David Procedure in Acute Type A Dissection

Edward P. Chen MD

Director Thoracic Aortic Surgery
Division of Cardiothoracic Surgery
Emory University School of Medicine
Atlanta, Georgia

The Houston Aortic Symposium, February 23, 2017
No disclosures
Root Replacement in Type A Dissection

• Performed in the setting of:
  – Extensive Tissue Destruction
  – Preexistent aortic root aneurysm
  – Known connective tissue disorder
Root Replacement in Type A Dissection

- Significantly more complex procedure than ascending/hemiarch replacement alone
- Longer myocardial ischemic and cardiopulmonary bypass times
- Often needed in the setting of end-organ malperfusion/cardiogenic shock
- Frequent coronary ostial involvement requiring:
  - Repair
  - Conduit extension (Cabrol)
  - Coronary bypass
VSRR in Acute Type A Dissection

- Compared with performing CVG
  - More complex procedure
  - Surgical dissection of the root from surrounding structures more extensive

- In acute dissection:
  - Disruption of normal tissue planes
  - Edema/hematoma

- Extended cross-clamp and CPB times
  - Additional time needed with significant AR after CPB
Root Replacement in Acute Type A Dissection

IRAD Study

- 1995 patients
  - 699 Root replacements
  - 1296 Root repair
- Root replacement patients:
  - Younger (56.9 vs 62.3)
  - Larger root size (4.7 cm vs 4 cm)
  - Marfan (8.7% vs 2.5%)
  - Bicuspid (9.4% vs 2.5%)
  - AI (64% vs 50.3%)
  - Hypotension/shock/tamponade (33% vs 26.5%)

Root Replacement Surgery Versus More Conservative Management During Type A Acute Aortic Dissection Repair

Marco Di Eusanio, MD, PhD, Santi Trimarchi, MD, PhD, Mark D. Peterson, MD, PhD, Truls Myrmel, MD, PhD, G. Chad Hughes, MD, Amit Korach, MD, Thoralf M. Sundt, MD, Roberto Di Bartolomeo, MD, Kevin Greason, MD, Ali Khoynezhad, MD, PhD, Jehangir J. Appoo, MD, Gianluca Folesani, MD, Carlo De Vincentis, MD, Daniel G. Montgomery, BS, Eric M. Isselbacher, MD, Kim A. Eagle, MD, Christoph A. Nienaber, MD, and Himanshu J. Patel, MD

Background. Aortic root management in type A acute aortic dissection is controversial. This study compared outcomes of root replacement (RR) interventions versus more conservative root (CR) management.

Methods. Of 1,995 type A acute aortic dissection patients enrolled in the International Registry of Acute Aortic Dissection, 699 (35%) underwent RR interventions and 1296 (65%) underwent CR management. Independent predictors of hospital and 5-year survival were identified using multivariable logistic and Cox regression models.

Results. Compared with CR patients, RR patients were younger (56.9 vs 62.3 years; p = 0.002) and more likely to present with larger root diameter (4.7 cm vs 4.0 cm; p < 0.001), Marfan syndrome (6.7% vs 2.5%; p < 0.001), aortic insufficiency (40.5% vs 25.3%; p < 0.001), and hypotension/shock/tamponade symptoms. Root replacement did not increase hospital mortality (propensity score-adjusted odds ratio, 1.1; p = 0.670). On Kaplan-Meier analysis, 3-year survival (RR, 90.5% ± 1.7% versus CR, 91.6% ± 1.5%; log-rank p = 0.623) and freedom from aortic root reintervention (RR, 99.2% ± 0.1% versus CR, 99.3% ± 0.1%; log-rank p = 0.770) were similar. Only 2 patients (1 per group) underwent follow-up root reintervention. Propensity score-adjusted Cox regression excluded a relationship between root treatment and follow-up survival (hazard ratio, 1.3; 95% confidence interval, 0.902 to 2.0ontgo p = 0.032).

