Acute Aortic Dissection: Decision and Outcome

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Acute Aortic Dissection

DECISION and OUTCOME

• Clinical presentation
• How do we image them?
• How do we treat them?
• Cerebral protection
• Long-term expectations
Acute Aortic Dissection

CARDINAL FEATURES

- Most common catastrophe involving the aorta
- Relatively rare cause of chest pain
  - Prevalence of CAD 100-200 times > AAD
  - 3 ADD for each 1,000 pts presenting to ER with CP/BP
- Morbidity and mortality remain high
Clinical Presentation

**IRAD DATABASE**

- Clinical manifestations are protean
- Diagnosis is Challenging! – Missed on initial exam in 38%
- Severe “worst ever” pain in 85%
  - Sharp in 65% > tearing/ripping
  - Localized to chest in 73%
  - Type B more often in back/abdo, but substantial overlap
- Abdominal pain only (no CP/BP) in 5%
  - Most often type B, ↑ mortality (28% vs. 10%)
  - mesenteric ischemia rare (4%) → poor prognosis (63% vs. 24%)
Acute Aortic Dissection

SIDE BRANCH INVOLVEMENT

- Renal  23-75%
- Peripheral  25-60%
- Mesenteric  10-20%
- Coronary  5-11%
- Cerebral  3-13%
- Spinal  2-9%
Acute Aortic Dissection

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Aortic Dissection

CT Scan Imaging
Aortic Dissection
CT Scan Imaging
Aortic Dissection
Magnetic Resonance Imaging

DeBakey II
Stanford A

DeBakey III
Stanford B
Aortic Dissection
Transesophageal Imaging
Choice of Imaging Study

IRAD DATABASE

- 628 patients – First diagnostic modality:
  - CT scan: 63%
  - TEE: 32%
  - Aortography: 4%
  - MRI: 1%
- 70% had multiple studies
- Sensitivity:
  
<table>
<thead>
<tr>
<th>Imaging Modality</th>
<th>TYPE A</th>
<th>TYPE B</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT scan</td>
<td>93%</td>
<td>93%</td>
</tr>
<tr>
<td>TEE</td>
<td>90%</td>
<td>80%</td>
</tr>
<tr>
<td>Aortography</td>
<td>87%</td>
<td>89%</td>
</tr>
<tr>
<td>MRI</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Moore et al.  
Am J Cardiol 2002;89:1235
Acute Aortic Dissection

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Acute Aortic Dissection

NATURAL HISTORY

• Lethal if undiagnosed early & not treated appropriately
  – 30% mortality by 24 hrs, 50% by 48 hrs, 90% by 3 months
• Hirst et al. – 505 patients with acute Ao dissection (1958)
• **Type A Dissection**
  - All patients deemed survivable (>80, CVA, CPR in OR)
  - Intramural Hematoma? (35% risk of rupture)

• **Type B Dissection**
  - β-blockers initially, then vasodilators (afterload > NTG)
  - Decreasing BP from HTN levels can reverse malperfusion
  - Surgical Tx: rupture “impending rupture” (not pleural effusion), malperfusion (endovascular), persistent pain
• Goals of Surgical Therapy
  – Obviate the usual causes of death (local phenomenon in 60-90% of cases)
  – Reconstitute distal flow in the true lumen
  – Correct compromise of contiguous Ao branches (coronary, innominate, carotid)
  – Restore aortic valve competence
  – Resect primary intimal tear (if exposed)
  – Eliminate flow in false lumen? (seldom accomplished)
Acute Aortic Dissection
SURGICAL INTERVENTION
Acute Type A Dissection
What is a Safe and Durable Surgical Strategy?

Surgery for Acute Type A Aortic Dissection
Tirone E. David, MD, Susan Armstrong, MSc, Joan Ivanov, MSc, and Sion Barnard, MB
Division of Cardiovascular Surgery, Toronto General Hospital, University of Toronto, Toronto, Ontario, Canada

- Pts were dying despite their best efforts!
- Dramatic reduction in mortality after adoption of reproducible repair technique
  - no cross clamp, resection of primary tear, antegrade reperfusion
- Suggested improved early and late outcomes

David et al.
ATS 1999; 67:1999
Incidence of AVR and Hemiarch Replacement by Era:

**AVR**
- 1984-1990: 60%
- 1991-1995: 40%
- 1996-2000: 20%
- 2001-2006: 0%

**Hemiarch**
- 1984-1990: 60%
- 1991-1995: 40%
- 1996-2000: 20%
- 2001-2006: 0%

*p < 0.001* for AVR.
*p = 0.01* for Hemiarch.

