Current Status of EVAR for Infra-renal Aneurysm and the Need for Re-Interventions

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No Disclosures
FDA Approved Stent Grafts and Commercially Available

- EVT Ancure 1999
- Medtronic AneuRx 1999
- Gore Excluder 2002
- Cook Zenith 2003
- Endologix Powerlink 2004
- Medtronic Talent 2008
- Medtronic Endurant 2010
- TriVascular Ovation 2011 Prime 2013
- Cook Fenestrated 2012
- Lombard Medical Aorfix 2013

* Officially discontinued

Clinical Trial and Commercial Experience with EVAR

- Immediate EVAR outcomes are comparable and/or superior to those obtainable with open surgery.
- No ICU stay
- No blood transfusions
- PEVAR option
- LOS < 2 days
- EVAR expands therapy to patients deemed too “high risk” for OSR.
- Post-discharge recovery: 7-10 days
- Reduced inpatient costs related to LOS may be off-set by high device-related costs.
Commercial Volumes with EVAR

- In 2015, ≈ 133,000 EVARs were performed world-wide.
  - EVAR utilization higher in the US for AAA repair (> 75%) compared to western Europe (52%)
  - The US represents >50% of market share
- Global market forecasts project a 5.5% growth of EVAR/year
- Largest global gains in EVAR volume will be in China and India
- Lowest gains will be in the US, Western Europe, and Japan.
- In the US in 2012, EVAR ≈ 47,000 cases
- Current US EVAR endograft market is valued at $650 million
- US EVAR endograft market growing ≈ 8% / year

Clinical Trial and Commercial Experience

Is EVAR a DURABLE and CURATIVE option?

86 years old and 18 years s/p EVAR
Clinical Trial and Commercial Experience with EVAR

- Long-term outcomes with commercial devices are better if physicians follow the IFU: anatomic applicability ≈ 50%
- Endoleak occurs in 1/3 of all EVARs
- Type II endoleaks:
  - Sac enlargement: ≈ 21% of endoleak patients
  - Sac enlargement: ≈ 41% at 5 years
- Liberal use of EVAR outside IFU
- Incidence of device failure necessitating revisions
- Need for lifelong surveillance
- Overall costs greater than OSR.
- Higher late AAA mortality with EVAR:
  - EVAR at 5 years ≈ 1.5% vs OSR ≈ 0.9%
  - Late rupture remains a concern

Device Specific Failure Modes Associated with the Talent AAA Stent Graft
Etiology of Late EVAR Failure

Progressive dilatation of the pararenal aorta
Type Ia endoleak w or w/o migration, sac expansion

Progressive dilatation of the common iliac arteries
Type Ib endoleak
Etiology of Late EVAR Failure
Material failure: Type III endoleak

Anders Wanhainen, MD, et al
Journal of Vascular Surgery
Volume 48, Issue 3, Pages 723-726 (September 2008)
DOI: 10.1016/j.jvs.2008.03.047

Other known etiologies of EVAR failure
More likely to be mid-term rather than > 10 years

- Migration in the absence of pararenal dilatation: less common today
- Stent graft infection
- Unresolved Type II endoleak and sac expansion
- Multiple endoleaks
- Endotension
- Graft limb thrombosis
### EVAR Clinical Trials and Limb Occlusion “LO”

<table>
<thead>
<tr>
<th>Device</th>
<th>Occurrence “LO”</th>
<th>Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ancure</td>
<td>39% limb interventions</td>
<td>1</td>
</tr>
<tr>
<td>AneuRx</td>
<td>8%</td>
<td>5</td>
</tr>
<tr>
<td>Talent</td>
<td>No LO</td>
<td>5</td>
</tr>
<tr>
<td>Zenith</td>
<td>No LO in Roll-in &amp; HR; &lt;2% in SR</td>
<td>5</td>
</tr>
<tr>
<td>Gore Excluder</td>
<td>&lt; 1%</td>
<td>5</td>
</tr>
<tr>
<td>Endologix</td>
<td>&lt; 2%</td>
<td>5</td>
</tr>
<tr>
<td>Trivascular Ovation</td>
<td>1%</td>
<td>1</td>
</tr>
<tr>
<td>Aptus</td>
<td>7.7% LO, 36% patients experienced TRE</td>
<td>3</td>
</tr>
<tr>
<td>Endurant</td>
<td>2.7%</td>
<td>1</td>
</tr>
<tr>
<td>Aorfix</td>
<td>No LO</td>
<td>1</td>
</tr>
<tr>
<td>Zenith LP</td>
<td>7.7%, 18.3% patients experienced TRE</td>
<td>1</td>
</tr>
<tr>
<td>Cordis Incraft</td>
<td>4%</td>
<td>1</td>
</tr>
<tr>
<td>Nellix EVAS</td>
<td>1.8 – 5%</td>
<td>1.5</td>
</tr>
</tbody>
</table>

