**MHIF Research Highlights: SEPT 2018**

Thanks to all who contribute to sharing MHIF research at important conferences:

**TCT:** 25 presentations; 15 sessions as moderators/discussants; 5 training session leaders; 1 live case panelist; and 12 posters!

**ELSO:** 21 presentations; 3 posters; 1 oral abstract presented by an MHIF intern!

**MHIF Heartbeat Gala – Oct. 13, 2018**

Join us for an evening of inspiration to benefit MHIF research and education!

REGISTER TODAY: Mplsheart.org/gala

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**FEATURED MHIF STUDIES**

Open for Enrollment and Referrals!

- **AEGIS** for acute coronary syndrome
- **TRANSCEND** for peripheral artery disease
- **ASAP-SVG** for coronary artery disease

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**CONGRATULATIONS FOR FIRST PATIENT ENROLLMENTS!**

- *Dr. Knickelbine and Stephanie Ebnet* for the AEGIS trial
- **Dr. Gössl and Sara Olson** for Prelude (mitral valve replacement study)
- **Dr. Gössl and Karen Meyer** for TVINCITIES study (racial and ethnic disparities in valve disease)

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**PUBLISHED**

- **Structural Heart Cases: A Color Atlas of Pearls and Pitfalls**
  by Dr. Paul Sorajja

- **Manual of Coronary CTO Interventions**
  by Dr. Emmanouil Brilakis

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1 of 39
Minneapolis Heart Institute Foundation® Cardiovascular Grand Rounds

**Title:** Endovascular management of the ascending aorta – the latest in dissection treatment?

**Speaker(s):** Christoph A. Nienaber, MD, PhD
- Ltd. Consultant, RBH Cardiology/Aortic Centre, London
- Consultant, Vascular Centre, Fuwai Hospital, Beijing, China
- Previous Head of the Department of Cardiology, Rostock University, Germany

**Date:** October 1, 2018

**Time:** 7:00 – 8:00 AM

**Location:** ANW Education Building, Watson Room

**OBJECTIVES**

At the completion of this activity, the participants should be able to:

1. Understand the complexity of aortic dissection.
2. Rationalize potential benefits of endovascular approaches in the near future.
3. Understand the multidisciplinary nature of managing aortic conditions.

**REMOTE ATTENDANCE**

If you cannot attend grand rounds in person, attend via webcast (you can join the webinar up to 15 minutes before the presentation starts at 7:00). To join the webinar please click the following link: [https://mhif.adobeconnect.com/gr/](https://mhif.adobeconnect.com/gr/)

Please enter as a guest, not a registered user.

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**Physician** - Allina Health is accredited by the Accreditation Council for Continuing Medical Education (ACCME) to provide continuing medical education for physicians. Allina Health designates this live activity for a maximum of 1.0 **AMA PRA Category 1 Credit(s)** TM. Physicians should only claim credit commensurate with the extent of their participation in the activity.

**Nurse** - This activity has been designed to meet the Minnesota Board of Nursing continuing education requirements for 1.0 hours of credit. However, the nurse is responsible for determining whether this activity meets the requirements for acceptable continuing education.

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The **ACCME defines a commercial interest** as “any entity” producing, marketing, re-selling, or distributing health care goods or services consumed by, or used on, patients. The ACCME does not consider providers of clinical service directly to patients to be commercial interests - unless the provider of clinical service is owned, or controlled by, an ACCME-defined commercial interest.
Moderator(s)/Speaker(s)
Dr. Christoph Nienaber has disclosed that he DOES NOT have any real or apparent conflicts with any commercial interest as it relates to presenting their content in this activity/course.

Planning Committee
Dr. Alex Campbell, Jake Cohen, Jane Fox, Dr. Mario Gössl, Dr. Kevin Harris, Dr. Kasia Hryniewicz, Rebecca Lindberg, Amy McMeans, Dr. Michael Miedema, Dr. JoEllyn Moore, Pamela Morley, Dr. Scott Sharkey, and Jolene Bell Makowesky have disclosed that they DO NOT have any real or apparent conflicts with any commercial interest as it relates to the planning of this activity/course. Dr. David Hurrell has disclosed the following relationship – Boston Scientific: Chair, Clinical Events Committee.

