Chronic Type B Aortic Dissection: Indications for Treatment and Strategies

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University Hospital Eppendorf
## Disclosure of speaker’s interests

<table>
<thead>
<tr>
<th>(Potential) conflict of interest</th>
<th>Yes</th>
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<td>Potentially relevant company relationships in connection with event</td>
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<tr>
<td>• Sponsorship or research funding</td>
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<td>• Fee or other (financial) payment</td>
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<td>• Other relationship, i.e. …</td>
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Research grants, travel, speaking-fees, proctoring and royalties with Cook Medical
Stanford Classification

Type A

Type B
DeBakey Classification

Type I
Chronic Type A Residual Dissection

Type II
Cured

Type III
Chronic Type B Dissection
Chronic Aortic Dissection

Classification:
- Acute \( \leq 14 \) days
- Chronic \( > 14 \) days

Is the dissection in a steady state after 14 days???
- No pain
- Hypertension controlled
- Inflammatory response to normal
- Vessel wall normalized
- No increased risk of progression
Chronic Aortic Dissection

Classification:
• Acute ≤ 14 days
• Chronic > 14 days

Subacute 15-30 (90) days

Is the dissection in a steady state after 14 days???
• No pain
• Hypertension controlled
• Inflammatory response to normal
• Vessel wall normalized
• No increased risk of progression

Most often not!
Chronic Aortic Dissection

• Acute: 0-14 days
• Subacute: 15-30 days
• Chronic: 31-90 days

Chronic Aortic Dissection

Distinction between Acute and Chronic Type B Aortic Dissection: Is there a Sub-acute Phase?

J. Steuer a, b, M. Björck a, D. Mayer b, A. Wanhainen a, T. Pfammatter b, M. Lachat b

a Department of Surgical Sciences, Vascular Surgery, Uppsala University, Uppsala, Sweden
b Clinic for Cardiovascular Surgery, University Hospital, Zurich, Switzerland
b Institute of Diagnostic Radiology, University Hospital, Zurich, Switzerland

- 2009-2011
- n=124 TEVAR
- n=22 >14days for
  - Endorgan ischemia
  - Rapid Enlargement

Steuer et al. 2013, Eur J Vasc Endovasc Surg 45: 627-31
Subacute Type B Aortic Dissection

Endovascular Repair of Type B Aortic Dissection
Long-term Results of the Randomized Investigation of Stent Grafts in Aortic Dissection Trial

INSTEAD:
“TEVAR associated with improved 5-year aorta-specific survival and delayed disease progression.”

Nienaber et al 2013, Circ Cardiovasc Interv. 6:407-416
Acute/Subacute Typ B Aortic Dissection

Survival After Endovascular Therapy in Patients With Type B Aortic Dissection
A Report From the International Registry of Acute Aortic Dissection (IRAD)

Conclusions

Historical data have supported the use of medical therapy in patients who survived an acute type B aortic dissection. In IRAD, a subgroup of acute type B dissection patients treated with endovascular repair showed better 5-year survival compared with patients with medical therapy alone. If long-term follow-up and randomized studies support these preliminary data, it appears that uncomplicated type B aortic dissection could become an indication for early elective endovascular stent grafting.

Fattori et al. 2013; JACC Cardiovasc Interv 6: 876-82
Good data to support:

- TEVAR for acute complicated TBAD
- TEVAR for subacute TBAD

But what about chronic TBAD?
Expert Consensus on CTBAD

Chronic Type B aortic dissection
After 6 weeks

Complicated defined as:
- Total aortic diameter $\geq 55$ mm
- Total aortic diameter yearly increase $>4$ mm
- Recurrent symptoms

Uncomplicated defined as:
No features of complicated dissection

Intervention

Medical Mgt & TEVAR

Medical Mgt & Open Surgery Repair (if TEVAR contraindicated)

Medical Mgt & Imaging surveillance protocol:
6 weeks and annually thereafter

Fattori et al. 2013, JACC 61: 1661-78
Indications for Intervention

* Chronic complicated Type B Dissection
  * Rupture and bleeding
  * False lumen aneurysm >5.5 - 6cm
  * Rapid growth > 5mm/year
  * Malperfusion
Strategies