### Other known etiologies of EVAR failure

More likely to be **mid-term** rather than > 10 years

- Elongation of the aorta from the SMA to aortic bifurcation:
  Component separation and Type III endoleak

Ashen A. Skibba MD et al
*Journal of Vascular Surgery*
Volume 62, Issue 4, Pages 868-875 (October 2015)
DOI: 10.1016/j.jvs.2015.04.454
Endovascular Solutions for late EVAR Failure:
Depends on etiology and stent graft design: trunk length / flow divider

Proximal extension of seal zone with 3 vessel snorkel

Fenestrated and branched devices

Zenia Martin, MD, et al
Journal of Vascular Surgery
Volume 59, Issue 6, Pages 1479-1487 (June 2014)
**Endovascular Solutions for Late EVAR Failure**
Progressive dilatation of the common iliac arteries
Type Ib endoleak

- Embolization of IIA with extension to EIA
- Branched iliac stent graft

**Etiology of Late EVAR Failure**
Material failure: Type III endoleak

- Stent graft relining with use of AUI devices as necessary

*Anders Wanhainen, MD, et al
Journal of Vascular Surgery
Volume 48, Issue 3, Pages 723-726 (September 2008)
DOI: 10.1016/j.jvs.2008.03.047*
Reinterventions following EVAR at Penn

Study Design

Exclusion criteria:
- EVAR performed at OSH
- Fenestrated or branched devices

Infrarenal EVAR, N=1,835

<table>
<thead>
<tr>
<th>FDA-approved devices</th>
<th>Trial devices</th>
</tr>
</thead>
<tbody>
<tr>
<td>N=1,543</td>
<td>N=292</td>
</tr>
</tbody>
</table>

Reintervention
N=337

<table>
<thead>
<tr>
<th>FDA-approved devices</th>
<th>Trial devices</th>
</tr>
</thead>
<tbody>
<tr>
<td>N=99</td>
<td>N=38</td>
</tr>
</tbody>
</table>

No Reintervention
N=1,698

Reintervention rate

- Overall reintervention rate 7.5%
- Trial vs. FDA-approved devices, 2000-2016
  - 14.4% vs. 6.4%, p=<0.001
- Trial devices, 2000-2008 vs. 2009-2016
  - 14.1% vs. 20.7%, p=0.420
Mean number of reinterventions by device type

<table>
<thead>
<tr>
<th>EVAR devices (N=137)</th>
<th>Mean # of Reinterventions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>p=0.009, Trial vs. FDA</td>
</tr>
<tr>
<td>Trial devices (n=38)</td>
<td>2.18</td>
</tr>
<tr>
<td>FDA-approved devices (n=99)</td>
<td>1.65</td>
</tr>
<tr>
<td>Ancure (1)</td>
<td>3.00</td>
</tr>
<tr>
<td>Excluder (3)</td>
<td>1.62</td>
</tr>
<tr>
<td>Endurant (10)</td>
<td>1.70</td>
</tr>
<tr>
<td>AFX (8)</td>
<td>1.90</td>
</tr>
<tr>
<td>Powerlink (13)</td>
<td>1.57</td>
</tr>
<tr>
<td>Talent (3)</td>
<td>1.71</td>
</tr>
<tr>
<td>AneuRx (11)</td>
<td>1.63</td>
</tr>
<tr>
<td>Zenith (50)</td>
<td>1.72</td>
</tr>
</tbody>
</table>

Mean Time to Reinterventions

<table>
<thead>
<tr>
<th>EVAR devices</th>
<th>Mean Time to Reinterventions (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1&lt;sup&gt;st&lt;/sup&gt; reintervention</td>
</tr>
<tr>
<td>Trial devices (n=38)</td>
<td>3.11</td>
</tr>
<tr>
<td>FDA-approved devices (n=99)</td>
<td>2.13</td>
</tr>
</tbody>
</table>

