Prediction of major cardiovascular events after lung resection using a modified scoring system

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Major lung resection morbidity

- Mortality: 2%-3%
- A-fib: 10%-15%
- PE: 10%-15%
- MI: 2%-3%
- Pneumonia
- Resp insuff
- ARDS
- Prolonged vent

STS Database 2002-2008
18,800 patients

Cardiovascular Complications

• Associated with
  – Prolonged LOS
  – Greater resource utilization
  – Increased costs of care

• Identification of patients at risk
  – Preoperative evaluation
  – Patient selection for surgery
  – Informed consent
  – Resource utilization
Revised Cardiac Risk Index (RCRI)

- CRI published in 1977
- RCRI published in 1999
  - Only 12% of derivation pool “thoracic”
  - Recent review identified only 6% “thoracic”

- Brunelli and others demonstrated only moderate predictive ability
- Developed thoracic specific index: ThRCRI

Circulation 1999;100:1043-9
## RCRI vs ThRCRI

<table>
<thead>
<tr>
<th>RCRI</th>
<th>ThRCRI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creatinine &gt;2 mg/dL</td>
<td>Creatinine &gt;2 mg/dL</td>
</tr>
<tr>
<td>Cerebrovascular disease</td>
<td>Cerebrovascular disease</td>
</tr>
<tr>
<td>Coronary artery disease</td>
<td>Coronary artery disease</td>
</tr>
<tr>
<td>High risk surgery</td>
<td>Pneumonectomy</td>
</tr>
<tr>
<td>Diabetes requiring insulin</td>
<td></td>
</tr>
<tr>
<td>Congestive heart failure</td>
<td></td>
</tr>
</tbody>
</table>

Circulation 1999;100:1043-9  
## RCRI vs ThRCRI

<table>
<thead>
<tr>
<th>Risk Class</th>
<th>RCRI</th>
<th>ThRCRI</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>-</td>
<td>1.5%</td>
</tr>
<tr>
<td>B</td>
<td>2.3%</td>
<td>5.8%</td>
</tr>
<tr>
<td>C</td>
<td>6%</td>
<td>19%</td>
</tr>
<tr>
<td>D</td>
<td>7.5%</td>
<td>23%</td>
</tr>
<tr>
<td>p value</td>
<td>0.001</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>c index</td>
<td>0.62</td>
<td>0.72</td>
</tr>
</tbody>
</table>
Validation studies

AUC 0.74
Question

• Characteristics of derivation and validation studies
  – Single institution
  – Centers of excellence
  – Relatively small numbers

• How applicable is ThRCRI to a general population of lung resection patients?
Methods

• STS General Thoracic Database 2003-2011
• Elective major lung resection
• Major cardiovascular complications
  – MI
  – ARDS
  – Ventricular arrhythmia
  – In-hospital death
## ThRCRI Scoring

<table>
<thead>
<tr>
<th>Category</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creatinine≥2; dialysis</td>
<td>1</td>
</tr>
<tr>
<td>CAD</td>
<td>1.5</td>
</tr>
<tr>
<td>Cerebrovascular disease</td>
<td>1.5</td>
</tr>
<tr>
<td>Pneumonectomy</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Risk Category</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0</td>
</tr>
<tr>
<td>B</td>
<td>1 - 1.5</td>
</tr>
<tr>
<td>C</td>
<td>2 - 2.5</td>
</tr>
<tr>
<td>D</td>
<td>&gt;2.5</td>
</tr>
</tbody>
</table>
Patients

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>16,216</td>
<td>8,214</td>
<td>261</td>
<td>1,394</td>
<td>26,085</td>
</tr>
<tr>
<td>Percent</td>
<td>62%</td>
<td>32%</td>
<td>1%</td>
<td>5%</td>
<td>100%</td>
</tr>
</tbody>
</table>

• Distribution among risk categories significantly different for:
  – Age, gender
  – BMI, ASA, DM, HTN, induction therapy
Major cardiovascular complications

• Incidence
  – 4.3%
  – 1,125 pts

• ThRCRI score was higher in those with complications
  – 0.6 ± 0.9 with no complications
  – 1.1 ± 1.1 with complications
  – p<0.0001
Incidence by risk category

Risk Category

Percent Affected

A
B
C
D

p value for trend <0.001
Comparative incidence by risk category

Risk Category

Percent Affected

A  B  C  D

Derivation  Validation  Current

p<0.001  p=0.016
Potential shortcomings

• STS Database not fully representative of lung resection practices in US

• Different outcomes definitions compared to derivation study

• No ability to account for concomitant procedures
Summary

• ThRCRI scores are different for patients with and without CV complications
• Risk score categories are predictive of incremental risk
• Overall incidence of complications similar to what is reported by others
Implications

• Low risk patients might be “fast-tracked”
• Higher risk patients might require closer monitoring
• Highest risk patients
  – Additional preoperative evaluation
  – Interventions to mitigate risk
• Informed decision making
Conclusions

• ThRCRI is accurate in predicting the risk of serious cardiovascular complications after major lung resection

• Use of ThRCRI might improve patient selection, resource utilization, and informed consent

• Further evaluation and refinement of the model may improve its predictive accuracy