Open

Endovascular
Availability of Endo-Equipment

- Iliac Legs (Spiral-Z)
- Flex AAA Low-Profile
- Ascend (Type A)
- TX2 Low Profile
- TXD
- Iliac Branch (ZBIS/ZHIS)
- p-Branch
- Fenestrated
- t-Branch
- (ZFEN-D UNIBODY)

CE Marked
Strategies

Open

Endovascular
Strategies

Open Surgery:

- Genetic disorders: Marfan, LDS, etc.
- Young age
- Good risks
Open surgical repair for chronic type B aortic dissection: a systematic review

David H. Tian¹, Ramesh P. De Silva¹, Tom Wang¹, Tristan D. Yan¹²

- Metaanalysis of 19 studies
- N=970, age 58y
- Chronic Type B aortic dissection (>14d)
- 30d mortality: 11% (0-33%)
- Stroke: 6%
- Spinal chord deficits: 5%
- 10y survival 50%

Tian 2014; Ann Thorac Surg: Epub

7 studies, n=458
Outcomes of open distal aortic aneurysm repair in patients with chronic DeBakey type I dissection

Joseph S. Coselli, MD, a,b,c Susan Y. Green, MPH, a,b,c Samantha Zarda, MS, a,b,c Courtney C. Nalty, MSPH, a

- 2005-2013, single center
- N=198, age 56y
- Residual Dissection 5y post Type A
- 30d mortality: 12%
- Stroke: 5%
- Spinal chord deficits: 16%, permanent: 6%

Open repair of chronic complicated type B aortic dissection using the open distal technique


- 1991-2013, single center
- N=240, age 59y
- CTBAD and residual dissection
- 30d mortality: 8%
- Stroke: 3%
- Dialysis: 6%
- Spinal chord deficits: 2%, permanent: 1%

Estrera et al. 2014; Ann Cardiothorac Surg 3: 375-84
IT’S CALLED ‘A BOOK.’
...NOT SURE WHERE THE BATTERIES GO.
Does TEVAR offer the same protection compared to open surgery?

Will it decrease early mortality?
Mid-term Outcomes and Aortic Remodelling After Thoracic Endovascular Repair for Acute, Subacute, and Chronic Aortic Dissection: The VIRTUE Registry

The VIRTUE Registry Investigators

* Prospective multicentre registry
* 2006-2009
* Non-consecutive
* Industry-sponsored
* 14 centers (7 patients/center)

* TEVAR for Type B Dissection
* Mortality, aortic remodelling
* N=100, 36 months FU
  * Acute complicated: n=50
  * Subacute: n=24
  * Chronic: n=26
TEVAR in Chronic Type B

- No statistical difference in all-cause mortality and dissection-related mortality at mid-term.
- Tendency to higher all-cause mortality in chronic patients.

VIRTUE Registry 2014; Eur J Vasc Endovasc Surg 48: 363-71
TEVAR in Chronic Type B

VIRTUE Registry 2014; Eur J Vasc Endovasc Surg 48: 363-71

-more aortic reinterventions in chronic patients: >30%

-overall false-lumen area increase in chronic patients
Concept of TEVAR in Dissection

- Occlusion primary entry tear
- Expand true lumen
- Thrombose false lumen
- Promote aortic remodelling
- Secure flow to intercostals and visceral arteries
Aortic Remodelling

False-lumen diameter at stentgraft

True-lumen diameter at stentgraft

Acute type B dissection

Sayer et al 2008, EJVES 36:522-9
„Why Does the Aorta Fail to Remodel in Chronic Dissection?“
Failure to Remodel in Chronic Dissection

- Perfusion and pressure unchanged in false lumen
- Presence of Intercostals originating from false lumen
- False lumen back flow to Intercostals
TEVAR in Chronic Type B

Efficacy of thoracic endovascular stent repair for chronic type B aortic dissection with aneurysmal degeneration

Salvatore T. Scali, MD, a Robert J. Feezor, MD, a Catherine K. Chang, MD, a David H. Stone, MD, c Philip J. Hess, MD, b Tomas D. Martin, MD, b Thomas S. Huber, MD, PhD, d and Adam W. Beck, MD, a
Gainesville, Fla; and Lebanon, NH

- 2004-2011
- n=80, 26 months FU
- TEVAR for type B and residual AD
- LSA-coverage 75%, 24% debranching
- Median 16 (1-74) months.
- 35% FL-expansion during FU (!)