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Etiology of reintervention by trial and FDA-approved device

**FDA-approved devices**
- Type II Endoleak: 55%
- Type I Endoleak: 23%
- Type III Endoleak: 10%
- Other: 7%
- Limb kink and iliac occlusive disease: 5%

**Trial devices**
- Type II Endoleak: 48%
- Type I Endoleak: 8%
- Type III Endoleak: 5%
- Other: 5%
- Limb kink and iliac occlusive disease: 34%
Etiology of reintervention by trial and FDA-approved device

**FDA-approved devices**

- Type II Endoleak 55%
- Type III Endoleak 10%
- Type I Endoleak 23%
- Limb kink and iliac occlusive disease 5%
- Other 7%

**Trial devices**

- Type II Endoleak 48%
- Type I Endoleak 8%
- Type III Endoleak 5%
- Limb kink and iliac occlusive disease 34%
- Other 5%

Type of reintervention for trial and FDA-approved device

<table>
<thead>
<tr>
<th>Type of Reintervention</th>
<th>Trial device (%)</th>
<th>FDA-approved device (%)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Translumbar embolization</td>
<td>34.21</td>
<td>38.38</td>
<td>0.763</td>
</tr>
<tr>
<td>Explant and open repair</td>
<td>13.16</td>
<td>13.13</td>
<td>0.986</td>
</tr>
<tr>
<td>Iliac angioplasty and/or stenting</td>
<td>26.32</td>
<td>7.07</td>
<td>0.001</td>
</tr>
<tr>
<td>Distal extension</td>
<td>10.53</td>
<td>16.16</td>
<td>0.444</td>
</tr>
<tr>
<td>Proximal extension</td>
<td>2.63</td>
<td>10.1</td>
<td>0.157</td>
</tr>
<tr>
<td>Arterial embolization</td>
<td>2.63</td>
<td>7.07</td>
<td>0.343</td>
</tr>
<tr>
<td>TEVAR</td>
<td>2.63</td>
<td>1.01</td>
<td>0.458</td>
</tr>
<tr>
<td>Embolectomy</td>
<td>2.63</td>
<td>1.01</td>
<td>0.458</td>
</tr>
<tr>
<td>Fem-fem only</td>
<td>5.26</td>
<td>1.01</td>
<td>0.113</td>
</tr>
<tr>
<td>AUI stent only</td>
<td></td>
<td>2.02</td>
<td></td>
</tr>
<tr>
<td>AUI stent and fem-fem</td>
<td></td>
<td>2.03</td>
<td></td>
</tr>
</tbody>
</table>
Reinterventions: need for explant

- The number of reinterventions was significantly associated with the need for explant (OR=1.86, 95% CI 1.17, 2.96, p=0.009)
- Trial device, etiology of reintervention, and type of reintervention were not predictive of the need for explant

Kaplan-Meier analysis, mortality

- Freedom from all cause mortality did not differ based on study cohort or need for explant
Conclusions

- Long term consistent total aortic surveillance remains essential to identify long term EVAR failures before rupture.
- An array of successful endovascular solutions eliminate the need for surgical conversion and explant in most instances.
- Re-interventions are less likely when the IFU guidelines are adhered to.
- Given the excellent short and long-term results of ZFEN in our practice at UPENN, we are more likely to move into a fenestrated design, rather than challenge the IFU with an infrarenal EVAR.
- Recent FDA approval of the Endurant stent graft to treat AAA with neck lengths down to 4 mm using the Heli-FX EndoAnchor system may change our algorithm.

Changing Spectrums Of Re-interventions After TEVAR With Different Evolving Commercial Devices
Background: Challenges of analyzing TEVAR Outcomes in regard to re-interventions

- Heterogenous patient populations
- Expanding indications for diverse thoracic aortic pathologies: Degenerative DTA Vs PAU Vs TBAD Vs BTAI
- Elective Vs Emergency indications: Acute Vs Chronic pathologies
- Changes in device iterations / technology over time
  - Lower profile → less peripheral vascular complications
  - Improved conformability → less Type I endoleaks
- What has we learned from 2017 published literature in the JVS?

