Retrograde Aortic Dissection After TEVAR: Incidence, Risk Factors, Precautions and Treatment

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VEITHsymposium
Session 40: More Topics Relating to the Ascending Aorta, the Arch, and Parallel Grafts
New York, New York • Wednesday, November 18, 2015

Disclosure

After Thoracic Endovascular Repair?

Major Complications After TEVAR
- Type I endoleak
- Type III endoleak
- Fistula
- Infection of stent-graft
- Aneurysm progression

After Thoracic Endovascular Repair?

Major Complications After TEVAR
- Type I endoleak
- Type III endoleak
- Fistula
- Infection of stent-graft
- Aneurysm progression
- Retrograde ascending aortic dissection
  - Most feared complication

Dissection – Conversion of Type B to Type A
After TEVAR

- Arizona Heart Hospital
- 2000-2006
- 287 pts
- 7 pts rAAD
- 2.4% incidence

**Incidence**

**Contributing factors rAAD**
- Female gender
- TEVAR for dissection
- Aggressive balloon angioplasty

**Mortality**
- 57% (n=4 pts)

**rAAD post-TEVAR**
- n=305; 8.5 years
- Omitted patients with previous aortic surgery that would have made rAAD an impossibility
- Patients excluded:
  - Previous ascending aortic replacement
  - Arch replacement
  - Stage 1 elephant trunk repair

Kpodonu EJCTS 2008
rAAD After TEVAR \(\rightarrow\) Incidence

<table>
<thead>
<tr>
<th>Author, year</th>
<th>rAAD n</th>
<th>Intra-operative</th>
<th>30 Postoperative days</th>
<th>60 Postoperative days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preventza, 2015</td>
<td>4 of 305</td>
<td>25% (1/4)</td>
<td>50% (2/4)</td>
<td>25% (1/4)</td>
</tr>
<tr>
<td>Williams, 2012</td>
<td>6 of 309</td>
<td>67% (4/6)</td>
<td>33% (2/6)</td>
<td>--</td>
</tr>
<tr>
<td>Idrees, 2014</td>
<td>15 of 766</td>
<td>--</td>
<td>20% (3/15)</td>
<td>80% (12/15)</td>
</tr>
<tr>
<td>Canaud, 2014</td>
<td>16 of 1010</td>
<td>13% (2/16)</td>
<td>38% (6/16)</td>
<td>50% (8/16)</td>
</tr>
<tr>
<td>Eggebrecht, 2009**</td>
<td>48 of 4750</td>
<td>15% (7/48)</td>
<td>33% (15/48)</td>
<td>54% (26/48)</td>
</tr>
</tbody>
</table>

*Data from MOTHER registry  
**Data from European registry  
Series with at least 4 rAAD events shown

TEVAR in Acute/Complicated Type B Aortic Dissection: Clinical Trials

- Medtronic Valiant Study: n = 50, rAAD = 2
- Gore Conformable Study: n = 50, rAAD = 5

Combined n = 100
*Counting 2 de novo proximal dissections

Risk Factors
rAAD After TEVAR: Risk Factors

- It has been associated with:
  - Acute Type III aortic dissection
  - Intramural hematoma of the descending aorta
  - Endograft landing in zone 0 (ascending aorta)
  - Dilated ascending aorta (> 4 cm)
  - Female gender

rAAD After TEVAR

- Potential etiologies can be classified as:
  - Procedure related
    - Oversizing of the stent graft
    - Aggressive balloon dilation
    - Manipulation near aortic arch
  - Device related
    - Free-flow bare spring proximal stent graft design
    - Devices with barbs for proximal fixation
  - Disease progression

