Knowledge Gaps in Treatment of Acute Type A Aortic Dissection

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Goals of Type A Dissection Surgery

1. Excise the intimal tear
2. Decrease or obliterate blood flow into false lumen
3. Replace the ascending aorta +/- aortic arch
4. Restore aortic valve competence
5. Correct malperfusion
Creation of a Scorecard to Predict In-Hospital Death in Patients Undergoing Operations for Acute Type A Aortic Dissection

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Background. This study evaluated preoperative predictors of in-hospital death for the surgical treatment of patients with acute type A aortic dissection (Type A) and created an easy-to-use scorecard to predict in-hospital death.

Methods. We reviewed retrospectively all consecutive patients who underwent operations for acute Type A between 1996 and 2011 at 2 tertiary care institutions. A logistic regression model was created to identify independent preoperative predictors of in-hospital death. The results were used to create a scorecard predicting operative risk.

Results. Emergency operations were performed in 534 consecutive patients for acute Type A. Mean age was 61 ± 14 years and 36.3% were women. Critical preoperative state was present in 31% of patients and malperfusion of one or more end organs in 36%. Unadjusted in-hospital mortality was 18.7% and not significantly different between institutions. Independent predictors of in-hospital death were age 50 to 70 years (odds ratio [OR], 3.8; \( p = 0.001 \)), age older than 70 years (OR, 2.8; \( p = 0.03 \)), critical preoperative state (OR, 3.2; \( p < 0.001 \)), visceral malperfusion (OR, 3.0; \( p = 0.003 \)), and coronary artery disease (OR, 2.2; \( p = 0.006 \)). Age younger than 50 years (OR, 0.3; \( p = 0.01 \)) was protective for early survival. Using this information, we created an easily usable mortality risk score based on these variables. The patients were stratified into four risk categories predicting in-hospital death: less than 10%, 10% to 25%, 25% to 50%, and more than 50%.

Conclusions. This represents one of the largest series of patients with Type A in which a risk model was created. Using our approach, we have shown that age, critical preoperative state, and malperfusion syndrome were strong independent risk factors for early death and could be used for the preoperative risk assessment.

Effect of Malperfusion on Type A Mortality

Predictors of Mortality (18.7%) for Type A Repair

Table 5. Risk-Adjusted Predictive Model for In-Hospital Death After Operation for Acute Type A Aortic Dissection (N = 534)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Odds Ratio</th>
<th>95% CI</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, y</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;50</td>
<td>0.37</td>
<td>0.16–0.85</td>
<td>0.01</td>
</tr>
<tr>
<td>50–70</td>
<td>3.8</td>
<td>1.7–8.7</td>
<td>0.001</td>
</tr>
<tr>
<td>&gt;70</td>
<td>2.8</td>
<td>1.1–6.7</td>
<td>0.01</td>
</tr>
<tr>
<td>Critical preoperative state</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Malperfusion syndrome</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coronary</td>
<td>1.6</td>
<td>0.9–3.0</td>
<td>0.1</td>
</tr>
<tr>
<td>Extremity</td>
<td>1.9</td>
<td>0.99–3.6</td>
<td>0.051</td>
</tr>
<tr>
<td>Visceral</td>
<td>3.0</td>
<td>1.4–6.3</td>
<td>0.003</td>
</tr>
<tr>
<td>Coronary artery disease</td>
<td>2.2</td>
<td>1.2–3.8</td>
<td>0.006</td>
</tr>
</tbody>
</table>

CI = confidence interval.
Importance of Malperfusion in Type A Dissection

<table>
<thead>
<tr>
<th>Malperfusion Subset- Outcomes</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortality</td>
<td>30-50%</td>
</tr>
<tr>
<td>Re-interventions</td>
<td>50%</td>
</tr>
<tr>
<td>New post-op malperfusion</td>
<td>8-10%</td>
</tr>
<tr>
<td>Post-op stroke</td>
<td>&gt;30%</td>
</tr>
<tr>
<td>Resolution of pre-op paralysis</td>
<td>Rare</td>
</tr>
</tbody>
</table>

**Importance of Malperfusion in Type A Dissection**

- **Mortality**: 30-50%
- **Re-interventions**: 50%
- **New post-op malperfusion**: 8-10%
- **Post-op stroke**: >30%
- **Resolution of pre-op paralysis**: Rare

„Frozen Elephant“ Trunk for Type A Dissection
Simplified Hybrid-Prothesis for Type A Dissection

Ascyrus (CryoLife) Medical Dissection Stent
What Causes Aortic Growth Post-Type A Repair?

