Predictors of abdominal aortic aneurysm sac enlargement after EVAR – Longterm results from the ENGAGE Registry

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Disclosure

Speaker name: Dittmar Böckler

I have the following potential conflicts of interest to report:

- Consulting
- Employment in industry
- Stockholder of a healthcare company
- Owner of a healthcare company
- Other(s)
- I do not have any potential conflict of interest
Predictors of Abdominal Aortic Aneurysm Sac Enlargement After Endovascular Repair

Andres Schanzer, MD; Roy K. Greenberg, MD; Nathaniel Hevshone, MPH; William P. Robinson, MD; Mohammad H. Ei, MD; Robert J. Goldberg, PhD; Luis Mosain, MD

Background—The majority of abdominal aortic aneurysm (AAA) repairs in the United States are performed with endovascular methods. Baseline anatomic and imaging characteristics are fundamental criteria for appropriate patient selection for endovascular repair (EVAR) and key determinants of long-term success. We evaluated compliance with anatomic guidelines for EVAR and the relationship between baseline anatomic criteria, anatomic and post-EVAR AAA sac enlargement, and patient outcomes.

Methods and Results—Patients with pre-EVAR and at least 1 post-EVAR computed tomography scan were included from the MEE, Inc. imaging database (1999 to 2008). Baseline anatomic and imaging characteristics were available for each patient. Data relating to the specific AAA endovascular device implanted were not available. Therefore, morphologic measurements were compared with the most liberal and the most conservative published anatomic guidelines as issued in each manufacturer’s instructions for use. The primary study outcome was post-EVAR AAA sac enlargement (>5 mm diameter increase). In 10,228 patients undergoing EVAR, 529 had a maximum AAA diameter below the 55-mm threshold at which intervention is recommended. Only 45% of patients had anatomy that met the most conservative definition of device instructions for cure (99%) and the most liberal definition of device instructions for use. The 3-year post-EVAR rate of AAA sac enlargement was 41%. Independent predictors of post-EVAR AAA sac enlargement included history of smoking, age ≥ 50 years, initial AAA diameter ≥ 55 mm, and common iliac artery diameter ≥ 20 mm.

Conclusions—In this multicenter observational study, compliance with EVAR device guidelines was low and post-EVAR aneurysm sac enlargement was high, raising concern for long-term risk of aneurysm rupture. (Circulation 2011;123:2464-2470.)

Key Words: abdominal aortic aneurysm • endovascular procedure •}

• Published in 2011 in Circulation
• Primary outcome: post-EVAR AAA sac enlargement > 5mm diameter increase
• Only 42 % had anatomy for conservative IFU
• 69 % met the most liberal definition of IFU
• 59 % had max. AAA diameter below 55 mm
• 5 - year post EVAR rate of AAA sac enlargement was 41%

The Current Benchmark?
AAA Sac Increase Through 5 Years

Freedom From Enlargement - Conservative Instructions for Use

logrank: $p < 0.001$

Figure 2-A and Figure 2B from “Predictors of Abdominal Aortic Aneurysm Sac Enlargement After Endovascular Repair”. Schanzer et al. Circulation. 2011.
AAA Sac Increase Through 5 Years

Freedom From Enlargement - Liberal Instructions for Use

logrank: p <0.001

Figure 2-A and Figure 2B from “Predictors of Abdominal Aortic Aneurysm Sac Enlargement After Endovascular Repair”. Schanzer et al. Circulation. 2011.
AAA Sac Increase Through 5 Years

Freedom From Enlargement - Year of Procedure

Figure 2B from “Predictors of Abdominal Aortic Aneurysm Sac Enlargement After Endovascular Repair”. Schanzer et al. Circulation. 2011.

logrank: p <0.001
Devices Available in M2S Database

Table 1 from "Predictors of Abdominal Aortic Aneurysm Sac Enlargement After Endovascular Repair" . Schanzer et al. Circulation. 2011.

