The conundrum about complicated and uncomplicated type B dissection – New concepts?

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vascular surgeon

Mike Rubens
Imaging
Models of Hemodynamic Stress and Aortic Dissection

Shear stresses on the aortic wall are highest at sites of increased dilatation.

dP/dt, which is affected by wave reflections, is greatest in areas of aortic dilatation

Chronic type B dissection on drugs!
Patients with aortic dissection are at risk for late aortic events

Medical management is expected to prevent ... rupture, aneurysm, aortic repair... but does it really?
Importance of Blood Pressure Control After Repair of Acute Type A Aortic Dissection: 25-Year Follow-Up in 252 Patients

Reoperation rates:
- SBP <120 mm Hg: 3/85 (4%)
- SBP 120-140 mm Hg: 13/63 (21%)
- SBP >140 mm Hg: 10/30 (33%)

What are the data on antihypertensive therapy after aortic dissection?

RCT: none
Group A included 2340 patients (25.74%) treated surgically for type A AD

Group B included 1144 patients (12.58%) treated endo/surgically for type B AD

Group C included 5608 patients (61.68%) with any type of AD treated with medical therapy only.

Overall survival rates of the three study groups in 9092 patients with aortic dissection in Taiwan.

### Universal Guidelines on Aortic Dissection

#### Table 1 Guideline-based medical management of aortic dissection

<table>
<thead>
<tr>
<th>Country/Guideline &amp; Year</th>
<th>Class</th>
<th>Evidence</th>
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<tbody>
<tr>
<td><strong>European Society of Cardiology (2001)</strong></td>
<td></td>
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<tr>
<td>Immediate treatment</td>
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<tr>
<td>Pain relief (morphine sulphate)</td>
<td>I</td>
<td>C</td>
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<tr>
<td>Reduction of systolic blood pressure using beta-blockers (i.v. propranolol, metoprolol, esmolol or labetalol)</td>
<td>I</td>
<td>C</td>
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<tr>
<td>Additional vasodilator for severe hypertension (i.v. sodium nitroprusside to titrate BP to 100-120 mmHg)</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>For obstructive pulmonary disease, blood pressure lowering with calcium channel blockers</td>
<td>II</td>
<td>C</td>
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<td>Immediate treatment</td>
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<tr>
<td>Medical treatment for uncomplicated type B cases (patent/thrombosed false lumen, ulcer-like projection)</td>
<td>I</td>
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<td>Medical treatment for cases resistant to anti-hypertensive treatment</td>
<td>IIa</td>
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<td>Chronic treatment</td>
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<td>Medical treatment if aortic diameter less than 50 mm and absence of rapid dilatation</td>
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<td>Exercise (e.g., cycling, running) should be kept to a blood pressure of less than 180 mmHg</td>
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<td>Beta-blockers should mainly be used for blood pressure treatment</td>
<td>IIb</td>
<td>C</td>
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<td>Target for systolic blood pressure is 130-135 mmHg</td>
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<td><strong>American (AHA/ACC) guidelines 2010</strong></td>
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<td>Initial management of thoracic aortic dissection</td>
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<td>Intravenous beta-blockade should be initiated and titrated to a target heart rate of &lt;60 bpm</td>
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<td>Non-dihydropyridine calcium channel blocking agents as an alternative for rate control</td>
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<td>If systolic BP remains &gt;120 mmHg after adequate heart rate control, angiotensin-converting enzyme inhibitors and/or other vasodilators should be administered to further reduce BP that maintains adequate end-organ perfusion</td>
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<td>Beta-blockers should be used cautiously with aortic regurgitation because they will block compensatory tachycardia</td>
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<td>Vasodilator therapy should not be initiated prior to rate control to avoid associated reflex tachycardia</td>
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AHA, American Heart Association; ACC, American College of Cardiology; BP, blood pressure.

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- **AAS without high risk features**
  - Apply morphologic risk predictor score
Survival in type A dissection

Kaplan-Meier Survival Curve
Dissection Type: A

Log Rank Chi-Sq p<0.001 between management types

- Surgical Management
- Medical Management

Time from Symptom Onset (days)

0-24 hours (hyperacute)
2-7 days (acute)
8-30 days (subacute)
greater than 30 days (chronic)
Type B dissection with malperfusion
Survival after TEVAR in complicated TBAD

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

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Importance of Refractory Pain and Hypertension in Acute Type B Aortic Dissection

Overall in hospital mortality

In hospital mortality with medical management

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Tsai TT et al. for IRAD: NEJM 2007
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- Type A dissection with an entry tear in the proximal part of the residual dissection (arrow) in the upper ascending aorta by longitudinal view
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After TEVAR

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PET-CT

Sakalihasan N, Nienaber CA et al, EHJ 2015
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late advantage also supported by MGH Cohort study

TEVAR for uncomplicated TBAD

Natural history of uncomplicated TBAD

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.
Remodeling with TEVAR…

Complete false lumen thrombosis in the descending thoracic aorta

Pre-procedure
Post-procedure
24 months
..2 predictors of long-term stability: FL thrombosis and Remodeling!