Scali et al. 2013; J Vasc Surg. 58:10-7
TEVAR in Chronic Type B

Predictors of Outcome after Endovascular Repair for Chronic Type B Dissection

K. Mani, R.E. Clough, O.T.A. Lyons, R.E. Bell, T.W. Carrell, H.A. Zayed, M. Waltham, P.R. Taylor

- 2000-2010
- N=58, 38 months FU
- TEVAR for chronic type B (>14days)
- Perioperative mortality 5.2%
- 3 year mortality 36%

Mani et al. 2012; Eur J Vasc Endovasc Surg 43: 386-91
Predictors of Outcome after Endovascular Repair for Chronic Type B Dissection

K. Mani, R.E. Clough, O.T.A. Lyons, R.E. Bell, T.W. Carrell, H.A. Zayed, M. Waltham, P.R. Taylor


<table>
<thead>
<tr>
<th>Parameters</th>
<th>Odds ratio</th>
<th>P-value</th>
<th>95% CI</th>
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<tr>
<td>Age, per year</td>
<td>1.08</td>
<td>0.04</td>
<td>1.00 - 1.17</td>
</tr>
<tr>
<td>Female vs male</td>
<td>0.01</td>
<td>0.03</td>
<td>0.00 - 0.64</td>
</tr>
<tr>
<td>Urgent vs elective</td>
<td>0.59</td>
<td>0.60</td>
<td>0.08 - 4.33</td>
</tr>
<tr>
<td>Maximal aortic diameter, pre-intervention, per cm</td>
<td>0.92</td>
<td>0.82</td>
<td>0.43 - 1.95</td>
</tr>
<tr>
<td>Increase in aortic size, per cm</td>
<td>2.70</td>
<td>0.01</td>
<td>1.23 - 5.96</td>
</tr>
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</table>

Figure 2. Kaplan–Meier analysis of survival after endovascular intervention for chronic type B dissection.

Mani et al. 2012; Eur J Vasc Endovasc Surg 43: 386-91
TEVAR in Chronic Type B

Predictors of Outcome after Endovascular Repair for Chronic Type B Dissection

K. Mani\textsuperscript{a,d,*}, R.E. Clough\textsuperscript{a,b}, O.T.A. Lyons\textsuperscript{a,c}, R.E. Bell\textsuperscript{a}, T.W. Carrell\textsuperscript{a,b}, H.A. Zayed\textsuperscript{a}, M. Waltham\textsuperscript{a,c}, P.R. Taylor\textsuperscript{a,b}

Mani et al. 2012; Eur J Vasc Endovasc Surg 43: 386-91

Figure 5. Kaplan–Meier analysis of survival based on remodelling of the aorta after endovascular intervention for chronic type B dissection.
False Lumen Perfusion
Open Fenestration

- 2007-2011; n=24
- Open first stage elephant trunk + fenestration of descending aorta
- Endovascular second stage completion
- Survival 92% @ 2 years

Roselli et al. 2011, Ann Thorac Surg 92: 2078-84
Open Fenestration

Roselli et al. 2011, Ann Thorac Surg 92: 2078-84
Knickerbocker-Technique
Knickerbocker-Technique
Knickerbocker-Technique
Knickerbocker-Technique
Knickerbocker-Technique
Knickerbocker-Technique
Knickerbocker-Technique
Knickerbocker-Technique

