Influence of Surgeon Experience on Patient Selection and Outcomes after Open AAA Repair

Dean J. Arnaoutakis, Kristina A. Giles, Adam W. Beck, David H. Stone, Philip P. Goodney, Thomas S. Huber, and Salvatore T. Scali

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Division of Vascular & Endovascular Surgery
University of Florida College of Medicine
Gainesville, Florida
Disclosures

• None
Impact of surgeon experience on outcomes after open AAA repair is poorly understood
  – No large national study examining this relationship

Current SVS guidelines advocate minimum annual case volumes
  – Impacted regionalization of care, referral patterns, and reimbursement
Patient selection and outcomes affected by differences in:

- Training era
- Evolution in technology
- Accrued experience
  - Technical skills
  - Procedure efficiency
  - Cognitive skills
- Institutional support/experience
Objective

• Explore influence of surgeon experience on case selection and outcomes after open AAA repair using national quality registry
Study Design

• Queried SVS-VQI database

• All open infrarenal AAA repairs from 2012-2017
  – Elective and non-elective

• Surgeon experience stratified by years in practice after training
  – ≤5 years
  – 6-10 years
  – 11-15 years
  – ≥16 years
Study End-points

• Major complications

• In-hospital mortality

• 1-year mortality
Statistical Methods

• Inter-group comparisons
  – Baseline characteristics and short-term outcomes
    • Wilcoxon rank sum, Pearson $X^2$

• Logistic regression for major complications and 1-year mortality
Outcomes

Open AAA Repairs (n=10,781)

Stratified by years of experience

- ≤5 years (n=1,480)
  - Elective (n=924)
  - Non-elective (n=556)

- 5-10 years (n=1,694)
  - Elective (n=1,176)
  - Non-elective (n=518)

- 11-15 years (n=1,670)
  - Elective (n=1,155)
  - Non-elective (n=515)

- ≥16 years (n=5,937)
  - Elective (n=4,357)
  - Non-elective (n=1,580)
## Preoperative Characteristics

<table>
<thead>
<tr>
<th>Feature, No. (%)</th>
<th>All Open AAA Repair (n=10,781)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean years (SD)</td>
<td>69.9(9)</td>
</tr>
<tr>
<td>Male</td>
<td>7979(74)</td>
</tr>
<tr>
<td>Non-White</td>
<td>994(9)</td>
</tr>
<tr>
<td>Any Smoking</td>
<td>9585(88)</td>
</tr>
<tr>
<td>ASA score ≥ 3</td>
<td>9148(84)</td>
</tr>
<tr>
<td>Hypertension</td>
<td>8935(82)</td>
</tr>
<tr>
<td>Chronic pulmonary disease</td>
<td>3585(33)</td>
</tr>
<tr>
<td>Coronary disease</td>
<td>2815(26)</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>1721(16)</td>
</tr>
<tr>
<td>Chronic renal disease (Cr &gt;1.8)</td>
<td>743(7)</td>
</tr>
</tbody>
</table>
## Preoperative Characteristics

<table>
<thead>
<tr>
<th>Feature, No.(%)</th>
<th>≤5 yrs (n=1480)</th>
<th>6-10 yrs (n=1694)</th>
<th>11-15 yrs (n=1670)</th>
<th>≥16 yrs (n=5937)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age, mean years (SD)</strong></td>
<td>69.7(9)</td>
<td>69.4(9)</td>
<td>69.5(9)</td>
<td>70.2(9)</td>
<td><strong>.03</strong></td>
</tr>
<tr>
<td>Male</td>
<td>1114(75)</td>
<td>1223(72)</td>
<td>1279(77)</td>
<td>4363(74)</td>
<td>.93</td>
</tr>
<tr>
<td>Non-White</td>
<td>183(12)</td>
<td>140(8)</td>
<td>164(10)</td>
<td>499(8)</td>
<td><strong>.0004</strong></td>
</tr>
<tr>
<td>Any Smoking</td>
<td>1307(89)</td>
<td>1509(90)</td>
<td>1490(90)</td>
<td>5279(89)</td>
<td>.84</td>
</tr>
<tr>
<td>ASA score ≥ 3</td>
<td>1231(95)</td>
<td>1449(97)</td>
<td>1379(96)</td>
<td>5089(95)</td>
<td>.59</td>
</tr>
<tr>
<td>Hypertension</td>
<td>1227(83)</td>
<td>1392(83)</td>
<td>1373(83)</td>
<td>4943(84)</td>
<td>.85</td>
</tr>
<tr>
<td>Chronic pulmonary disease</td>
<td>493(34)</td>
<td>524(31)</td>
<td>569(34)</td>
<td>1999(34)</td>
<td>.50</td>
</tr>
<tr>
<td>Congestive heart failure</td>
<td>116(8)</td>
<td>148(9)</td>
<td>141(9)</td>
<td>464(8)</td>
<td>.77</td>
</tr>
<tr>
<td>Coronary disease</td>
<td>367(25)</td>
<td>417(25)</td>
<td>457(28)</td>
<td>1574(27)</td>
<td><strong>.04</strong></td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>231(16)</td>
<td>247(15)</td>
<td>263(16)</td>
<td>980(17)</td>
<td>.52</td>
</tr>
<tr>
<td>Chronic renal disease (Cr &gt;1.8)</td>
<td>105(7)</td>
<td>116(7)</td>
<td>100(6)</td>
<td>422(7)</td>
<td>.58</td>
</tr>
<tr>
<td>Prior aneurysm repair</td>
<td>151(10)</td>
<td>163(10)</td>
<td>134(8)</td>
<td>563(10)</td>
<td>.16</td>
</tr>
<tr>
<td>Preoperative aspirin</td>
<td>857(59)</td>
<td>1052(63)</td>
<td>1014(61)</td>
<td>3569(60)</td>
<td>.95</td>
</tr>
<tr>
<td>Preoperative statin</td>
<td>876(60)</td>
<td>1061(63)</td>
<td>1048(63)</td>
<td>3909(66)</td>
<td><strong>.02</strong></td>
</tr>
</tbody>
</table>
## Presentation Status