Pathology-specific secondary aortic interventions after thoracic endovascular aortic repair
Salvatore T. Scali, MD, Adam W. Beck, MD, Khayree Butler, MD, Robert J. Feezor, MD, Tomas D. Martin, MD, Phillip J. Hess, MD, Thomas S. Huber, MD, PhD, Catherine K. Chang, MD
Journal of Vascular Surgery
Volume 59, Issue 3, Pages 599-607 (March 2014)
DOI: 10.1016/j.jvs.2013.09.050
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Journal of Vascular Surgery
Volume 59, Issue 3, Pages 599-607 (March 2014)
DOI: 10.1016/j.jvs.2013.09.050

SAI did not negatively affect long-term survival, aortic pathology did!

- TEVAR for TBAD does not prevent aneurysmal degeneration of the thoracic or abdominal aorta
- Aneurysmal degeneration occurred irrespective of acute or chronic indications
- Questions the appropriateness of TEVAR for uncomplicated TBAD
- Emphasizes the need for reporting standards
VES16. Study to Assess Outcomes for Multiple TEVAR Pathologies (SUMMIT) Registry
Nikolaos Tsilimparis, E. Sebastian Debus, Min Chen, Qing Zhou, Mary-Margaret Seale, Tilo Kölbl
Journal of Vascular Surgery
Volume 65, Issue 6, Pages 12S-13S (June 2017)
DOI: 10.1016/j.jvs.2017.03.026

- The SUMMIT registry includes aggregated data of 521 TEVAR patients from five prospective, multicenter trials evaluating thoracic endografts of the Zenith platform
- Acute and nonacute TBAD are associated with a higher risk for re-intervention compared to BTAI, DTAA, and PAU.
- Case complexity predictive of re-interventions
  - Intraop contrast
  - Blood transfusion

Long-term results of endovascular repair for descending thoracic aortic aneurysms
David N. Ranney, MD, Morgan L. Cox, MD, Babatunde A. Yerokun, MD, Ehsan Benrashid, MD, Richard L. McCane, MD, G. Chad Hughes, MD
Journal of Vascular Surgery
DOI: 10.1016/j.jvs.2017.06.094

- Single center series (192 patients) of TEVAR for DTAA (non-syndromic) with adherence to the IFU
- Mean follow-up of 69 ± 44 months
- Endovascular re-intervention in 14 patients (7.3%) for Types I, II, and III endoleak – all resolved.
- No open re-interventions required
- Late TEVAR durability (12 years) established for DTAA
- Outcomes not device related
Initial and midterm results of the Bolton Relay Thoracic Aortic
Endovascular Pivotal Trial

Mark A. Farber, MD, W. Anthony Lee, MD, Wilson Y. Szeto, MD, Jean M. Panneton, MD, Christopher J. Kwolek, MD

Journal of Vascular Surgery
Volume 65, Issue 6, Pages 1556-1566.e1 (June 2017)
DOI: 10.1016/j.jvs.2016.11.061

- 5 year outcomes for DTAA
- Secondary procedures were performed in 10 patients (7.5%), with seven procedures to correct Ia endoleak and one surgical conversion

Results of the VALOR II trial of the Medtronic Valiant Thoracic Stent Graft

Mark F. Conrad, MD, MMSc, James Tuchek, MD, Robert Freezor, MD, Joseph Bavaria, MD, Rodney White, MD, Ronald Fairman, MD

Journal of Vascular Surgery
Volume 66, Issue 2, Pages 335-342 (August 2017)
DOI: 10.1016/j.jvs.2016.12.136

- 5 year outcomes for DTAA
- Re-intervention rate 7% (11 patients) with 9 procedures for type I endoleak, 3 for aneurysm expansion, and 1 for rupture.
- Average time to re-intervention was 900 days; all but one were performed after at least one year follow-up.
VALOR I Vs VALOR II trials for DTAA: 

**TALENT Vs VALIANT devices**

**Endoleak Primary Reason for Secondary Procedures in Both Trials**

- **VALOR I**: 21 of 25 secondary procedures (84%) attributable to endoleak (any type)
- **VALOR II**: 5 of 8 secondary procedures (63%) attributable to endoleak (any type)

### Chart

- **RUPTURE**: 0.0% VALOR I, 25.0% VALOR II
- **SAC GROWTH**: 12.0% VALOR I, 37.5% VALOR II
- **MIGRATION**: 4.0% VALOR I, 0.0% VALOR II
- **ENDOLEAK**: 84.0% VALOR I, 62.5% VALOR II

