1** Streamlined care and swift management begins with rapid emergency transfer to a certified emergency care centre followed by diagnostic imaging. Diagnostic CT images may be shared with the surgical/interventional team in another hospital or directly fed into the hybrid theatre for optimal care e.g. an EVAR first strategy if anatomy allows.
• “Dios creó la aorta con solo un canal...así debería quedarse...”
• Papa Francisco y Juan Parodi 2015
Longterm outcomes in IRAD

TEVAR versus medical management of type B dissection

Fattori R, JACC CV Int 2013
Two patients with a small initial false lumen diameter at the upper descending thoracic aorta showed a complete resorption of the false lumen (left) or did not show an aneurysm for approximately 3 years (middle), while another patient with a large initial false lumen diameter developed an aorta aneurysm after approximately 2.5 years (right).


**New risk group:** False Lumen diameter: FL > 22 mm
Entry size: Long-term outcome of aortic dissection?

- Entry tear of aortic dissection visualized by 2-dimensional (left) and color-Doppler (right) TEE
- Type B dissection with an entry tear located in the proximal part of the descending aorta (arrow) by tranverse view
- Type A dissection with an entry tear in the proximal part of the residual dissection (arrow) in the upper ascending aorta by longitudinal view

Evangelista et al. Circulation 2012
New high risk group: *Pain & persisting hypertension*

Trimarchi S et al. Circulation 2009
Bicuspid Aortic Valve

- Most common congenital heart disease
  - 0.5-2% in population\(^1\)
- Recognised for >500 years
- Questions outstanding
- >1/3 cases inherited in Mendelian fashion\(^2\)
  - Syndromes eg Marfan, Kabuki
  - NOTCH1, GATA5, NKX2-5

PETTICOAT follow-up in complicated type B dissection

Stable trial; JVS 2012