NON-ENDORSEMENT OF COMMERCIAL PRODUCTS AND/OR SERVICES
We would like to thank the following company for exhibiting at our activity.

Novartis Portola Pharmaceuticals

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When you request a transcript this serves as your personal tracking of activities attended. Most professional healthcare licensing/certification boards will not accept a Learning Management System (LMS) transcript as proof of credit; there are too many LMS’s across the country and their validity/reliability are always in question.

If audited by a licensing board or submitting for license renewal or certification renewal, boards will ask you not the entity providing the education for specific information on each activity you are using for credit. You will need to demonstrate that you attended the activity with a copy of your certificate/evidence of attendance, a brochure/flier and/or the conference handout.

Each attendee at an activity is responsible for determining whether an activity meets their requirements for acceptable continuing education and should only claim those credits that he/she actually spent in the activity.

Maintaining these details are the responsibility of the individual.

PLEASE SAVE A COPY OF THIS FLIER AS YOUR CERTIFICATE OF ATTENDANCE.

Signature: ___________________________________________________________________________

My signature verifies that I have attended the above stated number of hours of the CME activity.

Allina Health - Learning & Development - 2925 Chicago Ave - MR 10701 - Minneapolis MN 55407
Endovascular Management of the ascending Aorta – The latest in Dissection Treatment?

Professor Christoph A. Nienaber
The Royal Brompton and Harefield NHS Trust
Cardiology and Aortic Centre
C.Nienaber@rbht.nhs.uk

CN: No relevant financial relationships to disclose.
Figure 1 Annual Survey of Cardio‐aortic Surgery [1984–2013] by Japanese Association for Thoracic Surgery. Modified from reference (2). TAA, thoracic aorta; CAD, coronary artery disease; VHD, valvular heart disease; CHD, congenital heart surgery.


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

Feasible
- Safe
- Quick recovery
- Open surgery abandoned

Dake MD, et al. NEJM 1999; 340:1546-1552
ESC 2014

All Type B Dissection

- Complicated
- Chronic
- Uncomplicated

Typical case of Type B Dissection managed by endovascular intervention (including a PETICOAT)
PETTICOAT for improved realignment?

Latest case & standard procedure from last week.

SOP in distal dissection
- LSA bypass/single branch
- LSA occluder
- Proximal Stentgraft
- Open extension (PETTICOAT)
- Distal management
Pragmatic Classification of Acute Aortic Syndrome

- Complicated AAS (acute aortic syndrome)
  - Any proximal dissection/IMH
  - Evidence of Malperfusion
  - Imminent rupture (extraaortic blood collection)

- AAS with high-risk features
  - Uncontrolled blood pressure
  - Recurrent episodes of pain
  - Early false lumen expansion (>4.5 cm)
  - Any FL expansion >4.5 cm
  - Partial FL thrombosis
  - Malperfusion >10 mm
  - True lumen collapse
  - Ongoing aortic inflammation on PET/CT

- AAS without high-risk features
  - Apply morphologic risk predictor score

Type B dissection with malperfusion
Survival after TEVAR in complicated TBAD

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


Type B aortic dissection: Survival and predictors

Estimated Survival by Predictors

- Lower risk type B
- High risk type B
- Hypotension/Shock
- Malperfusion

### Pragmatic Classification of Acute Aortic Syndrome

#### Complicated AAS (acute aortic syndrome)
- Any proximal dissection/IMH
- Evidence of Malperfusion
- Imminent rupture (extraaortic blood collection)

#### AAS with high risk features
- Uncontrolled blood pressure
- Recurrent episodes of pain
- Early false lumen expansion (>4.5 cm)
- Any FL expansion >4.5 cm
- Partial FL thrombosis
- Single entry tear; > 10 mm
- True lumen collapse
- Ongoing aortic inflammation on PET/CT

#### AAS without high risk features
- Apply morphologic risk predictor score

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### Cardiovascular Surgery

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

**Overall in-hospital mortality**
- 4.0% in low risk group
- 17.4% in intermediate risk group

**In-hospital mortality with medical management**
- 1.5% in low risk group
- 35.6% in intermediate risk group

Trimarchi S et al. Circulation 2009
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 high risk group: False lumen diameter: FL > 22 mm

High risk: Partial false lumen thrombosis

Tsai TT et al. for IRAD: NEJM 2007
**New high risk group: 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 transverse 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.