---

**Type I Endoleaks Most Frequently Led to Secondary Procedure in Both Trials**

- **VALOR I**: 12 of 21 (57%)
- **VALOR II**: 4 of 5 (80%)

### Chart

<table>
<thead>
<tr>
<th>Endoleak Type</th>
<th>VALOR I</th>
<th>VALOR II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type IA</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Type IB</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Type II</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Type III</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Type IV</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Type Not Specified</td>
<td>0</td>
<td>5</td>
</tr>
</tbody>
</table>
Incidence of all type Endoleaks Over 3 Years

- Total endoleak incidence (all types) through 3 years; VALOR I vs VALOR II

<table>
<thead>
<tr>
<th>Test Arm</th>
<th>VALOR I</th>
<th>VALOR II</th>
<th>VALOR I</th>
<th>VALOR II</th>
<th>VALOR I</th>
<th>VALOR II</th>
<th>VALOR I</th>
<th>VALOR II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Through 1-month</td>
<td>16.4%</td>
<td>17.9%</td>
<td>17.7%</td>
<td>*6.7%</td>
<td>*12.0%</td>
<td>*4.3%</td>
<td>*14.7%</td>
<td>*3.6%</td>
</tr>
</tbody>
</table>

Freedom from Secondary Procedures
VALOR I (3 year) and VALOR II (3 year)

\[ P = 0.03 \]
Composite-Freedom (Secondary Procedures, Surgical Conversions, and Ruptures): VALOR I vs VALOR II

- VALOR I
- VALOR II

Conclusions based on 2017 published JVS literature:

- Evolving commercial devices have the potential for reduced re-intervention rates for DTAA pathology:
  - Most dramatic improvements have occurred in first year
  - Endoleak (Type I) remains primary reason for re-intervention following TEVAR.
  - Lower profile devices and improved conformability may explain reduced re-intervention rates following TEVAR for DTAA.

- Current device technology continues to yield higher re-intervention rates for acute and non-acute TBAD than DTAA, BTAI, and PAU; indicating the need for further evolution in pathology driven commercial technology.
Penn Experience with TEVAR Re-intervention  
(Szeto, Desai, Fairman, Bavaria JTCVS 2014)

680 TEVAR patients, 80 Re-interventions in 77 patients

<table>
<thead>
<tr>
<th>Patient demographics</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>At index TEVAR</td>
<td></td>
</tr>
<tr>
<td>Age (y)</td>
<td>68 ± 13</td>
</tr>
<tr>
<td>Aortic pathologic features</td>
<td>680</td>
</tr>
<tr>
<td>Descending thoracic aortic aneurysm</td>
<td>381 (56%)</td>
</tr>
<tr>
<td>Type A dissection repair with FET</td>
<td>52 (8%)</td>
</tr>
<tr>
<td>Acute type B dissection</td>
<td>77 (11%)</td>
</tr>
<tr>
<td>Chronic type B dissection</td>
<td>34 (5%)</td>
</tr>
<tr>
<td>Arch hybrid repairs</td>
<td>46 (7%)</td>
</tr>
<tr>
<td>Traumatic transection</td>
<td>37 (5%)</td>
</tr>
<tr>
<td>Infection (mycotic, A-B-E fistula)</td>
<td>10 (1%)</td>
</tr>
<tr>
<td>Penetrating atherosclerotic ulcers</td>
<td>25 (4%)</td>
</tr>
<tr>
<td>Other</td>
<td>18 (3%)</td>
</tr>
</tbody>
</table>

Reintervention Rate by Type of Index Procedure

<table>
<thead>
<tr>
<th>Index pathologic indication for TEVAR</th>
<th>Reintervention rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All causes</td>
<td>80/680 (11.7%)</td>
</tr>
<tr>
<td>Descending thoracic aneurysm</td>
<td>46/381 (12%)</td>
</tr>
<tr>
<td>Type A dissection</td>
<td>13/52 (25%)</td>
</tr>
<tr>
<td>Acute type B dissection</td>
<td>11/77 (14%)</td>
</tr>
<tr>
<td>Chronic type B dissection</td>
<td>4/34 (12%)</td>
</tr>
<tr>
<td>Arch hybrid</td>
<td>1/46 (2%)</td>
</tr>
<tr>
<td>Traumatic transaction</td>
<td>2/37 (5%)</td>
</tr>
<tr>
<td>Infection (mycotic, A-B-E fistula)</td>
<td>2/10 (20%)</td>
</tr>
<tr>
<td>PAU</td>
<td>0/25 (0%)</td>
</tr>
<tr>
<td>Other</td>
<td>1/18 (6%)</td>
</tr>
</tbody>
</table>
Reason for Re-Intervention (80/680)