<table>
<thead>
<tr>
<th>Feature, No. (%)</th>
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<th>≥16 yrs (n=5937)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAA diameter, mm (SD)</td>
<td>66.5(19)</td>
<td>64.2(17)</td>
<td>64.2(17)</td>
<td>62.9(17)</td>
<td>.002</td>
</tr>
<tr>
<td>Non-elective</td>
<td>556(38)</td>
<td>518(31)</td>
<td>515(31)</td>
<td>1580(27)</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Hospital-to-hospital transfer</td>
<td>348(24)</td>
<td>309(18)</td>
<td>313(19)</td>
<td>932(16)</td>
<td>.03</td>
</tr>
<tr>
<td>Non-ambulatory</td>
<td>14(1)</td>
<td>13(1)</td>
<td>12(1)</td>
<td>45(1)</td>
<td>.99</td>
</tr>
<tr>
<td>Nursing home</td>
<td>13(1)</td>
<td>13(1)</td>
<td>17(1)</td>
<td>46(1)</td>
<td>.35</td>
</tr>
</tbody>
</table>
Postoperative Complications

**Respiratory Failure**

- Elective
- Non-elective

**Renal Failure**

- Elective
- Non-elective

**Myocardial Infarction**

- Elective
- Non-elective

**Return to OR for Bleeding**

- Elective
- Non-elective
Postoperative Complications

Major Complication (composite)

- Elective
- Non-elective

- <5 yrs: $p<.0001$
- 6-10 yrs: $p=.31$
- 11-15 yrs: $p<.0001$
- >16 yrs

Percent (%)
In-hospital Mortality

- Elective
- Non-elective

p = 0.001
p = 0.15
1-year Mortality

- For <5 yrs, the mortality rate is approximately 35% for both elective and non-elective cases.
- For 6-10 yrs, the mortality rate is around 30% for elective cases and slightly higher for non-elective cases.
- For 11-15 yrs, the mortality rate increases to around 35% for both categories.
- For >16 yrs, the mortality rate is slightly lower, around 30% for elective and non-elective cases.

The p-values for the difference between elective and non-elective cases are .17 for both age groups, indicating no statistically significant difference.
Major Complication: risk-adjusted comparisons

<table>
<thead>
<tr>
<th>Predictor</th>
<th>OR</th>
<th>95% CI</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Years Experience</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤5 yrs</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>6-10 yrs</td>
<td>0.84</td>
<td>0.71-0.99</td>
<td>0.69</td>
</tr>
<tr>
<td>11-15 yrs</td>
<td>0.75</td>
<td>0.63-0.89</td>
<td>0.06</td>
</tr>
<tr>
<td>≥16 yrs</td>
<td>0.73</td>
<td>0.64-0.84</td>
<td>0.001</td>
</tr>
<tr>
<td>Non-elective</td>
<td>4.36</td>
<td>3.63-5.23</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Creatinine &gt;1.8</td>
<td>2.26</td>
<td>1.89-2.69</td>
<td>&lt;.0001</td>
</tr>
</tbody>
</table>

• Additional significant predictors of major complication:
  – Age, Female, Non-white, COPD, CHF, Prior Aortic Surgery, Prior PCI
### 1-year Mortality: risk-adjusted comparisons

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<thead>
<tr>
<th>Predictor</th>
<th>OR</th>
<th>95% CI</th>
<th>P-value</th>
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</thead>
<tbody>
<tr>
<td>Years Experience</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤5 yrs</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>6-10 yrs</td>
<td>0.94</td>
<td>0.74-1.21</td>
<td>0.94</td>
</tr>
<tr>
<td>11-15 yrs</td>
<td>0.88</td>
<td>0.68-1.12</td>
<td>0.36</td>
</tr>
<tr>
<td>≥16 yrs</td>
<td>0.94</td>
<td>0.77-1.14</td>
<td>1.00</td>
</tr>
<tr>
<td>Non-elective</td>
<td>7.51</td>
<td>4.93-11.44</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Creatinine &gt;1.8</td>
<td>2.52</td>
<td>2.05-3.08</td>
<td>&lt;.0001</td>
</tr>
</tbody>
</table>

- Additional significant predictors of 1-year mortality:
  - Age, COPD, CHF, Prior Aortic Surgery, Prior PCI
• All surgeons encounter relatively similar comorbidities

• Increasing surgeon experience significantly associated with performing greater proportion of elective cases

• For elective repair,
  – Complications (except MI) and in-hospital death lower for more experienced surgeons

• For non-elective repair,
  – No difference for aggregate complications nor in-hospital mortality

• Strongest predictors of 1-year survival are non-elective status and CRI
  – Surgeon experience does not impact 1-year survival
Limitations

- Retrospective review
- Limited to 1-year follow-up
- Cannot discern level of experience of assistant surgeon
- Did not control for surgeon or institution volume
Conclusions

• Surgeons within first 5 years of practice:
  – Increased proportion non-elective cases
  – Similar 1-year outcomes

• Surgeons with greater years of experience:
  – Fewer post-operative complications
  – Decreased elective, in-hospital mortality
Conclusions

• Implications
  – Practice integration, organization and mentorship when hiring young surgeons
    • Focusing on elective cases
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