**New high risk group: Aortic inflammation**

Baseline | After TEVAR | Biology
---|---|---
CT | PET-CT | TEVAR

Sakalhasan N, Nienaber CA et al, EHJ 2015
But not all cases show therapeutic remodelling.

Definition: FL thrombosis & shrinkage, no progression

<table>
<thead>
<tr>
<th></th>
<th>FLT</th>
<th>TLD</th>
<th>Remod.</th>
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<tr>
<td></td>
<td>22%</td>
<td>18mm</td>
<td>10%</td>
</tr>
<tr>
<td></td>
<td>91%*</td>
<td>33mm*</td>
<td>79%*</td>
</tr>
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</table>

*p<0.0001

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!
2 predictors of long-term stability: FL thrombosis and remodeling

<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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<tr>
<td>Age</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>Female</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>STJ diameter</td>
<td>-1.880</td>
<td>.637</td>
<td>.003</td>
<td>.153</td>
<td>.044-532</td>
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<tr>
<td>Complete  FLT</td>
<td>1.678</td>
<td>.751</td>
<td>.025</td>
<td>5.354</td>
<td>1.229-23.329</td>
</tr>
</tbody>
</table>

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 open period (red) (P = .018). SE, Standard error.

Fig 4. Kaplan–Meier analysis shows freedom from anatomic events (A) in the occluded false lumen group and (B) in the patent false lumen perfusion group.
Uncomplicated TBAD…

Really…?

- Complicated AAS (acute aortic syndrome)
  - Any proximal dissection/IMH
  - Evidence of Malperfusion
  - Imminent rupture (extraaortic blood collection)
  - AAS with high risk features
    - Uncontrolled blood pressure
    - Recurrent episodes of pain
    - Dilatation true lumen expansion (>4.5 cm)
    - Any false lumen (>1.5 cm)
    - True lumen collapse
    - Malperfusion syndrome
    - False lumen expansion >10 mm
    - True lumen collapse
    - Ongoing aortic inflammation on PET/CT
  - AAS without high risk features
    - Apply morphologic risk predictor score

Pragmatic Classification of Acute Aortic Syndrome
Estimation of risk in type B aortic dissection

Stanford Aortic Dissection Risk Calculator

<table>
<thead>
<tr>
<th>Patient Data</th>
<th>Risk Score</th>
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<tr>
<td>1. Connective tisue disease</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
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<tr>
<td></td>
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</tr>
</tbody>
</table>

Result

Linear predictor (LP): -0.877

Risk of adverse event within 2 years: 20.6%}


On October 23, 1760 George II rose at 6 am, asked for his chocolate and repaired to his closet-stool. The valet heard a "noise louder than the royal wind and a groan." The King was...

...pericardium extended with coagulated blood and a transverse fissure on the inner side of the ascending aorta 3.75 cm...
MHIF Grand Rounds – October 1, 2018

Hybrid theatre: new options of complex endovascular approaches

Hybrid: My 1st TEVAR in the arch
Endovascular SG placement during cardiac arrest

Successful SG placement in aortic arch under Rapid Pacing for cardiac arrest!
Pioneering work led to custom-made Chuter endograft

- Total-arch solutions
- Ascending aorta
- Dissection-specific devices
- Type A dissections
- More long-term data

Ready for broader applications? TEVAR and the near future

Expanding Indications

- Low profile branch technology

Technology on the horizon, but not successful and not approved
Previous sternotomy for type A
Not suitable for re-do surgery
Pharyngolaryngectomy
Neck dissection, radiotherapy etc
Tracheostomy
The NEXUS device

(A) Final angiography showing no aortic regurgitation or endoleak with patency of the coronary arteries and bridging stents perfusing the supra-aortic trunks. Results were confirmed on the postoperative 3-dimensional reconstruction (B) and maintained on the 7-month follow-up scan (C).