<table>
<thead>
<tr>
<th>Year of release</th>
<th>Guidant Ancure</th>
<th>Medtronic AneuRX</th>
<th>Gore Excluder</th>
<th>Cook Zenith</th>
<th>Gore Excluder Low Permeability</th>
<th>Endologix Powerlink</th>
<th>Cook Zenith Enlarged Neck</th>
<th>Medtronic Talent</th>
<th>Endologix Enlarged Neck</th>
<th>Gore Excluder Enlarged Neck</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neck length, mm</td>
<td>≥15</td>
<td>≥10*</td>
<td>≥15</td>
<td>≥10</td>
<td>≥15</td>
<td>≥10</td>
<td>≥15</td>
<td>≥15</td>
<td>≥15</td>
<td>≥15</td>
</tr>
<tr>
<td>Neck angle, °</td>
<td>NS</td>
<td>≤45</td>
<td>≤60</td>
<td>≤60</td>
<td>≤60</td>
<td>≤60</td>
<td>≤60</td>
<td>≤60</td>
<td>≤60</td>
<td>≤60</td>
</tr>
<tr>
<td>Iliac fixation length, mm</td>
<td>≥20</td>
<td>NS</td>
<td>≥10</td>
<td>≥15</td>
<td>≥15</td>
<td>≥15</td>
<td>≥15</td>
<td>≥15</td>
<td>≥15</td>
<td>≥10</td>
</tr>
<tr>
<td>Iliac diameter, mm</td>
<td>&lt;13.5</td>
<td>NS</td>
<td>10–18.5</td>
<td>15</td>
<td>10–20</td>
<td>8–22</td>
<td>10–23</td>
<td>10–18.5</td>
<td>10–18.5</td>
<td>10–18.5</td>
</tr>
</tbody>
</table>

First and second generation devices >> off the market
Does contemporary EVAR practice demonstrate similar increases in AAA sac diameter over time?
Or: Is there a New Benchmark?

How much have EVAR results improved over the last years?

Are EVAR results more durable with new generation stent grafts?
ENGAGE Registry

ENDURANT STENT GRAFT NATURAL SELECTION
GLOBAL POST-MARKET REGISTRY

Designed for Consecutive Enrollment

Follow-up:
30-day, Annual Visits Through 10 Years

100% Data Management Review

Extensive On-going Monitoring

Independent Clinical Event Committee
Adjudicates all 30-day MAE and all deaths

High Quality Data
Are ENGAGE Data relevant and comparable?
Study Design of “THE SCHANZER PAPER”

- AAA imaging database included IDE and non-IDE patients; non-consecutive enrollment
- Multicenter retrospective review of 10,228 US patients
- Enrollment period: September 1999 – August 2004
- Patients required to have at least 1 FU CT
- Follow-up: 31 ± 18 months
- Multiple 1st generation endografts used
- Imaging data were assessed; clinical outcome data not collected
Study Design of the ENGAGE Registry

- Real world “all comer” registry
- Multicenter prospective enrollment of patients
- 1263 patients consecutively enrolled (2009-2011)
- Follow-up: 30-day, annual visits through 10 years
- Single 4th generation device Endurant (Medtronic)
- Extensive monitoring on-going
- Independent Clinical Event Committee
- High quality data management processes and procedures
LIMITATIONS IN COMPARISON

**Schanzer et al.**
- First generation devices utilized
- Required patients to undergo at least 1 CT study after EVAR; excluded patients who underwent other imaging modality
- Data from M2S is not a consecutive, observational series
- Selection bias potential as M2S imaging services more likely to be used on higher risk patients vs. all comers

**ENGAGE**
- Single device (Endurant) utilized
- may be considered “liberal” IFU (within-IFU: prox. necks ≥10mm)
<table>
<thead>
<tr>
<th></th>
<th>Schanzer et al</th>
<th>ENGAGE Within-IFU</th>
<th>ENGAGE Outside-IFU</th>
<th>P-value of ENGAGE data</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>N</strong></td>
<td>10,228 pts</td>
<td>1038 pts</td>
<td>225 pts</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td><strong>% Male</strong></td>
<td>84.1%</td>
<td>91.3%</td>
<td>80.9%</td>
<td></td>
</tr>
<tr>
<td><strong>Age (Mean±SD) (years)</strong></td>
<td>73.9 years</td>
<td>73.0 ±8.2 years</td>
<td>73.3 ±7.7 years</td>
<td>0.660</td>
</tr>
<tr>
<td><strong>Implant Geography</strong></td>
<td>Real-practice</td>
<td>Real-practice</td>
<td>Real-practice</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>US</td>
<td>Worldwide</td>
<td>Worldwide</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Excluding US)</td>
<td>(Excluding US)</td>
<td></td>
</tr>
<tr>
<td><strong>% of pts implanted</strong></td>
<td>31.1 - 58.5%</td>
<td>NA</td>
<td>17.8%</td>
<td>NA</td>
</tr>
<tr>
<td><strong>outside of IFU</strong></td>
<td></td>
<td></td>
<td>of total ENGAGE</td>
<td></td>
</tr>
</tbody>
</table>
Comparison of Results- AAA Anatomy