Conclusions. In type A acute aortic dissection patients, more-extensive RR interventions are not associated with increased hospital mortality. This supports such an approach in young patients and patients with connective tissue disease and bicuspid aortic valves. Excellent midterm survival and freedom from root reintervention in both groups suggests stable behavior of the nonreplaced aortic sinuses at 3 years. Thus, pending studies with longer follow-up, the use of aggressive RR techniques can be determined by patient-specific and dissection-related factors.

AHA Thromb Surg 2014;69(9):878-855 © 2014 by The Society of Thoracic Surgeons

Surgery, by converting a 90% mortality risk to a 25% chance of survival, is recognized as the best therapeutic option for patients with type A acute aortic dissection (TAAAD) [4]. The primary aim of surgery—prevention of death from aortic rupture—is mainly accomplished by exclusion of the proximal intimas tear, supracoronary ascending aortic replacement, and reestablishment of dominant flow in the distal true lumen [2]. Conservative repair of the dissected aortic root with commissural reseparation or prosthetic replacement of the pathologic aortic valve leaflets frequently completes the operation [5]. Increasingly, surgeons have advocated more extensive interventions to replace the entire dissected aortic root tissue, but this has not achieved broad consensus [4, 5]. Compared with conservative root (CR) techniques, root
Root Replacement in Acute Type A Dissection

- Compared with Root Repair:
  - No increase in hospital mortality (propensity score-adjusted OR 1.14, p=0.674)
- Similar 3 year survival:
  - RR 92.5% vs CR 91.6%; log-rank p=0.623
- Freedom from aortic root reintervention:
  - RR 99.2% vs CR 99.3%; log-rank p=0.77)
## Early Experience of Valve-Sparing in Acute Dissection

<table>
<thead>
<tr>
<th>First Author</th>
<th>Year (Journal)</th>
<th>No. pts</th>
<th>Op Mortality</th>
<th>Mean F/U (months)</th>
<th>Freedom from &gt;2+ AI</th>
<th>Freedom from AVR</th>
</tr>
</thead>
<tbody>
<tr>
<td>RG Leyh</td>
<td>2000 (ATS)</td>
<td>20</td>
<td>10%</td>
<td>26</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>RG Leyh</td>
<td>2002 (Circ)</td>
<td>30</td>
<td>17%</td>
<td>22.6</td>
<td>Unknown</td>
<td>95%-David</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>63%-Yacoub</td>
</tr>
<tr>
<td>AW Erasmi</td>
<td>2003 (ATS)</td>
<td>36</td>
<td>19.4%</td>
<td>11.3-David</td>
<td>100%</td>
<td>100%-David</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>29.6-Yacoub</td>
<td></td>
<td>*82%-Yacoub</td>
</tr>
<tr>
<td>K Kallenbach</td>
<td>2002 (EJCTS)</td>
<td>22</td>
<td>14%</td>
<td>18.4</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>F Farhat</td>
<td>2007 (EJCTS)</td>
<td>15</td>
<td>6.7%</td>
<td>11</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>TP Graeter</td>
<td>2000 (ATS)</td>
<td>22</td>
<td>9.1%</td>
<td>24</td>
<td>93.2%</td>
<td>100%</td>
</tr>
<tr>
<td>K Kallenbach</td>
<td>2004 (EJCTS)</td>
<td>44</td>
<td>11.4%</td>
<td>19</td>
<td>100%</td>
<td>97%</td>
</tr>
<tr>
<td>K Kallenbach</td>
<td>2004 (Circ)</td>
<td>48</td>
<td>10.4%</td>
<td>19</td>
<td>100%</td>
<td>*65%@5 yrs</td>
</tr>
<tr>
<td>S Leontyev</td>
<td>2012 (EJCTS)</td>
<td>28/179 pts</td>
<td>7.1%</td>
<td>Unknown</td>
<td>93.6% overall</td>
<td>95.9% overall</td>
</tr>
<tr>
<td>F Kerendi</td>
<td>2010 (ATS)</td>
<td>16/37 pts</td>
<td>6.3%</td>
<td>8.8 overall</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>B Leshnower</td>
<td>2012 (JTCVS)</td>
<td>29/150 pts</td>
<td>6.8%</td>
<td>19 overall</td>
<td>93%</td>
<td>100%</td>
</tr>
<tr>
<td>S Miyahara</td>
<td>2015 (ATS)</td>
<td>21/183 pts</td>
<td>4.8%</td>
<td>Unknown</td>
<td>85.8% (&gt;1+)</td>
<td>92.9%</td>
</tr>
</tbody>
</table>
- Largest single series to date, 1995-2010
- 374 pts with Type A Dissection

