After Thoracic Endovascular Repair?

Adverse Events After TEVAR
- Type I endoleak
- Type III endoleak
- Fistula
- Infection of stent-graft
- Aneurysm progression
- Retrograde ascending aortic dissection

Lethal complication

rAAD After TEVAR → Mortality

- Is the mortality rate for rAAD after TEVAR any different from that for acute proximal aortic dissection (no prior TEVAR)?

Mortality rates Range
rAAD after TEVAR 7-50%
Acute type A (no TEVAR) 8-27%

Mortality rates appear elevated in rAAD after TEVAR

Mortality of rAAD After Hybrid Arch Repair

<table>
<thead>
<tr>
<th>Author, year</th>
<th>n</th>
<th>n (%) rAAD</th>
<th>Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>De Rango, 2014</td>
<td>104</td>
<td>4 (3.8%)</td>
<td>2 of 4 (50.0%)</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 4 (40.0%)</td>
</tr>
<tr>
<td>Geibusch, 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>

Incidence

The reported incidence of rAAD after TEVAR is 1-13.80%
Retrograde Ascending Aortic Dissection After TEVAR

305 pts, 8.5 years excluded pts with TEVAR who had prior ascending repair
RTAD 4 (1.3%)

Risk Factors

• Potential etiologies can be classified as:
  – Procedure and Operator Related
    ▪ Oversizing of the stent graft
    ▪ Aggressive balloon dilation
    ▪ Manipulation near aortic arch

Incidence Immediate vs Delayed rAAD

<table>
<thead>
<tr>
<th>Author, year</th>
<th>rAAD n</th>
<th>Intra-operative</th>
<th>30 Postoperative days</th>
<th>Beyond 30 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>Coselli</td>
<td></td>
<td></td>
<td></td>
<td></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>Ishree, 2014</td>
<td>15 of 766</td>
<td>--</td>
<td>25% (3/15)</td>
<td>80% (12/15)</td>
</tr>
<tr>
<td>Cnaud, 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>35% (15/48)</td>
<td>54% (26/48)</td>
</tr>
</tbody>
</table>

Manipulation of the arch
38x152 Cook Zenith TX2

Manipulation of the arch
38x152 40x81 aortic cuff
Manipulation of the arch

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%.

Avoid oversizing in pts with acute dissection
Caution in pts with chronic dissection

Avoid aggressive balloononing proximal landing zone regardless the initial pathology

Intraoperative ballooning
CT scan 3 days later

Retrograde Ascending Aortic Dissection After TEVAR

Potential etiologies can be classified as:
- Procedure and Operator 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

Avoid oversizing
rtAAD
rAAD
Type B dissection cohort

203 pts TBAD (chronic and acute)
- Mean rate of oversizing of the proximal landing was 10% (0-32%)
- RTAD [0 in the ≤5% group vs 11 (11.2%) in the >5% group]

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8969 pts
• RTAD 2.5% (post aneurysms and dissection)
• Mortality rate 37.1%
• More frequent for acute dissection and bare stent

J Am Heart Assoc 2017
Chen Y and colleagues

997 pts, TEVAR, TBAD, 361 chronic
• RTAD 3.17%
• Proximal bare stent (PBS) and non-PBS, RTAD same
• Stent graft length <165 mm, associated with RTAD

Ma T and colleagues
JVS 2018

Device rAAD group Study
TAG (Gore) 33% (2/6) Williams 2012
37% (7/19)
33% (1/3)
Preventza 2015
33% (9/27)
33% (9/27)
Preventza 2015
20% (3/15)
33% (2/6)
Williams 2012
Williams 2012
32% (1/3)
Endograft (Le Maitre) 6% (3/48) Eggebrecht 2009
75% (3/4)
Preventza 2015

rAAD After TEVAR → Incidence by device

Retrograde Ascending Aortic Dissection After TEVAR
• Potential etiologies can be classified as:
  — Procedure and Operator 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 Related

Retrograde Ascending Aortic Dissection After TEVAR
• It has been associated with:
  — Descending thoracic aortic dissection
  — Intramural hematoma of the descending aorta
  — Endograft landing in Zone 0 (native ascending aorta)
Retrograde Ascending Aortic Dissection After TEVAR

- MOTHER Registry (n=1010)
- Incidence of rAAD after TEVAR
  - For TEVAR in acute dissection:
    - 8.4% incidence
    - Odds ratio 10.0 as compared to aneurysm
  - For TEVAR in chronic dissection:
    - 3% incidence
    - Odds ratio 3.4 vs aneurysm


Patients with connective tissue

GenTac Registry (connective tissue disorders etc)
371 pts with DTA dissection (acute and chronic)
- RTAD after TEVAR for acute TBAD 25%
- can be lifesaving in the acute setting though associated with high risk of retrograde aortic dissection in acute TBAD

Anderson et al J Vasc Surg 2013

Incidence of rAAD:
- Zone 0 Hybrid Arch Repair

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<tr>
<td>Luehr, 2013</td>
<td>9</td>
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<tr>
<td>Anderson 2013</td>
<td>27</td>
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“Technical aspects of TEVAR have been shown to influence rAAD with oversizing of the endograft being implicated. Inappropriate endograft oversizing, particularly in patients with aortic wall fragility, should be avoided.”

Canaud et al Ann Surg 2014 MOTHER database n=1010; rAAD in 16
Retrograde Ascending Aortic Dissection After TEVAR: Precautions

- Intraoperative (for patients with hybrid arch, requiring landing in Zone 0)
  - Partial clamp on the ascending aorta, SBP 70-80 mmHg
  - If ascending aorta ≥4.5 cm → replacement

Retrograde Type A Aortic Dissection After TEVAR: Operator Dependent, Disease Dependent: How to Prevent Them

Conclusion

- rAAD after TEVAR is a rare but lethal complication
- Enhancing conformability of stent graft design can minimize the incidence of this lethal complication

Retrograde Type A Aortic Dissection After TEVAR: Operator Dependent, Device and or Disease Dependent: How to Prevent Them

Conclusion

- Expertise in wire, catheter, and stent graft manipulation especially in the percutaneous heart valve era is a key to avoid rAAD
- Knowledge and judgment of the operator can minimize all the variables associated with disease, and device which could lead to RTAD
  - Caution with
    - acute type B, pts with connective tissue disorders, zone 0, pts with ascend >4 cm