<table>
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<th>P-value of ENGAGE data</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAA Max Diam. in mm</td>
<td>54.8mm</td>
<td>60.2±11.0mm</td>
<td>60.7±14.5mm</td>
<td>0.675</td>
</tr>
<tr>
<td>(mean±SD)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prox. Neck Length</td>
<td>20.7mm</td>
<td>27.4 ± 11.7mm</td>
<td>24.9 ± 15.3mm</td>
<td>0.025</td>
</tr>
<tr>
<td>in mm</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(mean±SD)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AAA Prox. Neck Angle</td>
<td>36.9°</td>
<td>26.9 ± 19.9°</td>
<td>46.5 ± 32.3°</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>In degrees ° (infrarenal)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Mean±SD)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Comparison of Final Endpoint

<table>
<thead>
<tr>
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<th>ENGAGE Within-IFU</th>
<th>ENGAGE Outside-IFU</th>
<th>P-value of ENGAGE data</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AAA Sac Enlargement</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Through 1 year</td>
<td>3%</td>
<td>3.2% (25/791)</td>
<td>5.7% (9/158)</td>
<td>0.1550</td>
</tr>
<tr>
<td>Through 3 year</td>
<td>17%</td>
<td>7.9% (44/555)</td>
<td>13.6% (14/103)</td>
<td>0.0860</td>
</tr>
<tr>
<td>Through 5 year</td>
<td>41%</td>
<td>9.2% (39/422)</td>
<td>18.6% (13/70)</td>
<td>0.0330</td>
</tr>
</tbody>
</table>
AAA Sac Increase Through 5 Years – Conservative IFU Use

Schanzer et al. AAA Sac Increase – Conservative IFU Through 5 years
AAA Sac Increase Through 5 Years – Conservative IFU USE

![Graph showing comparison of AAA Sac Increase with different IFU USEs]

- Inside IFU—ENGAGE
- Outside IFU—ENGAGE
- Inside conservative IFU—Schanzer et al. (2011)
- Outside conservative IFU—Schanzer et al. (2011)

Schanzer- AAA Sac Increase - Conservative IFU vs ENGAGE AAA Sac Increase Through 5yrs
AAA Sac Increase Through 5 Years – liberal IFU use

Schanzer et Al. AAA Sac Increase - Liberal IFU Through 5 years
AAA Sac Increase Through 5 Years – liberal IFU use

Schanzer et al. AAA Sac Increase - Liberal IFU vs ENGAGE AAA Sac Increase through 5 yrs
AAA Sac Increase Through 5 Years – time after Index Proc.

Schanzer et al. AAA Sac Increase - Time Dependent Through 5 years
AAA Sac Increase Through 5 Years – time dependent

Schanzer et Al. AAA Sac Increase - Time Dependent vs ENGAGE Through 5 years
AAA Sac Increase Through 5 Years – time dependent

Schanzer et Al. AAA Sac Increase - Time Dependent vs ENGAGE Through 5 years
Summary

• In ENGAGE, patients were treated both within IFU and outside IFU

• Baseline anatomical characteristics were similar between M2S dataset (Schanzer et al) and ENGAGE

• Schanzer et al: 41% AAA sac enlargement through 5 years

• ENGAGE: 9.2% AAA sac enlargement in patients “within-IFU” and 18.6% sac enlargement in patients “outside-IFU” through 5 years
Conclusions

• AAA sac enlargement can still occur, continued surveillance is key

• ENGAGE demonstrates a much lower AAA sac enlargement through 5 years

• 41% of sac enlargement (Schanzer) may be overestimated as patients doing well may not have undergone additional CT and thus could have been missed

• The” oft-quoted Schanzer Paper” involved devices & techniques of the early days of EVAR

• Specific predictors need to be determined
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