Extended Distal Aortic Repair: Evolving Global Paradigm Shift in the Surgical Treatment of Type A Dissection

CSCS PostGrad Course
2014 CCC Vancouver
Oct 26th, 2014

Jehangir Appoo
Libin Cardiovascular Institute
University of Calgary
Emerging techniques

Global Tour – Far East, Europe, N. America

Very recent results – 2012-2014

Surgical techniques/audience

Share case examples from local experience

Go Forward
Current “standard of care” for acute Type A Dissection

Very good operation
Saves many lives in distressful times

But, is it enough in all cases?

Does it satisfactorily treat the aorta and side branches at risk?
Case Example: 46y.o male flown in from OSH – May 2014

Hemodynamic shock

Abdomen distended, tender
Case Example: 46y.o male flown in from OSH – May 2014

Compromised visceral flow
Renal infarct/malperfusion
Case Example: 46y.o male flown in from OSH – May 2014

Both legs:
Paralyzed
Cold
Mottled
Pulseless
Our 46y.o patient

Is standard “hemiarch” surgery the right operation?

Will visceral, renal, & peripheral malperfusion be resolve?

Will he survive?
Extended Distal Aortic Repair
Problem:

Long term survival is compromised

Distal aortic problems may be higher than we appreciate
Problem:

Long term survival is compromised

Distal aortic problems may be higher than we appreciate

Immediate op mortality is high:

- IRAD (2005) 25%
- GERAADA (2014) 17%
- US Registry Data (Oct. 2014) 21%
**Problem:**

Long term survival is compromised

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**Question:**

Can extended distal aortic repair decrease long term mortality?

Can increase complexity be accomplished without increased periop morbidity?
Problem:

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Question:

Can extended distal aortic repair decrease long term mortality?
Can increase complexity be accomplished without increased periop morbidity?

Goal:
Decrease both long term and short term mortality
Underappreciated Fact

Primary entry tear located in distal arch or descending thoracic aorta up to 20-30%

Replacing ascending aorta does not satisfy surgical principle of resecting primary entry tear
Global evolving technical approaches to extended distal repair

Classification according to extent of aorta resected:

I. Zone 2/3 Arch + Stent graft

II. Arch Debranching + Zone 0 Stent Graft

III. Conventional Hemiarch + Stent Graft under Circ Arrest (FET)
Uchida 2013 (Personal Communication)

Zone 2 Arch

118 pts

6% op mortality
Indications for frozen elephant trunk in type A aortic dissection

- Younger Patients (Age < 70 Years)  
  N=40

- Age $\geq 70$ yrs

  - Primary Entry: Located on the distal arch  
    N=36

  - True Lumen: Occluded or severely collapsed  
    N=27

  - Arch Dilatation > 40 mm  
    N=15

To Consider

Frozen elephant trunk technique as a Distal Repair
398 patients with acute Type A

Mortality 7.8%
Stroke 2.5%
SCI 2.5%

False lumen thrombosis: 95%

Ma et al. Ann Cardiothorac Surg 2013
E-Vita
E-vita open registry

416 patients
10 high aortic volume European centres

142 acute dissection cases

Op. Mortality 16%
CVA 7%
SCI 4%

Global evolving technical approaches to extended distal repair

Classification according to extent of aorta resected:

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III. Conventional Hemiarch + Stent Graft under Circ Arrest (FET)
Arch Debranching and Zone 0 TEVAR for acute Type A Dissection
Transforming “difficult distal” operation to a more “proximal” operation

Siena technique
Staged approach
An Alternative Approach to Diffuse Thoracic Aortomegaly: On-Pump Hybrid Total Arch Repair Without Circulatory Arrest

William D. T. Kent, MD, MS, Jason K. Wong, MD, Eric J. Herget, MD, Joseph E. Bavaria, MD, and Jehangir J. Appoo, MDCM

Diffuse thoracic aortomegaly has conventionally been managed with a two-stage elephant trunk procedure, requiring prolonged circulatory arrest, with an inherent risk of major morbidity and mortality. Recently, to improve outcomes, several hybrid arch procedures have been proposed using off-pump techniques. We have adopted an alternative, single-stage hybrid strategy using cardiopulmonary bypass without circulatory arrest to replace the ascending aorta and perform arch debranching and anastomosis endovascular stent graft deployment. Unlike off-pump procedures, pathology of the aortic valve, root, and ascending aorta is addressed while avoiding the complications of stent graft placement in the native ascending aorta.

