Current State of Thoracic Endovascular Surgery

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Professor and Chief, Cardiothoracic Surgery
Medical University of South Carolina

American Association for Thoracic Surgery
Allied Health Professional Symposium
May 4, 2013
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NO DISCLOSURES

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Thoracic Endografting

History

- Dotter, Judkins: first endoluminal approaches, 1964
- Parodi: endovascular AAA repair, 1991
- Introduction of DTA endovascular repair, 1992

- FDA approvals:
  - Gore TAG®: March 23, 2005
  - Cook Zenith TX2®: May 23, 2008
  - Medtronic Talent®: July 9, 2008
Thoracic Endografting for Aneurysm Disease

Preoperative Evaluation: Gore TAG® Device
Thoracic Endografting for Aneurysm Disease

Preoperative Evaluation: Gore TAG® Device
Thoracic Endografting for Aneurysm Disease

Preoperative Evaluation: Gore TAG® Device
Thoracic Endografting for Aneurysm Disease

*Cook Zenith TX2® Device:*

- **Proximal**
- **Distal**
Thoracic Endografting for Aneurysm Disease

Medtronic Talent® Device:

4 times the radial force of TAG at the proximal sealing zone

5 times the radial force of TAG at the distal sealing zone
Thoracic Endografting for Type B (III) Dissection

Stanford Classification:

Daily PO, Trueblood HW, Stinson EB, Wuerflein RD, Shumway NE. Management of Acute Aortic Dissections
Thoracic Endografting for Type B (III) Dissection

Baylor Classification:

Thoracic Endografting for Type B (III) Dissection

Location of Tear

Thoracic Endografting for Type B (III) Dissection

Coverage of Primary Intimal Tear
Thoracic Endografting for Type B (III) Dissection
Thoracic Endografting for Type B (III) Dissection

- Mixed series
- Early: often reported with TAA repair
- Mixture of acute and chronic
# Thoracic Endografting for Type B (III) Dissection

<table>
<thead>
<tr>
<th>Series</th>
<th>Device</th>
<th>Number of patients</th>
<th>% Acute</th>
<th>Procedural success</th>
<th>Paraplegia</th>
<th>Other morbidity</th>
<th>30-Day mortality</th>
<th>Thrombosis</th>
<th>F/U</th>
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<td>Dake [63] '96-'98</td>
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<td>14 m</td>
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<tr>
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<tr>
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<td>0%</td>
<td>83%</td>
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<td>100%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>89%</td>
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<tr>
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<td>0%</td>
<td>0%</td>
<td>0%</td>
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<td>15 m</td>
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<tr>
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<td>7%</td>
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<td>8 m</td>
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<td>7%</td>
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<td>0%</td>
<td>n/a</td>
<td>14 m</td>
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<tr>
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<td>Gravenwoger [76] '97-'02</td>
<td>Gore</td>
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<td>100%</td>
<td>9%</td>
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<td>17 m</td>
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<td>10</td>
<td>40%</td>
<td>90%</td>
<td>0%</td>
<td>20%</td>
<td>0%</td>
<td>90%</td>
<td>21 m</td>
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<tr>
<td>Nienaber [78] '99-'02</td>
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<td>11</td>
<td>100%</td>
<td>100%</td>
<td>9%</td>
<td>18%</td>
<td>0%</td>
<td>54%</td>
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<tr>
<td>Lambrechts [59] '00-'02</td>
<td>Talent/Gore</td>
<td>11</td>
<td>45%</td>
<td>100%</td>
<td>0%</td>
<td>14%</td>
<td>0%</td>
<td>91%</td>
<td>n/a</td>
</tr>
</tbody>
</table>

Mean 420 pts 60% 98% 2.2% 12.9% 3.8% 82% 15m

Surg Clin N Am 2004;84:1295-1318
Thoracic Endografting for Type B (III) Dissection

Specific Complications

- Retrograde dissection (1.9%)
  - not device specific
  - careful consideration of anatomy
  - careful balloon manipulation

- Post-implantation syndrome (up to 70%)
Acute, Uncomplicated:
- no evidence, currently, to support TEVAR in uncomplicated cases
  - Medtronic Talent INSTEAD (INvestigation of STEnt Grafts in Patients With Type B Aortic Dissection) trial
    - 136 patients, enrollment completed Feb 07
    - results do not support survival benefit or reduction in complications
  - Gore ADSORB (Acute Dissection Stent-grafting Or Best Medical Treatment) Trial
    - 250 patients, 30 European Centers
Thoracic Endografting for Type B (III) Dissection

Acute Dissections

Acute, Complicated:

IRAD Database:
- 571 pts, acute B Ao Dissection
- 390 Medical Rx
- 59 Open Sx
- 66 EVSG

J. Am. Coll. Cardiol. Intv. 2008;1;395-402
Chronic:

- *weak* aorta – arch manipulation may cause retrograde dissections or stroke
- usually have to cover Left Subclavian Artery orifice – type II endoleaks, neurologic complication risk
- complete deployment in the true lumen problematic if true lumen compressed
- distal landing zone issues:
  - patent T₈–T₁₂ intercostal arteries
  - persistent, multiple fenestrations past landing zone promote continued false lumen patency
- false lumen must *thrombose* to prevent continued pressurization of the aorta
Thoracic Endografting for Type B (III) Dissection