rAAD After TEVAR → Incidence by device

<table>
<thead>
<tr>
<th>Device</th>
<th>rAAD group</th>
<th>Study</th>
</tr>
</thead>
<tbody>
<tr>
<td>TAG (Gore)</td>
<td>33% (2/6)</td>
<td>Williams 2012</td>
</tr>
<tr>
<td></td>
<td>13% (6/48)</td>
<td>Eggebrecht 2009</td>
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<tr>
<td></td>
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<td>Idrees 2014</td>
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<tr>
<td>Talent (Medtronic)</td>
<td>33% (2/6)</td>
<td>Eggebrecht 2009</td>
</tr>
<tr>
<td></td>
<td>10% (1/10)</td>
<td>Preventza 2015</td>
</tr>
<tr>
<td></td>
<td>19% (9/48)</td>
<td>Eggebrecht 2009</td>
</tr>
<tr>
<td></td>
<td>33% (3/9)</td>
<td>Idrees 2014</td>
</tr>
<tr>
<td>Zenith TX2 (Cook)</td>
<td>33% (2/6)</td>
<td>Williams 2012</td>
</tr>
<tr>
<td></td>
<td>2% (1/48)</td>
<td>Eggebrecht 2009</td>
</tr>
<tr>
<td></td>
<td>33% (5/15)</td>
<td>Idrees 2014</td>
</tr>
<tr>
<td></td>
<td>75% (3/4)</td>
<td>Preventza 2015</td>
</tr>
<tr>
<td>Endograft (Le Maitre)</td>
<td>5% (3/58)</td>
<td>Eggebrecht 2009</td>
</tr>
</tbody>
</table>

Caused of rAAD (n=48) after TEVAR (n=4750) n(%)

- Stent graft induced 29 (60%)
- Procedure-related (Manipulation of guide wires and sheaths) 7 (15%)
- Progression of underlying aortic disease 7 (15%)
- Unable to establish cause 5 (10%)

European Registry on Endovascular Aortic Repair Complications

rAAD After TEVAR

- Data from MOTHER registry (n=1010; rAAD in 16)
  (and systematic literature review)

Key finding:

1. rAAD is associated with extent of device oversizing—each percentage increase in endograft oversizing above 9% resulted in a relative increased risk of RTAD by 14%.


Comparison of Hybrid Experience

Zone 0 Hybrid Arch

2-stage Hybrid ET

Early death

Stroke

Retrograde A dissection

Intervention for endoleak

Zone 0 n = 48

Hybrid ET (2-stages) n = 20

20.8% (10)

4.2% (2)

6.3% (3)

17% (8)

Risk factors for dissection: previous dissection, ascending > 4 cm, exposed proximal barbs or springs.

Anderson et al J Vasc Surg 2013 [Duke University experience]. Data regarding 87 hybrid repairs with overall mortality of 16.3%. Zone 0 n = 48, Zone 1 n = 19, Hybrid ET n = 20. No paraplegia.

Incidence of rAAD: Hybrid Arch Repair

Small Series Reports Regarding Hybrid Arch Repair

<table>
<thead>
<tr>
<th>Author, year</th>
<th>n</th>
<th>n (%) rAAD</th>
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<tr>
<td>De Rango, 2014</td>
<td>104</td>
<td>4 (3.8%)</td>
</tr>
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<td>Luehr, 2013</td>
<td>9</td>
<td>2 (22.2%)</td>
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<td>Lotfi, 2012</td>
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<td>33</td>
<td>1 (3.0%)</td>
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- Czerny: 2 early (death) and 3 late RAAD (open conversion)

“Retrograde type A dissection appears to be a frequent and often lethal complication of hybrid arch repair….In patients with native ascending aorta who underwent zone 0 endograft placement, the rate was 11.1% (3/27).”

Anderson et al J Vasc Surg 2013 [Duke University experience]. Data regarding 87 hybrid repairs with overall mortality of 16.3%. Zone 0 n = 48, Zone 1 n = 19, Hybrid ET n = 20. No paraplegia.