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Arch Debranching and Zone 0 TEVAR for acute Type A Dissection

  Siena technique
  Staged approach

  Single stage total arch repair
  Without circ arrest
Arch Debranching and Zone 0 TEVAR for acute Type A Dissection

Siena technique
Staged approach

Ann Cardiothoracic Surg 2013
Single stage total arch repair
without circ arrest

Chang et al. JTCVS 2013
Single stage total arch repair
without circ arrest
21 patients with Type A
Classification according to extent of aorta resected:

I. Zone 2/3 Arch + Stent graft

II. Arch Debranching + Zone 0 Stent Graft

III. Conventional Hemiarch + Stent Graft under Circ Arrest (FET)
Antegrade Thoracic Stent Grafting During Repair of Acute DeBakey I Dissection Prevents Development of Thoracoabdominal Aortic Aneurysms

Alberto Pochettino, MD, William T. Brinkman, MD, Patrick Moeller, BS, Wilson Y. Szeto, MD, William Moser, CRNP, Katherine Cornelius, BSN, Frank W. Bowen, MD, Y. Joseph Woo, MD, and Joseph E. Bavaria, MD

Division of Cardiovascular Surgery, Department of Surgery, University of Pennsylvania School of Medicine, Philadelphia, Pennsylvania

Technique currently used by some surgeons at N. American Centres: Penn, Mayo & Texas

### Early Outcomes of FET 2005-2012

**Vallabhajosyula** J Thorac Cardiovasc Surg 2014  
**Preventza** J Thorac Cardiovasc Surg 2014

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<tr>
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<th>Stented (N)</th>
<th>Standard Repair (N)</th>
<th>Mortality: Stented vs. Standard</th>
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<tbody>
<tr>
<td>Penn</td>
<td>62</td>
<td>180</td>
<td>10% vs. 14% (p = NS)</td>
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<tr>
<td>Texas</td>
<td>25</td>
<td>87</td>
<td>12% vs. 14% (p = NS)</td>
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<tr>
<td>Penn</td>
<td>62</td>
<td>180</td>
<td>5% vs. 8% (p = NS)</td>
<td>6% vs. 2% (p = NS)</td>
</tr>
<tr>
<td>Texas</td>
<td>25</td>
<td>87</td>
<td>12% vs. 10% (p = NS)</td>
<td>8% vs. 2% (p = NS)</td>
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Early Outcomes of FET 2005-2012

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<tr>
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<th>Stented (N)</th>
<th>Standard Repair (N)</th>
<th>Malperfusion Resolved Stented vs. Standard</th>
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<tbody>
<tr>
<td>Penn</td>
<td>62</td>
<td>180</td>
<td>NA</td>
</tr>
<tr>
<td>Texas</td>
<td>25</td>
<td>87</td>
<td>84% vs. 54% (p &lt; 0.05)</td>
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Vallabhajosyula J Thorac Cardiovasc Surg 2014
Preventza J Thorac Cardiovasc Surg 2014
Does standard surgical repair of Debakey Type 1 Dissection alter true lumen geometry downstream?

Harmse, Appoo, Herget, Merchant, Wong & Ferris. 2014 In submission
Is standard “hemiarch” surgery the right operation?

Will visceral, renal, & peripheral perfusion be restored?

Will he have use of his legs?

Will he survive?

Our 46y.o patient

50/50 chance that complicated malperfusion resolves with standard repair
Simplified frozen elephant trunk repair for acute DeBakey type I dissection