Summary

- Excellent technical results
- Low paraplegia and complication rates
- Experience-dependence of results
- Acute: uncomplicated may not be appropriate
- Chronic: fate of false lumen?
Traumatic Aortic Tear

- Inertial forces on deceleration
- Severe hyperextension
- Compression Osseous pinch
- Shoveling effect
Traumatic Aortic Tear
Traumatic Aortic Tear
Traumatic Aortic Tear
Traumatic Aortic Tear

Cumulative risk of paraplegia

- Simple cross-clamp
- Passive perfusion
- Active perfusion

Cross-clamp time (min)

%
Thoracic Endografting for Acute Aortic Transection
Thoracic Endografting for Acute Aortic Transection
Thoracic Endografting for Acute Aortic Transection

Specific Complications

- Late device compression
  - more common than reported
  - repeat stent graft

- Post-implantation syndrome

- coverage of left subclavian common
Thoracic Endografting for Acute Aortic Transection

Summary

- Technically feasible
- Few device related complications
- long-term data required
Thoracic Endografting for Aneurysm Disease
Size Criteria for TAA Therapy

J Thorac Cardiovasc Surg 1997;113:476–91

Should “Conventional” Criteria for Non-Medical Therapy for Thoracic Aortic Aneurysm be “Relaxed” With The Availability of Endovascular Aortic Repair?

Currently, not enough data exists to support this.
Thoracic Endografting for Aneurysm Disease
Proximal Fixation
Thoracic Endografting for Aneurysm Disease

*Proximal Fixation for Zones 0-2*

- Open web design
- Left subclavian occlusion
- Fenestrations, stents & branches
- Hybrid techniques (elephant trunk, carotid/subclavian, carotid/carotid by-pass, etc)
- Open debranching
Thoracic Endografting for Aneurysm
Zone 2 Coverage
Thoracic Endografting for Aneurysm Disease
Zone 2 – Carotid Subclavian Bypass
Thoracic Endografting for Aneurysm Disease
Zone 2 - Retrograde Stenting
Thoracic Endografting for Aneurysm Disease
Zone 2 - Retrograde Stenting
Thoracic Endografting for Aneurysm Disease
“Off The Shelf” Branched Stent Grafts

W. L. Gore & Associates
Thoracic Endografting for Aneurysm Disease
“Off The Shelf” Branched Stent Grafts
Deployment Steps

**Step 1:**
- Insert guidewires in aorta and branch vessel

**Step 2:**
- Introduce aortic component over both guidewires into position within the arch

**Step 3:**
- Deploy aortic component and withdraw catheter

**Step 4:**
- Introduce Bend-E sheath and dilator

**Step 5:**
- Advance and deploy branch component
Thoracic Endografting for Aneurysm Disease

Zone 1 - Fenestrated Grafts
Thoracic Endografting for Aneurysm Disease
Zone 1 - Open Debranching-Proximal
Thoracic Endografting for Aneurysm Disease
Zone 1 - “Chimney Graft”

CRIADO F: Pushing the Envelope With Complex TEVAR
SUPPLEMENT TO ENDOVASCULAR TODAY I NOVEMBER 2007
Thoracic Endografting for Aneurysm Disease
Zone 0 - Challenges

Issues with the Root and Ascending Aorta:

Large
Viscoelastic
“Catch and throw” Function
Prox/Dist Landing zones
- STJ, innominate
Coronary Arteries
Aortic Valve
Stent Graft Durability - Connective tissue disorders
Thoracic Endografting for Aneurysm Disease

Zone 0 - Open Debranching - Proximal
Thoracic Endografting for Aneurysm Disease
Zone 0 - Open Debranching - Proximal
Thoracic Endografting for Aneurysm Disease
Zone 0 Deployment
Thoracic Endografting for Aneurysm Disease

*Not all Zone 0’s are the same!*
Thoracic Endografting for Aneurysm Disease
“Zone 00”
Composite Valve-Graft Replacement
Composite Valve-Graft Replacement
Composite Valve-Graft Replacement
Thoracic Endografting for Aneurysm Disease

Zone 00 Stent Graft Placement

Features of the Ideal Zone 00 stent graft:

- Fixation likely at the aortic annulus (with no paravalvular leak)
- Side grafts extending into the coronary arteries
- A tapered design to accommodate discordant proximal and distal fixation sites
- Possibly need distal side graft to innominate artery to allow distal landing
- Custom synthesized using 3-D radiographic images
Thoracic Endografting for Aneurysm Disease

Transcatheter Valve

- Tri-leaflet bovine pericardial tissue treated with ThermaFix Process
- Balloon expandable stainless steel stent for sutureless implantation
Thoracic Endografting for Aneurysm Disease
“Off The Shelf” Branched Stent Grafts

W. L. Gore & Associates
Current State of Thoracic Endovascular Surgery

Conclusions

- Continued technical and device advancements have allowed more of the aorta to be safely stent grafted, *with lower morbidity and mortality*, than open surgery, for a variety of conditions.

- The final challenge, proximal ascending aortic and root stent grafting, will require continued development and integration of new percutaneous aortic valve and stent graft construction technology.
Q27. Endovascular stent grafting of the thoracic aorta:

A. has relaxed the size criteria for aneurysm treatment
B. is contraindicated for traumatic aortic injury
C. should not be performed for arch aneurysms
D. reduces morbidity compared to open surgery