Size Matters

Retrograde ascending aortic dissection as an early complication of thoracic endovascular aortic repair

<table>
<thead>
<tr>
<th>Risk factor</th>
<th>Frequency</th>
<th>Incidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ascending aortic diameter &gt; 4.0 cm (n=6)</td>
<td>Increased risk if ascending aortic diameter is &gt; 4.0 cm (P= 0.047)</td>
<td></td>
</tr>
<tr>
<td>Trend towards increased risk when landing in Zone 0 (P=1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>More common after treatment for dissection than for aneurysm (P= 0.88)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rare springs or barbs</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Williams J Vasc Surg 2013 Durham, NC
Precautions

- Oversizing
- Bare metal stents
- Ballooning
- Zone O
- Barbs
- Manipulation at arch

rAAD After TEVAR: Precautions

Treatment

Images: J Thorac Cardiovasc 2014; 147(1): 151-4
rAAD After TEVAR → Treatment

<table>
<thead>
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<th>n</th>
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<tr>
<td>Eggebrecht, 2009</td>
</tr>
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<td>10% (5/48) - Elective surgery</td>
</tr>
<tr>
<td>19% (9/48) - Conservative management</td>
</tr>
</tbody>
</table>

Mortality rates were similar for conservative management (33%), elective surgery (20%) and emergent repair (28%, P = 0.9)

rAAD After TEVAR → Mortality

- Is the mortality rate for rAAD after TEVAR any different when onset is immediate (intraprocedural) vs delayed?

Mortality rates were similar for conservative management (33%), elective surgery (20%) and emergent repair (28%, P = 0.9)

Mortality rates appear elevated in rAAD after TEVAR

Mortality of rAAD: Hybrid Arch Repair

Small Series Reports Regarding Hybrid Arch Repair

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<tr>
<td>Luehr, 2013</td>
<td>9</td>
<td>2 (22.2%)</td>
<td>0</td>
</tr>
<tr>
<td>Lotfi, 2012</td>
<td>51</td>
<td>3 (5.9%)</td>
<td>1 of 3 (33.3%)</td>
</tr>
<tr>
<td>Czerny, 2012</td>
<td>66</td>
<td>5 (7.5%)</td>
<td>2 of 5 (40.0%)</td>
</tr>
<tr>
<td>Geisbusch, 2011</td>
<td>47</td>
<td>3 (6.3%)</td>
<td>2 of 3 (66.7%)</td>
</tr>
<tr>
<td>Antoniou, 2010</td>
<td>33</td>
<td>1 (3.0%)</td>
<td>1 of 1 (100%)</td>
</tr>
</tbody>
</table>

- Czerny: 2 early (death) and 3 late RAAD (open conversion)

Mortality → Acute Type A Dissection

<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>n</th>
<th>Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pape → IRAD</td>
<td>2015</td>
<td>2552</td>
<td>502 (20%)</td>
</tr>
<tr>
<td>Conway [4 US centers]</td>
<td>2014</td>
<td>140</td>
<td>17 (12%)</td>
</tr>
<tr>
<td>Andersen [Duke]</td>
<td>2014</td>
<td>128</td>
<td>21 (16%)</td>
</tr>
<tr>
<td>Preventza [Coselli]</td>
<td>2014</td>
<td>112</td>
<td>15 (13%)</td>
</tr>
<tr>
<td>Ryński → GERAADA</td>
<td>2013</td>
<td>2137</td>
<td>366 (17%)</td>
</tr>
<tr>
<td>Krüger → GERAADA</td>
<td>2011</td>
<td>1558</td>
<td>248 (16%)</td>
</tr>
<tr>
<td>Trimarchi → IRAD</td>
<td>2010</td>
<td>769</td>
<td>186 (24%)</td>
</tr>
<tr>
<td>Tsai → IRAD</td>
<td>2009</td>
<td>289</td>
<td>77 (27%)</td>
</tr>
<tr>
<td>Raghupathy →IRAD</td>
<td>2008</td>
<td>531</td>
<td>124 (23%)</td>
</tr>
<tr>
<td>Narayan</td>
<td>2008</td>
<td>165</td>
<td>30 (18%)</td>
</tr>
<tr>
<td>Knipp → NIS</td>
<td>2007</td>
<td>3013</td>
<td>783 (26%)</td>
</tr>
</tbody>
</table>
Conclusions

• Retrograde acute ascending aortic dissection is a rare event
• Because rAAD is an infrequent event, it is difficult to identify predictors
  Cause is complex and difficult to determine
• Care should be taken in TEVAR for acute DeBakey type III dissection
  Great care taken to avoid oversizing and device manipulation near arch
• If rAAD should occur, the risk of death is nearly doubled

Thank You!