Kölbel et al. 2014; J Endovasc Ther 21: 117-22
Knickerbocker-Technique

Kölbel et al. 2014; J Endovasc Ther 21: 117-22
Knickerbocker-Technique

Kölbel et al. 2014; J Endovasc Ther 21: 117-22
Knickerbocker-Technique

Kölbel et al. 2014; J Endovasc Ther 21: 117-22
Knickerbocker-Technique

Kölbel et al. 2014; J Endovasc Ther 21: 117-22
Knickerbocker-Technique

- Investigational technique
- Diameter reducing ties
- One sided bulge
- Gold-markers
- N=8
- Technical success 8/8
- 2 requiring additional coils and cyanoacrylate
- FL-thrombosis all patients

Kölbel et al. 2014; J Endovasc Ther 21: 117-22
False Lumen Deployment
Hybrid Repair - Octopus
Outcomes of Fenestrated/Branched Endografting in Post-dissection Thoracoabdominal Aortic Aneurysms

K. Oikonomou a,b, R. Kopp a, A. Katsargyris a, K. Pfister a, E.L. Verhoeven b, P. Kasprzak a,*

a Department of Surgery, Division of Vascular Surgery, University Hospital Regensburg, Regensburg, Germany
b Department of Vascular and Endovascular Surgery, Paracelsus Medical University, Nürnberg, Germany

- 2010-2014
- N=31, 17 months FU
- 6 Type II EL; 6 type 1b EL
- 30d-mortality: 9.6%
- Technical success: 93.5%
- FL-thrombosis: 88%

Oikonomou et al. 2014; J Vasc Endovasc Surg 48: 641-8
fEVAR in Chronic Type B

Challenging Procedures

- Proximal and Distal Sealing
- Narrow true lumen
- Target vessels perfused by false lumen
- Limited experience

Courtesy of Stephan Haulon, Lille
fEVAR in Chronic Type B

Courtesy of Stephan Haulon, Lille
Direct False Lumen Occlusion

- Separates aortic FL-compartments!
- Does not restrict further distal techniques like fenestrated EVAR
Cork in the Bottleneck

How to Exclude the Dilated False Lumen in Patients After a Type B Aortic Dissection? The Cork in the Bottleneck

Maartje C. Loubert, MD¹; Victor P.M. van der Hulst, MD, PhD³; Cees De Vries, MD³; Kees Bloemendaal, MD²; and Anco C. Vahl, MD, PhD¹

2 Cases

1. FL-TAA-occlusion with:
   • 2 Greenfield filters
   • 6 detachable balloons
   • 5ml thrombin

2. FL-TAA-occlusion with:
   • 24mm Talent occluder

Loubert et al. 2003; J Endovasc Ther 10: 244-8
Outcomes after false lumen embolization with covered stent devices in chronic dissection

Jahanzaib Idrees, MD, Eric E. Roselli, MD, Susan Shafii, MD, Joshua Reside, BS, and Bruce W. Lytle, MD, Cleveland, Ohio

Table II. Outcomes

<table>
<thead>
<tr>
<th>Variable</th>
<th>Outcome (%)</th>
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<tbody>
<tr>
<td>Early</td>
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<tr>
<td>30-day mortality</td>
<td>1 (4.7)</td>
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<tr>
<td>Follow-up, median months</td>
<td>26 (24-42)</td>
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<tr>
<td>Aortic rupture</td>
<td>0</td>
</tr>
<tr>
<td>Complete thrombosis after index embolization</td>
<td>15 (71)</td>
</tr>
<tr>
<td>Partial thrombosis</td>
<td>6 (29)</td>
</tr>
<tr>
<td>Endovascular re-intervention</td>
<td>4 (19)</td>
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<tr>
<td>(re-embolization)</td>
<td></td>
</tr>
<tr>
<td>Complete thrombosis after further embolization</td>
<td>19 (90)</td>
</tr>
<tr>
<td>Failure of thrombosis</td>
<td>0</td>
</tr>
<tr>
<td>Reduction in postoperative max descending</td>
<td>13 (62)</td>
</tr>
<tr>
<td>diameter</td>
<td></td>
</tr>
<tr>
<td>Shrinkage, median mm</td>
<td>4.6 (0.2-27)</td>
</tr>
</tbody>
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Candy-Plug