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Figure 4: Kaplan-Meier analysis shows freedom from aortic events (A) in the occluded false lumen group and (B) in the patent false lumen perfusion group.

IRAD data on file

Suenaga H. et al. EJCTS 2016
**TEVAR in Complicated and “uncomplicated” TBAD is backed-up by Guidelines...**

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**ESC Guidelines 2014**
**Background:** Type B aortic dissection is a life-threatening acute aortic condition often with acute ischemic signs or symptoms. With initial management focusing on alleviating malperfusion and pain, and avoiding propagation of dissection or rupture both systolic blood and pulse pressure should be reduced initially by an aggressive medical approach. In the setting of persistent signs of complications endovascular strategies have replaced open surgery and led to a fourfold increase in early survival and better long-term outcomes.

**Methods:** An electronic health database search was performed on articles published between January 2006 and July 2017. Publications were included in this review if (I) the index aortic pathology was type B aortic dissection (II) the medical management was initially medical and not surgical and (III) uncomplicated type B dissection almost 90% of patients survive initial hospitalization and were subjected to medical management with a 5-year survival of 50–80%. However, up to 20–55% of medically treated patients develop aneurysmal degeneration after 5 years with an unknown risk of rupture.
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 degr.

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

5. **False lumen outflow:**
   - 700 mL

*Please tick supplying lumina (true lumen (TL) or false lumen (FL), or none) for every artery.*

- **Left subclavian artery (375)**
  - TL
  - FL
- **Celiac trunk (550)**
  - TL
  - FL
- **Superior mesenteric artery (550)**
  - TL
  - FL
- **Left renal artery (500)**
  - TL
  - FL
- **Right renal artery (500)**
  - TL
  - FL
- **Inferior mesenteric artery (190)**
  - TL
  - FL
- **Left common iliac artery (400)**
  - TL
  - FL
- **Right common iliac artery (400)**
  - TL
  - FL

**Risk Score**

- **Y1**
- **Y2**
- **Y3**

- **Survival probability**
  - Low risk
  - Intermediate risk
  - High risk

- **Days**
  - 28
  - 27
  - 28
  - 365
  - 730
  - 1,065
  - 1,400
  - 1,625

**Result**

- **Linear predictor (LP):** 6.522
  - 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%
Therapy 2018: Every patient should receive medical management, but that is almost never enough!

Nienaber CA and Clough RE, Lancet 2015
Uncomplicated type B aortic dissection: Survival & predictors


Estimated Survival by Predictors

Low risk type B any benefit?

Hypotension/Shock Malperfusion

Days of Follow-up

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)

“Medical” Management after Aortic Dissection

E-A-S-Y-T-I-P

Establish the underlying diagnosis
Achieve normal blood pressure (regardless of drug!)
Stop cigarette smoking
Yearn to exercise moderately
Test 1st degree relatives for TAA disease
Image the aorta over time
Perform aortic repair when appropriate
**Interventional Repair of type a aortic dissection**

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 (accepted 2018)
Individual approach – false lumen management in type A dissection

CT scan 3 days after procedure

No contrast communication to the false lumen

CT scan 6 months after procedure

Device sealing in site precisely with excellent remodelling

Yuan X et al. JEVT 2017
Survival with acute type B aortic dissection on drugs....

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.

Models of Hemodynamic Stress and Aortic Dissection

Shear stresses on the aortic wall are highest at sites of increased dilatation.

dP/dt, which is affected by wave reflections, is greatest in areas of aortic dilatation

**Multiple guidelines**: IV beta-blockers as first-line therapy based on theoretical ability to decrease aortic wall shear stress (Labetalol).

- HR <60 bpm
- Systolic BP of 100-120 mm Hg or as tolerated while maintaining adequate end-organ perfusion

CCB (diltiazem, verapamil) suggested as alternatives if intolerance to beta-blockers.