Hertault et al. JEVT 2018
Recent trends in management in type A dissection

- Fewer rejections for type A surgery
- Declining open surgery for type B dissection
- Increasing endovascular intervention

In Hospital Mortality: Operated Type A Dissection

<table>
<thead>
<tr>
<th>Year period</th>
<th>Frequency (%)</th>
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<tbody>
<tr>
<td>1996-2003 (n=229)</td>
<td>17.5%</td>
</tr>
<tr>
<td>2004-2009 (n=692)</td>
<td>15.8%</td>
</tr>
<tr>
<td>2010-2016 (n=811)</td>
<td>12.2%</td>
</tr>
</tbody>
</table>

Linear Trend p=0.013

Increasing Use of Valve Sparing

Linear Trend \( p < 0.001 \)

Frequency (%)


Retrograde Linear Trend \( p = 0.005 \)  Antegrade Linear Trend \( p = 0.005 \)

Cerebral Perfusion Strategies

Frequency (%)


Parikh N et al. IRAD 2016.
The ultimate goal: Dr. DeBakey at age 95... had chest pain!

- Finally my 1st AMI...?
- No, a DeBakey Type II Dissection!
- Difficult decision to go for surgery!
- Intermittent loss of consciousness!
Acute Type A Dissection: proximal TEVAR

Implantation under rapid RV pacing
Delivery of 36 mm x 6.4 cm TX2 Graft
The ultimate goal in treating any dissection is mending the layers and healing of the aorta which requires stent-graft induced FLR, reexpansion and remodelling.

**TEVAR in type A dissection**

Sakalihasan N, Nienaber CA et al. in preparation

**Ascending Aorta + TEVAR**

Endovascular Repair of Ascending Aortic Dissection

A Novel Treatment Option for Patients Judged Unfit for Direct Surgical Repair

Objective: This paper reports on retrospective outcomes of patients who were considered unfit for urgent surgical repair of ascending aortic dissections. The main factors considered were poor co-morbidities and previous thoracic surgery.

Background: Ascending aortic dissections are a surgical emergency with high mortality rates. The current standard of care is surgical repair, which is associated with significant postoperative morbidity and mortality.

Methods: A retrospective review of all patients with ascending aortic dissections treated with TEVAR at our institution from January 2010 to December 2015 was conducted. Patient demographics, clinical characteristics, and outcomes were recorded.

Results: A total of 20 patients were included in the study. The median age was 68 years (range 35-85). The most common co-morbidities were hypertension (55%), diabetes mellitus (20%), and a history of previous thoracic surgery (45%). The median follow-up duration was 36 months (range 0-84 months). The overall survival rate at 1 year was 85%, and at 3 years was 75%. There were no device-related complications or deaths in the perioperative period. Median follow-up was 36 months (range 0-42 months). The number of reinterventions was low, with only 2 patients requiring additional procedures.

Conclusion: Endovascular repair of ascending aortic dissections appears to be a safe and effective treatment option for patients who are considered unfit for surgical repair. Further studies are needed to confirm these findings and to evaluate the long-term outcomes of this treatment strategy.
Emerging Therapy for the ascending Aorta


Figure 1 Ascending Aortic Dissection with Compressed Branch Artery

(A) Sagittal computed tomography angiography (CTA) image obtained before stent grafting showing that the primary cusp reinserted the left internal artery, which had been compromised by the dissection. (B) Preoperative angiography showing the incomplete expansion of the ascending aortic dissection. (C) Completion angiography showing that the entire tear was completely excluded. Comparison between (D) preoperative CTA image and (E) CTA image obtained at the 24-month follow-up of the same patient of maximal ascending aorta showing that the diameter of ascending aorta cross-sectional area had been expanded. (F) Follow-up CTA image confirming complete thrombosis of the false lumen along the ascending aorta and the patency of the coronary arteries and the suprarenal branch arteries.