<table>
<thead>
<tr>
<th></th>
<th>No. pts</th>
<th>Op Mortality</th>
<th>Ave F/U (months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bentall</td>
<td>130</td>
<td>27%</td>
<td></td>
</tr>
<tr>
<td>Yacoub</td>
<td>51</td>
<td>16%</td>
<td>44</td>
</tr>
<tr>
<td>David</td>
<td>27</td>
<td>15%</td>
<td>27</td>
</tr>
</tbody>
</table>

Valve-Sparing Root Reconstruction Does Not Compromise Survival in Acute Type A Aortic Dissection

Sreekumar Subramanian, MD,* Sergey Leontyev, MD,* Michael A. Borger, MD, PhD, Constanze Trommer, MD, Martin Misfeld, MD, PhD, and Friedrich W. Mohr, MD, PhD

Department of Cardiac Surgery, Heart Center Leipzig, Leipzig, Germany; Department of Surgery, University of Arizona Medical Center, Tucson, Arizona; and Department of Cardiothoracic Surgery, Southern Arizona Veterans Affairs Health Care System, Tucson, Arizona

Fig 1. Survival by aortic root procedure for acute type A aortic dissection.

Fig 2. Freedom from root reoperation by aortic root procedure for acute type A aortic dissection.

Survival

Freedom from Reop

VSRR in Type A

- 2005-2013
- 350 patients with Acute Type A
- 98 patients with root replacement
- 43 patients (14%) VSRR
- Mean age 46 years

### Table 2. Perioperative Data and Outcomes

<table>
<thead>
<tr>
<th>Variables</th>
<th>David V (n = 43)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiopulmonary bypass (min)</td>
<td>280 ± 61</td>
</tr>
<tr>
<td>Cross-clamp (min)</td>
<td>237 ± 45</td>
</tr>
<tr>
<td>Hypothermic circulatory arrest (min)</td>
<td>43 ± 20</td>
</tr>
<tr>
<td>Temperature at HCA (°C)</td>
<td>26.3 ± 2.5</td>
</tr>
<tr>
<td>Total arch replacement (%)</td>
<td>8 (19)</td>
</tr>
<tr>
<td>Mortality (%)</td>
<td>2 (4.7)</td>
</tr>
<tr>
<td>Permanent stroke (%)</td>
<td>2 (4.7)</td>
</tr>
<tr>
<td>Temporary neurologic dysfunction (%)</td>
<td>1 (2.3)</td>
</tr>
<tr>
<td>Dialysis-dependent renal failure (%)</td>
<td>2 (4.7)</td>
</tr>
<tr>
<td>Tracheostomy (%)</td>
<td>2 (4.7)</td>
</tr>
</tbody>
</table>

*All data are presented as mean ± standard deviation or number (%).

HCA = hypothermic circulatory arrest.

Midterm Results of David V Valve-Sparing Aortic Root Replacement in Acute Type A Aortic Dissection

Bradley G. Leshnower, MD, Richard J. Myung, MD, LaRonica McPherson, RN, and Edward P. Chen, MD

Division of Cardiothoracic Surgery, Joseph B. Whitcomb Department of Surgery, Emory University School of Medicine, Atlanta, Georgia

**Background.** The David V valve-sparing aortic root replacement (David V) has been shown to provide excellent long-term valve function and low rates of valve-related complications in the elective treatment of aortic root aneurysms. The safety and durability of the David V in the repair of acute type A aortic dissection (type A) are currently unclear. In this study, the midterm results of David V in the setting of type A aortic dissection were analyzed.