Kölbel et al. 2013; J Endovasc Ther 20: 484-9

22mm Amplatzer plug II
Candy-Plug

- Investigational technique
- Max. 46mm diameter
- 22mm Amplatzer II
- N=6
- Technical success 6/6
- FL-thrombosis all patients

Kölbel et al. 2013; J Endovasc Ther 20: 484-9
Iliac False Lumen Embolisation
Iliac False Lumen Embolisation

Ballon-occlusion to prevent plug-embolisation
Iliac False Lumen Embolisation
Spot Stenting of the Tear in Type B Aortic Dissection

Alain Bel, Jean-Marc Alvaro, Valentine Ballestas, Pierre Julka, and Jean-Noël Fabiani
Paris, France

Background: In selected type B acute aortic dissection with aortic growth and patent false lumen, an intervention may be required to prevent aortic rupture. Apart from stent grafting of the thoracic aorta, aimed at occluding the primary intimal tear, some have advocated closure of the false lumen by placing the stent graft of the true lumen after hybrid revascularization of the excluded visceral or by aortic endografts.

Methods: We describe a simple technique for occluding a major reentry tear in the visceral abdominal aorta, using an off-the-shelf covered stent graft, arising from the aortic true lumen, closing the dissection septum tear and aortic false lumen, and being directly anchored in the visceral branch vessel, acting as a cusp on the dissection septum tear, achieving aortic false lumen thrombosis.

Results: In selected cases, we achieved aortic false lumen thrombosis by spot stenting of the tear.

Conclusions: This spot stenting technique may be a useful way of achieving complete false lumen thrombosis or lowering the false lumen pressure of degenerating dissecting aneurysms.

INTRODUCTION

The treatment of type B aortic dissection remains controversial. Most centers utilize selective interventions, with medical antihypertensive management for uncomplicated cases. In recent years, thoracic endovascular aortic repair (TEVAR) has been advanced as a treatment strategy that may delay aortic growth, lower rupture risk, and improve clinical outcome compared with medical management in patients with uncomplicated type B aortic dissection. The premise of TEVAR is that the stent graft will prevent blood flow into the false lumen causing thrombosis and depressurization while redirecting the circulation through the true lumen. Usually, the stent graft covers the primary entry tear and as much as possible of the thoracic descending aorta, which generally achieves false lumen thrombosis at the level of the stent graft but not beyond. This leaves unsealed the dissected distal thoracic and abdominal aorta, which remains at risk of continued aneurysmal expansion and rupture.

Here, we describe 2 patients with a type B dissection who underwent placement of a covered stent graft to occlude either the primary or secondary tear in a visceral aortic branch. Both procedures were achieved to achieve thrombosis or depressurization of the aortic false lumen.

METHODS

Case 1

A 69-year-old man was admitted for an unusual presentation of acute type B aortic dissection, retrograde from the visceral aorta, with dorsal and chest pain for 12 hours. On computed tomography (CT)
Spot-Stentgrafting
Spot-Stentgrafting
Candy-Plug and Spot-Stentgrafting
Candy-Plug and Spot-Stentgrafting

Entry at renal artery stent: Faring-technique
Candy-Plug and Spot-Stentgrafting

Infrarenal entry

External iliac artery entry
Candy-Plug and Spot-Stentgrafting

16 months postop
Post Type A, Branched Arch
Post Type A, Branched Arch
Post Type A, Branched Arch
Post Type A, Branched Arch
Aortic dissection requires individualized strategies.

Tubular stent-graft sufficient in majority cases of chronic TBAD.

False lumen backflow limiting treatment success.

New techniques to occlude false lumen backflow
- Direct false lumen occlusion: Candy-plug, Knickerbocker
- Extension of aortic coverage: Hybrid-repair, fEVAR
- Proximal sealing: branched and fenestrated arch grafts
“No patient should be considered cured of the disease. “

E. Stanley Crawford