Series of 12 patients unfit for open surgery

<table>
<thead>
<tr>
<th>Patient</th>
<th>Age &amp; sex</th>
<th>Diagnosis</th>
<th>CTA</th>
<th>Procedure outcome (mm)</th>
<th>Follow-up (months)</th>
<th>Complications</th>
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<tr>
<td>1</td>
<td>75M</td>
<td>xTAAD</td>
<td>6.9</td>
<td>Cook</td>
<td>90</td>
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<tr>
<td>2</td>
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<td>xTAAD</td>
<td>8.1</td>
<td>Robson NIS</td>
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<tr>
<td>3</td>
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<td>13.4</td>
<td>Robson NIS</td>
<td>74</td>
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<tr>
<td>4</td>
<td>89F</td>
<td>xTAAD</td>
<td>15.0</td>
<td>Cook</td>
<td>249</td>
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<td>5</td>
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<td>xTAAD</td>
<td>18.3</td>
<td>Cook</td>
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<td>6</td>
<td>60M</td>
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<td>3.9</td>
<td>Cook</td>
<td>61</td>
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<tr>
<td>7</td>
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<td>4.9</td>
<td>Robson NIS</td>
<td>70</td>
<td>None</td>
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<td>8</td>
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<td>xTAAD</td>
<td>9.4</td>
<td>Cook</td>
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<tr>
<td>9</td>
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<td>xTAAD and FYR</td>
<td>7</td>
<td>Ostendix</td>
<td>120</td>
<td>25</td>
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<tr>
<td>10</td>
<td>89M</td>
<td>xTAAD</td>
<td>6.9</td>
<td>Cook</td>
<td>69</td>
<td>None</td>
</tr>
<tr>
<td>11</td>
<td>75F</td>
<td>xTAAD</td>
<td>5.9</td>
<td>Cook</td>
<td>68</td>
<td>None</td>
</tr>
<tr>
<td>12</td>
<td>75F</td>
<td>xTAAD</td>
<td>8.9</td>
<td>Cook</td>
<td>68</td>
<td>None</td>
</tr>
</tbody>
</table>

Characteristics

Total Block
9 M, 3 F, aged 81±7 years
Proximal tear in ascending aorta
EuroScore II 9.1±4.5
Procedural success 91.7%
30 d mortality 8.3%
The opposite of FLUTI: True Lumen Intervention...nice Initial Results!
Evolution after successful proximal stent-grafting

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).

Pre-TEVAR At discharge 16 months F/U

Yuan X et al. Cath Cardiovasc Int 2018
This time another strategy... why not a FLIRT this time?

CASE M.P
Inoperable
Euroscore II 21%

Is it worth a FLIRT?

Yuan X et al Cath Cardiovasc Interv 2018
CASE M.P

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.

Interventional Repair of Type a aortic dissection

pre-procedure (FLIRT)

At discharge

6 months F/U

Yuan X et al. CCI 2018
64 y/o male patient
- Sudden onset of chest/back pain

- History of chronic HTN
- Triple rule out CT diagnosis:
  - Acute type B dissection
  - Lusoria anatomy
  - Distal malperfusion
    - Right arm claudication/ischemia
    - Lower extremity hypotension

Another FLIRT: Subacute/Chronic dissection to induce remodeling?

Sequential follow-up CT scans after the 1st procedure

Tear in fabric of SG and partial thrombosis of FL at day 5 post TEVAR

At day 55 the FL thrombosis has improved, but is still incomplete and fed from the fabric tear

Strategy:
Secondary induction of complete FL thrombosis
3D CT-guided reintervention with FLIRT concept in type B dissection

1st attempt

2nd attempt

Coils, occluder and iliac Stentgraft to isolate FL

...or false lumen coils & occluder to facilitate thrombosis and aortic remodeling

Pre-TEVAR 55 d post-TEVAR 3 d post-repair

Complex, but uncomplicated case with secondary reperfusion of false lumen from proximal inflow caused by rupture of graft fabric. Retrograde coiling and an occluder turn procedural failure into a great success with additional procedures!
75 y/o female

- Admitted from a routine surveillance CT of thoracic aortic aneurysm showed a new dissection in aortic root
- Hypertension
- Apronectomy in Feb 1999
- Coronary angiogram: LAD 70% stenosis in 2001
- Intra-renal, AAA repair in 2006
- Permanent pacemaker implantation in Mar 2007
- Osteoarthritis with total knee replacements
- Lower gastrointestinal haemorrhage with bowel resection in 2015, end-to-end anastomosis
- Aorto-femoral bypass

**FLIRT with the impossible... FL management in this type A dissection?**

- Type A dissection confined to just above the aortic root to mid ascending aorta.
- Measured 26 x 42 mm
- Entry tear diameter 5mm

**Individual approach – false lumen management in type A dissection**
Angiogram confirms the false lumen and entry tear.

- 15 x 5 mm coils deployed via MP followed by a 10mm Amplatzer PFO closure device placed across the entry tear.
- Final angiogram shows tear sealed and coronary ostium unblocked.