**Methods.** From 2008 to 2013, 350 patients underwent surgical repair of type A aortic dissection. Outcomes were analyzed in 43 consecutive patients who received a David V during repair of type A aortic dissection. Patients were followed with annual postoperative echocardiograms. Follow-up was 85% complete, with a mean duration of 40 ± 31 months.

**Results.** The mean age of these patients was 46 ± 10 years. There were two operative deaths (4.7%), and 93% of patients required a hemiaortic replacement (n = 32) or a total arch replacement (n = 8) using hypothermic circulatory arrest. Cusp repairs were performed in 6 (14%) patients; 51% of patients had 3+ or greater preoperative aortic insufficiency (AT). 85% of patients left the operating room with zero AI, and the remainder had 1+ AI or less. No patient in the follow-up period developed endocarditis or required aortic valve replacement. At midterm follow-up, freedom from 2+ AI was 94%, and freedom from aortic valve replacement was 100%.

**Conclusions.** The David V can be performed with low morbidity and mortality in young patients presenting with type A aortic dissection who require aortic root replacement. At midterm follow-up, valve function is durable, and the incidence of valve-related complications is low.
VSRR in Type A

- Follow-up: 85% complete
- Mean follow-up:
- 40 months (0.2-103 months)

---

Midterm Results of David V Valve-Sparing Aortic Root Replacement in Acute Type A Aortic Dissection

Bradley G. Leshnower, MD, Richard J. Myung, MD, LaRonica McPherson, RN, and Edward F. Chen, MD

Department of Cardiothoracic Surgery, Joseph B. Whitehead Department of Surgery, Emory University School of Medicine, Atlanta, Georgia

Background. The David V valve-sparing aortic root replacement (David V) has been shown to provide excellent long-term valve function and low rates of valve-related complications in the elective treatment of aortic root aneurysms. The safety and durability of the David V in the repair of acute type A aortic dissection (type A) are currently unclear. In this study, the midterm results of David V in the setting of type A aortic dissection were analyzed.

Methods. From 2008 to 2013, 390 patients underwent surgical repair of type A aortic dissection. Outcomes were analyzed in 134 consecutive patients who received a David V during repair of type A aortic dissection. Patients were followed with annual postoperative echocardiograms. Follow-up was 85% complete, with a mean duration of 40 ± 31 months.

Results. The mean age of these patients was 66 ± 10 years. There were two operative deaths (1.4%), and 91% of patients received a baffle replacement (n = 32) or a total arch replacement (n = 8) using hypothermic circulatory arrest. Cusp repairs were performed in 6 (14%) patients. 51% of patients had type A or less. No patient in the follow-up period developed endocarditis or required aortic valve replacement. At midterm follow-up, freedom from type A was 98%.

Conclusions. The David V can be performed with low mortality and mortality in young patients presenting with type A aortic dissection who require aortic root replacement. At midterm follow-up, valve function is durable, and the incidence of valve-related complications is low.


The primary objective of surgical treatment of acute type A aortic dissection is survival of the patient. The goals of operative intervention include resection of the primary intimal tear with obliteration of the false lumen and all essential procedures that may prevent reinvention on the aortic root and aortic arch. In high-volume aortic treatment centers, survival after surgical repair of type A aortic dissection has improved as a result of advances in surgical techniques, circulation management strategies, and methods of cerebral protection [1-4]. In these centers, patients typically undergo ascending aorta replacement and proximal aortic arch reconstruction using hypothermic circulatory arrest. The aortic valve is usually reimplanted, and the dissection sinus segments of the aortic root are reconstructed with Teflon felt or biologic glue. This strategy has resulted in a low incidence of proximal aortic reintervention [5, 6, 7].