- Friability of the dissected aorta results in creation of a distal anastomotic new entry (DANE) 50-70% of the time which acts as a Primary Entry Tear (PET).
- Pressurization of the new PET leads to true lumen collapse, malperfusion and aortic growth.

Fate of the dissected aortic arch after ascending replacement in type A aortic dissection†

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Abstract

OBJECTIVES: To evaluate the fate of a dissected aortic arch after limited surgical repair of type A aortic dissection.

METHODS: Of the 271 patients operated for acute type A dissection between 2001 and 2015, 86 (age 57 ± 13 years, 74% men) with predischARGE computed tomographic (CT) scans had a residual dissection in the arch. Aortic diameters, lengths, ellipticity and communications between lumina were assessed using predischARGE and follow-up CT scans. The median CT scan follow-up was 31 months (first quartile 15, third quartile 52).

RESULTS: The largest increase in the total aortic diameter at follow-up was 20 mm distal to the left subclavian artery (median +4.0 mm; first quartile +1.5, third quartile +9.2 mm; P = 0.004), with an average growth rate of 1.5 mm/year (first quartile 0.6, third quartile 3.9 mm). The true lumen diameter was unchanged at follow-up. At least 1 communication between the true and the false lumen was observed in 80% of patients on the predischARGE CT scan, and 70% had communications at the distal aorta-graft anastomosis. Accelerated increase in the diameter of the dissected aorta was associated with the number of communications between the lumina, communication at the distal anastomosis and false lumen perfusion (all, P < 0.01).

CONCLUSIONS: Dissection of the residual aortic arch leads to aortic growth that may result in an aneurysm requiring treatment. The number of communications between the lumina, communication at the distal anastomosis and false lumen perfusion are associated with the accelerated aortic growth. Endovascular repair may be difficult due to the small true lumen and the presence of many communications between the lumina.

Keywords: Aortic dissection • Imaging
Communications Between True and False Lumen

Location of luminal communications at discharge

Number of patients with communications

- Distal aorta-graft anastomosis: 70%
- Lesser curvature: 9%
- Greater curvature: 12%
- At LCA: 9%
- At IA: 15%

A. No entry at distal anastomosis
- Diameter change (mm)
- Time from surgery (years)

B. Entry at distal anastomosis
- Diameter change (mm)
- Time from surgery (years)

Rylski B et al. EJCTS 2017;51:1127-1134
# Effect of DANE on Aortic Growth

<table>
<thead>
<tr>
<th>Patients with communications at</th>
<th>No aortic growth $(n=13)$</th>
<th>Moderate aortic growth $(n=18)$</th>
<th>Accelerated aortic growth $(n=23)$</th>
<th>$P$-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distal anastomosis</td>
<td>4 (30.8)</td>
<td>13 (72.2)</td>
<td>22 (95.6)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Lesser curvature</td>
<td>2 (15.4)</td>
<td>3 (16.7)</td>
<td>3 (13.0)</td>
<td>1.000</td>
</tr>
<tr>
<td>Greater curvature</td>
<td>1 (7.7)</td>
<td>6 (33.3)</td>
<td>8 (34.8)</td>
<td>0.101</td>
</tr>
<tr>
<td>Proximal descending aorta</td>
<td>4 (30.8)</td>
<td>5 (27.8)</td>
<td>8 (34.8)</td>
<td>0.697</td>
</tr>
<tr>
<td>Communications size &gt;5 mm</td>
<td>1 (8.3)</td>
<td>8 (44.4)</td>
<td>7 (30.4)</td>
<td>0.212</td>
</tr>
<tr>
<td>False lumen thrombosis</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>2 (16.7)</td>
<td>14 (77.8)</td>
<td>15 (65.2)</td>
<td>0.006</td>
</tr>
<tr>
<td>Partial</td>
<td>3 (25.0)</td>
<td>2 (11.11)</td>
<td>8 (34.8)</td>
<td>0.708</td>
</tr>
<tr>
<td>Total</td>
<td>8 (66.7)</td>
<td>2 (11.11)</td>
<td>0</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>
Effect of DANE Sealing on Survival and Aortic Remodeling

Single-Stage Management of Dynamic Malperfusion Using a Novel Arch Remodeling Hybrid Graft

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Background. Organ malperfusion remains challenging, causing complications associated with acute DeBakey I dissections. We describe the results of malperfusion management after implantation of the Ascurys Medical Dissection Stent (AMDS; Ascurys Medical, Boca Raton, FL), an adjunct to current surgical aortic dissection repair.