CT scan 3 days after procedure

No contrast communication to the false lumen

Device sealing in site precisely with excellent remodelling

Yuan X et al. JCVT 2017
### Demographic Information, Pathology, and Procedures

<table>
<thead>
<tr>
<th>Age (yr)</th>
<th>Sex</th>
<th>Type of Pathology</th>
<th>Previous Surgery/Intervention</th>
<th>Occlusion</th>
<th>Number of occluders</th>
<th>Access FLIRT</th>
<th>Complications</th>
<th>MAECCE</th>
<th>FU duration (months)</th>
</tr>
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#### Procedural Details (FLIRT Concept) and Success Rate

<table>
<thead>
<tr>
<th>Occlusion (Type)</th>
<th>Wrist</th>
<th>Intra(Ky)</th>
<th>Interventions</th>
<th>Number of coils used</th>
<th>Access FLIRT</th>
<th>Complications</th>
<th>MAECCE</th>
<th>FU duration (months)</th>
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</table>

ASD, atrial septal defect; MAECCE, major adverse cardiovascular and cerebrovascular events; PFO, patent foramen ovale.
Impact of FLIRT on anatomic details, remodelling and false lumen thrombosis in proximal (type A) and distal (type B) aortic dissection

<table>
<thead>
<tr>
<th>Type of dissection</th>
<th>Max diameter of aorta (mm)</th>
<th>Area of true lumen at the level of max diameter aorta(cm²)</th>
<th>False lumen thrombosis</th>
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<tr>
<td>Pre-procedure</td>
<td>Discharge*</td>
<td>6 months follow-up*</td>
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<tr>
<td>Pre-procedure</td>
<td>Discharge*</td>
<td>6 months follow-up*</td>
<td></td>
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<tr>
<td>Type A</td>
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<td></td>
<td>Complete</td>
</tr>
<tr>
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<td>75</td>
<td>51</td>
<td>11.8</td>
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<tr>
<td>Type B</td>
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<td>At the level of left subclavian artery</td>
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<td>36</td>
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<tr>
<td>Case 6</td>
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<td>65</td>
<td>8.9</td>
</tr>
<tr>
<td>Case 7</td>
<td>64</td>
<td>75</td>
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</tr>
<tr>
<td>Case 8</td>
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<td>71</td>
<td>8.5</td>
</tr>
<tr>
<td>Case 9</td>
<td>45</td>
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<tr>
<td>Case 10</td>
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<td>53</td>
<td>8.8</td>
</tr>
<tr>
<td>At the level of pulmonary artery bifurcation</td>
<td>36</td>
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<td>36</td>
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<tr>
<td>Case 7</td>
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<td>75</td>
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</tr>
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<td>71</td>
<td>5.5</td>
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<td>Case 9</td>
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<td>At the level of diaphragm</td>
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<tr>
<td>Case 9</td>
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<tr>
<td>Case 10</td>
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<td>50</td>
<td>8.2</td>
</tr>
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</table>

*The same level as pre-procedure.

Proximal dissection cases treated with FLIRT (occluders and coils), demonstrated the increasing true lumen area and shrinking maximum diameter of the aorta over time.

![Graph showing area and diameter changes over time](image-url)
Can this be replaced by an Endovascular Procedure?

Bentall Procedure
Open Heart Surgery

Final Challenge:
Is There a Potential for an Endovascular Bentall Procedure?

Sketch from Engineering Lab in 2006
Covered stents (Jostent) for Coronaries
Anatomic Feasibility of an Endovascular Valve-Carrying Conduit for the Treatment of Type A Aortic Dissection

- 157 patients
- 3 landing zones
- 113 patients (68%)

With high quality CT scans were screened for anatomic flexibility

- Distal sealing zone
- Proximal sealing zone
- Transcatheter valve

Are potential candidates, but most would require tapered stent grafts

Kreibich M et al., JTCVS 2018

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The future is approaching... but not close yet!

Wishful thinking by Ted Diethrich † in 2006
Is an Endo - Bentall a Feasible Option soon?

Answer:
Almost Certainly, but not today & not tomorrow!