Table 3. Echocardiographic Data

<table>
<thead>
<tr>
<th>Degree of AI</th>
<th>Preoperative (n = 43)</th>
<th>Postoperative (n = 42)</th>
<th>Last Follow-Up (n = 35)</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>7</td>
<td>35</td>
<td>23</td>
</tr>
<tr>
<td>Trace (0.5+)</td>
<td>3</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>Mild (1+)</td>
<td>6</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Moderate (2+)</td>
<td>5</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Moderate-severe (3+)</td>
<td>5</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Severe (4+)</td>
<td>17</td>
<td>17</td>
<td>0</td>
</tr>
</tbody>
</table>

AI = aortic insufficiency.

Accepted for publication Aug 28, 2014

Presented at the 85th Annual Meeting of The Society of Thoracic Surgeons, Dallas, TX, June 29, 2014.

Address correspondence to Dr. Chen, Division of Cardiothoracic Surgery, Emory University School of Medicine, 1364 Clifton Road, NE, Suite 3B, Atlanta, GA 30322; e-mail: edward.chen@emory.edu.

© 2013 by The Society of Thoracic Surgeons
Published by Elsevier
Valve Durability and Survival: Mid Term Results

- Freedom from 2+ AI: 94%
- Freedom from AVR: 100%
- Freedom from Proximal Aortic Reintervention: 100%
- Freedom from Distal Aortic Reintervention: 80%
  - 1 Total Arch replacement
  - 7 DTA/TAAA replacements
- Survival at 9 years: 88%
Salient Points of Valve-Sparing in Type A Dissection

- Cusps should have minimal degeneration and sclerosis
- Role for extensive cusp repair
- AI is due to acute prolapse so the nature of the regurgitant jet less of a concern with normal cusps
- Coronary buttons can be friable
- Not indicated in the setting of shock, organ malperfusion or surgeon inexperience
- In high volume centers and experienced hands, not associated with worse outcome
Factors Influencing VSRR vs. CVG in Type A Dissection

**VSRR**
- Younger patients
- Absence of cusp degeneration
- *Aortic regurgitation/Bicuspid valves do not represent absolute contraindications*

**CVG**
- Patients over 65 years old
- Malperfusion syndromes
- Neurologic complications
- Coronary artery disease
- Cardiomyopathy
Case Presentation
Baseline TEE Images
Valve sparing root replacement in Type A Dissection

*Initial surgical maneuvers*

- Excision of abnormal sinus tissue (leaving 4-5 mm rim of aortic tissue)
- Creation of coronary buttons
Assessment of Feasibility

- Upward traction on commissural posts
- Creation vacuum in LV to induce valve coaptation (LV vent and cell saver)-”suction test”
- Examine valve cusps for competency:
  - Degeneration
  - Coaptation zone
  - Presence of prolapse
  - Cusp restriction
  - Fenestrations
  - Free margin length

EMORY AORTIC CENTER
Next Steps for VSRR

- Graft Sizing/Tailoring: David-Feindel Formula
  - \(2 \times [(\text{Average Cusp Height}) \times \frac{2}{3}] + 6\)
- Anchoring graft to base of heart
- Tacking commissural posts: \textit{key step}
  - Post heights and angles not necessarily equal
- Reimplant valve inside graft
- Assess for valve competency
- Valve/cusp repair if needed
- Coronary reimplantation
TEE Images after Repair
Summary and Conclusions

• In acute Type A dissection, performance of an aortic root replacement has not been shown to be associated with an increase in operative risk.

• Despite unique technical challenges related to the disease process, valve-sparing procedures can be safely and effectively performed with acceptable operative risk in patients presenting with acute Type A aortic dissection and aortic root pathology.

• In experienced hands, the indications for valve-sparing aortic root surgery should be expanded to include Type A dissection.