Zierer et al.
*ATS 2007;83:2122*
• 25-year period: 1984 to 2009, 26 surgeons
• 201 patients: 158 men (63%), 94 women (37%)
• Mean age: 60 ± 16 years, range 18 to 88 years
• Operative mortality 16% ± 3%

ATS 2007;83:2122
Acute Type A Dissection
What is a Safe and Durable Surgical Strategy?

• At Wash U, 196 acute type A (1996-2012)
  – Group 1 (Classic David): No X-clamp, DHCA, antegrade reperfusion – 49 pts
  – Group 2-6: All other strategies – 147 pts

<table>
<thead>
<tr>
<th>Group</th>
<th>Aortic Cross Clamp</th>
<th>DHCA</th>
<th>Antegrade Reperfusion</th>
<th>Number of Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>49</td>
</tr>
<tr>
<td>2</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>6</td>
</tr>
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<td>3</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>46</td>
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<td>4</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>20</td>
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<td>5</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>19</td>
</tr>
<tr>
<td>6</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>56</td>
</tr>
</tbody>
</table>

Lawton et al.
JTCVS 2015 (in press)
• **Classic David** (No X-clamp, DHCA, antegrade reperfusion) vs **Other Strategies**:
  - No difference in operative mortality or morbidity
  - No difference in FL patency
  - **Long-term survival impaired with non-David strategy**
Acute Aortic Dissection

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Surgery for Type A Dissection
CEREBRAL PROTECTION

- Crawford’s classic dictum: With HCA:
  - >40 minutes → Stroke
  - >65 minutes → Death
- Retrograde Cerebral Perfusion
  - Maintains brain cooling
  - Retrograde flushing of debris
  - Only 10-15% of nutrient flow
- Antegradce Cerebral Perfusion
  - ↑ nutrient flow
  - ↑ “safe” circulatory arrest time?
  - Allows warmer perfusion?
• HCA with ACP (28°C): Frankfurt & Bad Neustadt (AATS 2012, 2013)
  – 1,002 pts: ↑mortality with HCA > 30 min
• Unilateral vs. Bilateral ACP – 1097 pts, elective arch, propensity matched
  – No difference in mortality or TND, but
  – ↑CVA with bilateral (6% vs. 2%, p=.06)
Surgery for Type A Dissection

CEREBRAL PROTECTION

- CA Time 0-30 min: Any approach seems adequate
- CA Time 30-45 min: RCP / ACP
- CA Time > 45 min: ACP?

- ACP can be unilateral, but only with cerebral oximetry
Acute Aortic Dissection
DECISION and OUTCOME

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Acute Type A Dissection

LATE REOPERATION – Wash U.

- Unrelated to initial surgical technique (prox/distal extent, perfusion strategy)
- Non-resected primary tear \( (p = 0.05) \)
- Marfan syndrome \( (p < 0.001) \)
- Elevated systolic BP at late F/U \( (p = 0.008) \)
- Absence of \( \beta \)-blocker \( (p = 0.02) \)

Zierer et al.
ATS 2007, 84:479
Impact of late β-blocker use (250 pts) – *J Clin HTN* 2012 (in press):

Impact of late β-blocker use (250 pts) – *J Clin HTN* 2012 (in press):

ATS 2007;83:2122

Impact of late systolic BP control (250 pts) *J Clin HTN* 2012 (in press):

Impact of late BP control (250 pts) *J Clin HTN* 2012 (in press):
Method to determine aortic expansion over time:

- 412 total CT scans:
  - 6 ± 5 scans/patient
  - mean interval: 11 ± 16 mo
  - mean total F/U: 7 ± 6 mo
- 343 CT intervals for analysis

Zierer et al.
ATS 2007, 84:479
Acute Type A Dissection
Method to determine Ao expansion