If BP remains over target, ACE-inhibitors and other IV vasodilators can be used.

Once stable, transition to oral medications and continue long-term. Beta-blockers are recommended long-term.
What are the data on antihypertensive therapy after aortic dissection?

RCT: none
Importance of Blood Pressure Control After Repair of Acute Type A Aortic Dissection: 25-Year Follow-Up in 252 Patients

Reoperation rates:
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Overall in hospital mortality

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Evangelista et al. Circulation 2012
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Uncomplicated Type B Dissection
Total Diameter >44mm - bad long-term Outcome

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*Class of recommendation.

*Level of evidence.

Reference(s) supporting recommendations.

AD = aortic dissection; TEVAR = thoracic endovascular aortic repair.
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.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.15 However, open aortic repair is currently the only reliable way to treat chronic TBAD when repair is indicated.
Conservative management versus endovascular or open surgery in the spectrum of type B aortic dissection

Xun Yuan, Andreas Mitsis, Mohammed Ghonem, Ilias Iakovakis, Christoph A. Nienaber

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Background: Type B aortic dissection is a life-threatening acute aortic condition often with acute ischemic signs or symptoms. With initial management focusing on alleviating malperfusion and pain, and avoiding propagation of dissection or rupture both systolic blood and pulse pressure should be reduced initially by an aggressive medical approach. In the setting of persistent signs of complications endovascular strategies have replaced open surgery and led to a fourfold increase in early survival and better long-term outcomes.

Methods: An electronic health database search was performed on articles published between January 2006 and July 2017. Publications were included in this review if (I) the index aortic pathology was type B aortic dissection; (II) the clinical presentation was primarily medical; (III) the index event was uncomplicated type B dissection almost 90% of patients survive initial hospitalization and were subjected to medical management with a 5-year survival of 50–80%. However, up to 20–55% of medically treated patients develop aneurysmal degeneration after 5 years with an unknown risk of rupture.

in the setting of distal aortic dissection and provides an up-to-date interpretation of the published evidence. For complicated cases, treated acutely, the 30-day or in-hospital mortality was 7.3% when managed by
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


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)
  - TL
  - FL
- Celiac trunk (550)
  - TL
  - FL
- Superior mesenteric artery (550)
  - TL
  - FL
- Left renal artery (500)
  - TL
  - FL
- Right renal artery (500)
  - TL
  - FL
- Inferior mesenteric artery (190)
  - TL
  - FL
- Left common iliac artery (400)
  - TL
  - FL
- Right common iliac artery (400)
  - TL
  - FL

Result

Linear predictor (LP): 6.522

- 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%

Outcomes and Economic Comparison of Strategies in Type B Aortic Dissection

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Total costs ($) (Median)</th>
<th>Cost per day ($) (Median)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open surgery</td>
<td>54,371</td>
<td>5,007</td>
</tr>
<tr>
<td>Medical</td>
<td>10,149</td>
<td>2,391</td>
</tr>
<tr>
<td>Endovascular</td>
<td>46,907</td>
<td>5,748</td>
</tr>
</tbody>
</table>

TEVAR provided **best** short-term mortality benefit & may-be cost-effective over open surgery and medical management!

Hsieh RW et al. JTCVS 2018 (in press)
Therapy 2018: Every patient should receive medical management, but that is almost never enough!

- Patient with chest pain
- Blood biomarkers, ECG
- Urgent CT scan
- Triple rule out CT if intermediate pretest probability of CAD
  - Negative initial imaging, high clinical suspicion—add TTE
  - Pulmonary embolus
  - Aortic dissection
  - Acute coronary syndrome
- Stanford type A
- Stanford type B

+ Risk calculator in low risk TBAD

- 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 and Clough RE, Lancet 2015
“Medical” Management after Aortic Dissection

E-A-S-Y-T-I-P

E - Establish the underlying diagnosis
A - Achieve normal blood pressure (regardless of drug!)
S - Stop cigarette smoking
Y - Yearn to exercise moderately
T - Test 1st degree relatives for TAA disease
I - Image the aorta over time
P - Perform aortic repair when appropriate
Interventional Repair of type a aortic dissection

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 (accepted 2018)
Individual approach – false lumen management in type A dissection

CT scan 3 days after procedure

No contrast communication to the false lumen

Device sealing in site precisely with excellent remodelling

CT scan 6 months after procedure

Yuan X et al. JEVT 2017
Survival with acute type B aortic dissection on drugs....