Modes of failure

<table>
<thead>
<tr>
<th>Failure Type</th>
<th>Count (Percentage)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Endoleak</td>
<td>45 (56%)</td>
</tr>
<tr>
<td>Type I</td>
<td>24</td>
</tr>
<tr>
<td>Type II</td>
<td>5</td>
</tr>
<tr>
<td>Type III</td>
<td>9</td>
</tr>
<tr>
<td>Multiple or unclear origin</td>
<td>7</td>
</tr>
<tr>
<td>Proximal aortic events</td>
<td>11 (14%)</td>
</tr>
<tr>
<td>Retrograde type A dissection</td>
<td>9</td>
</tr>
<tr>
<td>Aneurysmal degeneration</td>
<td>2</td>
</tr>
<tr>
<td>Distal aortic events (dissection/expansion)</td>
<td>15 (18%)</td>
</tr>
<tr>
<td>Multiple failure modes</td>
<td>4 (5%)</td>
</tr>
<tr>
<td>Endograft infection</td>
<td>3 (4%)</td>
</tr>
<tr>
<td>Other (carotid occlusion, stent collapse)</td>
<td>2 (3%)</td>
</tr>
</tbody>
</table>

Re-Interventions

1. **Endovascular TEVAR (n=55)**
   - 52 adjunct TEVAR
   - 1 aortic bare metal stent
   - 1 TEVAR LCC “Snorkle” endograft
   - 1 TEVAR with additional amplatz to LSC, simultaneous EVAR

2. **Open repair (n=18) 22%**
   - 16 open re-operations incorporating new or prior stent graft
   - 9 Retrograde Type A Repairs (hemi or total arch sewn to stent)
   - 1 Arch Debranching w/ Additional TEVAR
   - 1 Total Arch replacement sewn to stent graft
   - 3 Visceral artery Debranchings w/ new TEVAR graft
   - 2 Distal TAAA w/ dacron graft sewn to previous stent graft

3. **Other (n=7)**
   - 1 Amplatz device
   - 3 Branch artery coil embolization
   - 2 Re-balloon ed TEVAR graft
   - 1 ascending aorta to Left Common Carotid bypass
## Outcomes By Open Vs Endo Reintervention

<table>
<thead>
<tr>
<th>Complication</th>
<th>Total (n = 80)</th>
<th>Open (n = 20)</th>
<th>Endovascular (n = 60)</th>
<th>P value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>30-d Mortality</td>
<td>7 (8.7%)</td>
<td>3 (15%)</td>
<td>4 (6.7%)</td>
<td>.35</td>
</tr>
<tr>
<td>Reoperation for bleeding</td>
<td>2 (2.5%)</td>
<td>1 (5%)</td>
<td>1 (1.7%)</td>
<td>.43</td>
</tr>
<tr>
<td>Permanent paraplegia/paraparesis</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td></td>
</tr>
<tr>
<td>Temporary paraplegia/paraparesis</td>
<td>2 (2.5%)</td>
<td>0 (0%)</td>
<td>2 (3.3%)</td>
<td>1</td>
</tr>
<tr>
<td>Stroke</td>
<td>1 (1.3%)</td>
<td>0 (0%)</td>
<td>1 (1.7%)</td>
<td>1</td>
</tr>
<tr>
<td>Renal failure</td>
<td>7 (8.7%)</td>
<td>3 (15%)</td>
<td>4 (6.7%)</td>
<td>.35</td>
</tr>
<tr>
<td>Renal failure requiring dialysis</td>
<td>4 (5%)</td>
<td>3 (15%)</td>
<td>1 (1.7%)</td>
<td>.04</td>
</tr>
</tbody>
</table>

### Overall Survival

- **P = .29 No statistical difference**

- **Cum Survival**
  - N at risk: 80, 59, 41, 31, 17, 1, 1
  - Years: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9
Conclusions

- Re-intervention after TEVAR is not uncommon (11% in our series)
- Does not negatively impact on long term survival.

- Although most secondary interventions will be endovascular, a variety of open techniques will be indicated for definitive repair.
  - Stent graft incorporation
  - Stent graft explant