Descending Aorta

Diaphragmatic Hiatus

Abdominal Aorta

Zierer et al.
ATS 2007, 84:479
• Aortic expansion:
  – 18% (62/343) CT scan intervals, 49% pts

• Onset of growth unpredictable:
  – most often > 1 year postoperatively
  – mean: 59 ± 45 months (maximum: 167 months)

• Independent predictors of aortic growth:
  – Greater aortic diameter  \((p < 0.001)\)
  – Elevated systolic BP at late F/U  \((p = 0.04)\)
  – Patent false lumen  \((p = 0.05)\)
  – Unrelated to initial surgical technique (prox/distal extent)

Median growth rate
\(\text{mm/year}\)

\[\begin{align*}
\text{Desc.} & \quad 6.0 \\
\text{Diaphr.} & \quad 3.8 \\
\text{Abdo.} & \quad 4.1
\end{align*}\]

\(p < 0.001\)

\(Zierer et al.\)
\(ATS 2007, 84:479\)
### Interval Between Imaging Studies

<table>
<thead>
<tr>
<th>Aortic Diameter</th>
<th>&lt; 6 mo (n=172)</th>
<th>6–12 mo (n=92)</th>
<th>&gt; 12 mo (n=79)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small (&lt; 35 mm)</td>
<td>5 ± 2%</td>
<td>13 ± 5%</td>
<td>21 ± 7%</td>
</tr>
<tr>
<td>Moderate (35-49 mm)</td>
<td>12 ± 5%</td>
<td>23 ± 9%</td>
<td>31 ± 8%</td>
</tr>
<tr>
<td>Large (≥ 50 mm)</td>
<td>23 ± 12%</td>
<td>34 ± 9%</td>
<td>83 ± 15%</td>
</tr>
</tbody>
</table>

Zierer et al.  
ATS 2007, 84:479
• 451 op survivors: 62% FL patent overall
  – 4%: late rupture – FL patent in 94%
  – 8%: distal aortic reoperation – FL patent in 92%
  – 88% no reoperation, no rupture – FL patent in 58%

• Multivariate analysis:
  – FL patent: ↓survival OR=1.70, ↑distal aortic event OR=4.11

Kimura et al.
JTCVS 2015; 149:S91
Impact of FL patency on survival

IRAD Database – TYPE B DISSECTION

Tsai et al.
NEJM 2007;357:349
Total Arch for Dissection
Impact on False Lumen Patency

- 8 studies, 1602 patients – asc/d/hemiarch vs. total arch +/- S-G
  - 5 “total arch is safe”, 3 ↑ mortality with total arch
  - Freedom from reop is similar with hemiarch or total arch at 5-10 years
  - complete FL thrombosis was seen more often with total arch
- Recommend extended resection when entry tear is in the arch
- Total arch may be justified in experienced hands

Beijing Anzhen Hosp.
JTCVS 2014;148:2466
• 78 Type A, DeBakey I dissections at Penn (2005-2008)
  – 42 standard hemiarch, 26 additional descending stent-graft
• At 16 months, open TAA repair performed in 0% stented pts vs.
  11% standard hemiarch group (p=0.08)
• Don’t make the stent-graft too long!

Pochettino et al.
ATS 2009;88:482
Type A Dissection
EXTENT OF DISTAL RESECTION

• Baylor / Texas Heart – 157 pts (2005-2013)
  – 60% unilateral ACP, 41% bilateral ACP (22-24°C)
  – conservative approach to arch replacement (7%)  
  – ↑ACP, CPB, and cardiac ischemia → mortality (p<.04 for all)
  – HCA > 30 min associated with CVA (p=.03)

• Conclusion #1: “In this intrinsically complex disease, survival is the most important outcome.”
• Conclusion #2: “A conservative approach to the distal end of the repair can address the primary objectives”
  – prevent rupture, re-establish TL flow, maintain competent AoV

ATS 2015;99:80-7
JTCVS 2015; 148:2123
• Surgical treatment does not cure the generalized disease
• Postoperatively, close medical follow-up mandates:
  – Strict BP control
  – Negative inotropic therapy (β-blockers even if normotensive)
  – Serial (imaging) surveillance (indefinitely)
• Life-long surveillance with radiographic follow-up
Thank you for your attention.