J Thorac Cardiovasc Surg 2013

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<th>Single anastomosis frozen elephant trunk repair</th>
<th>n = 17 (%)</th>
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<tr>
<td>Acute outcomes</td>
<td></td>
</tr>
<tr>
<td>Hospital mortality</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Stroke</td>
<td>2 (12)</td>
</tr>
<tr>
<td>Paraplegia</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Temporary paraparesis</td>
<td>2 (12)</td>
</tr>
<tr>
<td>Tracheostomy</td>
<td>2 (12)</td>
</tr>
<tr>
<td>New hemodialysis</td>
<td>3/16 (19)</td>
</tr>
<tr>
<td>Mean length of stay (mean ± SD)</td>
<td>20 ± 12</td>
</tr>
<tr>
<td>ICU</td>
<td>10 ± 9</td>
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<tr>
<td>Intermediate outcomes</td>
<td></td>
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<td>Late deaths</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Reintervention</td>
<td>1 (6)</td>
</tr>
<tr>
<td>False lumen thrombosis</td>
<td>14/16 (88)</td>
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Total arch repair with open triple-branch stent graft placement for acute type A aortic dissection: Experience with 122 patients

Liang-Wan Chen, MD, Lin Lu, MD, Xiao-Fu Dai, MD, Xi-Jie Wu, MD, Gui-Can Zhang, MD, Guo-Feng Yang, MD, and Yi Dong, MD

J Thorac Cardiovasc Surg 2014;148:521-8
Depending on whether you are at CCF, Mayo, Calgary, Penn, Germany, Japan or China & which surgeon is on call, variety of novel operations being carried on for Type A dissection. Not standardized….yet
2014 ESC Guidelines on the diagnosis and treatment of aortic diseases

Document covering acute and chronic aortic diseases of the thoracic and abdominal aorta of the adult

The Task Force for the Diagnosis and Treatment of Aortic Diseases of the European Society of Cardiology (ESC)
2014 ESC Guidelines on the diagnosis and treatment of aortic diseases
Document covering acute and chronic aortic diseases of the thoracic and abdominal aorta of the adult

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Validation!
Share local experience with some of these techniques

Share our thought process
Multidisciplinary Clinical Team
CV Anaesthesia
CV nurses
IR
Cardiac Surgery
CVICU

Portable or Fixed fluoroscopy
Example of Arch Debranching for acute Type A Aortic Dissection
69y.o male with Type A dissection and Distal Arch Tear
69y.o male with Type A dissection and Distal Arch Tear

Type II Hybrid Arch Repair

Total arch reconstruction without circ arrest
Example of Siena Technique

Debranch then re-assess
Debranch then re-assess – may or may not need stent graft

39y.o acute Type A
BMI 60!

Pulseless/Ischemic leg

Debranched but no stent graft

Stable at 2 year follow up
Example of Frozen Elephant Trunk for acute Type A Aortic Dissection
Our 46y.o male flown in from OSH – May 2014
Type A dissection with shock, visceral, renal & LE malperfusion
Post CPB on table Angio after FET, HemiArch, Asc Ao Replacement, Ao valve repair

Thoracic Ao TL expansion seen on angio & TEE

Good perfusion of celiac, SMA & nephrograms visible
Our next stage of evolution:

Type II Hybrid Zone 2 Arch
Zone2 Arch
Summary

Contemporary results of Conventional Surgery of Acute Type A Dissection

IRAD
GERAAD
US Registry Data

Operative Mortality ≈ 20%
Substantial long term morbidity and mortality
Summary

World wide tour of novel techniques used by select cardiac surgeons – not institution wide yet

Early results 2012-2014

Currently on a steep learning curve

Guidelines supportive
Goal:

Decrease both long term and short term mortality
consider the importance of the effaced true lumen to your patients.

Which of their organs are perfused by this narrow channel?

Heightened awareness for malperfusion
Reasonable to consider extended distal repair:

- Primary Intimal Tear in distal arch
- Distal malperfusion syndrome
- Enlarged false lumen/true lumen ratio
- Dilated arch
- Young patient
Endovascular therapy here to stay
First line treatment for abdominal & descending aortic aneurysms
Big Picture

Arch and Asc Ao are much tougher… but on horizon

Unique opportunity for surgeons, interventionalists and trainees to add to skill set
Considerations

Awareness of malperfusion as possible etiology of poor outcome

Assigned Aortic Surgeon per centre who can consult/help with cases that have high risk features

Develop collaborations with Radiology, Cardiology, Vascular Surgery different groups interested at different centres

Consider adding endovascular surgery to your group’s armamentarium

Keep in realm of cardiac surgery
Thank You

Surgical colleagues
IR colleagues
OR Team

Th Ao Research Team
  DI
  Biomed Engineering
  Pathology
  CV Anaesthesia
  Coordinators