Methods. From March 2017 to January 2019, 47 consecutive patients (median age, 65 years; interquartile range, 15.8 years; 61.9% male) presented with acute DeBakey I aortic dissections and underwent emergent surgical aortic repair with AMDS implantation. Malperfusion was detected preoperatively in 55.3% (n = 26) of patients. Two patients were excluded from efficacy analysis due to lack of follow-up. Overall, 66 vessel malperfections were identified, consisting of 1.5% (n = 1) coronary, 33.3% (n = 22) supraaortic, 21.2% (n = 14) visceral, 24.2% (n = 16) renal, and 15.1% (n = 10) extremities. Three patients (11.5%) had clinical evidence of paralysis at presentation.

Results. All 26 device implants were successful. In the malperfusion cohort, 30-day mortality was 7.7% (n = 2). A new neurologic deficit identified postoperatively in patients without neurologic symptoms preoperatively occurred in 7.7% (n = 2). During the follow-up period, 95.5% (n = 63) of vessel malperfections had resolved without an additional procedure, including 95.5% (n = 21) supraaortic, 92.9% (n = 13) visceral, 93.8% (n = 15) renal, and 100% (n = 10) extremity. All patients with paralysis at presentation had complete resolution.

Conclusions. The AMDS provides an effective single-stage malperfusion management strategy. In this study, dynamic malperfusion involving supraaortic, visceral, spinal cord, and lower extremities were treated concurrently with the index standard-of-care operation without delay in life-saving care.

Correction of Malperfusion Post-Type A Repair with Ascuryus Device

Midterm Outcomes of the Dissected Aorta Repair Through Stent Implantation Trial

Sabin J. Bozso, MD, Jeevan Nagendran, MD, PhD, Michael W. A. Chu, MD, Bob Kiaii, MD, Ismail El-Hamamsy, MD, PhD, Maral Ouzounian, MD, PhD, Jörg Kempfert, MD, Christoph Starck, MD, and Michael C. Moon, MD

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Background. The intimal flap at the distal aortic anastomosis after standard aortic dissection repair creates distal anastomotic new entry, leading to false lumen (FL) pressurization and true lumen (TL) collapse and resulting in increased mortality, malperfusion, aortic growth, and reinterventions. The Ascyrus Medical Dissection Stent (AMDS; Ascyrus Medical, Boca Raton, FL) is a hybrid prosthesis that seals and depressurizes the FL at the distal anastomosis while expanding and pressurizing the TL.

Methods. The Dissected Aorta Repair Through Stent Implantation trial is a prospective, nonrandomized, international type A dissection trial where patients with acute DeBakey I dissections were enrolled between March 2017 and January 2019. Forty-seven patients were enrolled (median age, 62.5; 67.4% men) with a median follow-up of 631 days.

Results. All patients underwent emergent surgical repair with successful AMDS implantation. One patient was excluded because of use in iatrogenic dissection. Overall mortality at 30 days and 1 year was 13.0% (6/46) and 19.6% (9/46), whereas new strokes occurred in 6.5% (3/46). Over 93% of vessel malperfusions resolved because of AMDS-induced TL expansion, including 3 patients with preoperative paralysis. Positive remodeling of the aortic arch occurred in 100% of cases with complete obliteration or thrombosis of the FL in 74%. In the proximal descending thoracic aorta positive remodeling occurred in 77% and complete obliteration or FL thrombosis in 53% of cases.

Conclusions. AMDS facilitates single-stage management of malperfusion and induces positive remodeling of the aortic arch through effective sealing of the distal anastomotic FL, depressurization of the FL with expansion, and pressurization of the TL. Importantly, the use of AMDS is safe and reproducible.
Aortic Remodeling Post-Type A Repair with Ascyrus

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Thank you!

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