Defining surgical risk

NCEPOD Presentation
December 9th 2011

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Defining surgical risk

• Challenges from the report “Knowing the Risk”
• Defining risk and allocating care: clinical judgement or objective measurement?
• Understanding the dynamic nature of surgical risk
Challenges from the report

• “The first challenge is to reliably and accurately predict the patient group that is at high-risk of mortality and morbidity………. the literature is full of differing descriptions, scoring systems and tests to meet this aim.

• “the difficulty is that the NHS generally does not seem to be rising to the challenge”
Challenges from the report

• **Pre-assessment**
  • 16% - no anaesthetic clinic
  • 17% - no surgical clinic

• 20% of high-risk elective patients not seen in pre-assessment clinics (with x7 mortality)

• Mortality estimate given in only 7.5% of high-risk cases
Challenges from the report – defining the risk for the individual

- **High-risk procedures**
  - vascular / abdominal / thoracic / emergency

- **High-risk patients**
  - co-morbidities / lack of functional capacity

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Expected Risk</th>
<th>Actual Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elective open aneurysm repair</td>
<td>12%</td>
<td>1.5%</td>
</tr>
<tr>
<td>Elective colorectal resection</td>
<td>4.0%</td>
<td>0.5%</td>
</tr>
</tbody>
</table>
Challenges from the report – defining the risk for the individual

- Clinical judgement
  - Definition?
- Clinical (objective) measurement
  - Utility?
## Co-morbidities

<table>
<thead>
<tr>
<th>Comorbidities</th>
<th>Alive</th>
<th>Deceased</th>
<th>% mortality</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respiratory disease</td>
<td>1743</td>
<td>67</td>
<td>3.7</td>
<td>1810</td>
</tr>
<tr>
<td>Ischaemic heart disease</td>
<td>1402</td>
<td>55</td>
<td>3.8</td>
<td>1457</td>
</tr>
<tr>
<td>Cancer</td>
<td>1363</td>
<td>54</td>
<td>3.8</td>
<td>1417</td>
</tr>
<tr>
<td>Arrhythmia</td>
<td>970</td>
<td>59</td>
<td>5.7</td>
<td>1029</td>
</tr>
<tr>
<td>Diabetes (non insulin)</td>
<td>976</td>
<td>29</td>
<td>2.9</td>
<td>1005</td>
</tr>
<tr>
<td>Transient ischaemic attack (TIA)/Stroke</td>
<td>565</td>
<td>26</td>
<td>4.4</td>
<td>591</td>
</tr>
<tr>
<td>Diabetes (insulin)</td>
<td>370</td>
<td>16</td>
<td>4.1</td>
<td>386</td>
</tr>
<tr>
<td>Congestive cardiac failure</td>
<td>223</td>
<td>20</td>
<td>8.2</td>
<td>243</td>
</tr>
<tr>
<td>Documented cirrhosis</td>
<td>112</td>
<td>11</td>
<td>8.9</td>
<td>123</td>
</tr>
</tbody>
</table>
Impact of heart failure on patients undergoing major noncardiac surgery
Hammill et al. Anesthesiology 2008; 108: 559-67

- 159,327 procedures
- Heart failure: 18%
- Ischaemic heart disease: 34%

<table>
<thead>
<tr>
<th>Operative mortality</th>
<th>Heart failure</th>
<th>IHD</th>
<th>Neither</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart failure</td>
<td>8.0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IHD</td>
<td>3.1%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neither</td>
<td>2.4%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Graph showing operative mortality rates for various procedures with heart failure and other conditions.
Co-morbidities

Figure 3.4 Comorbidities
Co-morbidities

Figure 3.7 Distribution of comorbidities between the high risk and low risk groups
Lee’s cardiac risk index

- Risk of cardiac events only
- No consideration of treatment effect
- No estimate of the effect of disease on functional capacity i.e., ability to perform tasks of daily living
Co-morbidities

Figure 4.3 Anaesthetists view of risk against Lee class
Cardio-pulmonary exercise testing

- Assessment of functional capacity
- Available in ~ 40% of units (NCEPOD 2011)
- ~ 10 min cycle test with increasing workload
- >90% of elderly surgical patients can do the test
Cardio-pulmonary exercise testing

• Anaerobic threshold (AT)
  – Oxygen consumption at the onset of anaerobic metabolism
  – The **lower** the AT, *the less fit the patient*!

• Ventilatory efficiency (VE/VCO$_2$)
  – The effort required to get rid of CO$_2$
  – The **higher** the VE/VCO$_2$, *the less fit the patient!*
Cardio-pulmonary exercise testing – the risks of dying after surgery

• Anaerobic threshold (AT)
  – Less than 11 ml/kg/min: Higher risk
  – Relative risk of hospital death: 6.8 (1.6-29.5)

• Ventilatory efficiency (VE/VCO\(_2\))
  – Greater than 34: Higher risk
  – Relative risk of hospital death: 4.6 (1.4-14.8)
VO2 max and AT values (mean) for NYHA Classes II-IV

<table>
<thead>
<tr>
<th>NYHA Class</th>
<th>VO2 max (ml/kg/min)</th>
<th>AT     (ml/kg/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class II</td>
<td>20.5</td>
<td>15.8</td>
</tr>
<tr>
<td>Class III</td>
<td>12.8</td>
<td>10.7</td>
</tr>
<tr>
<td>Class IV</td>
<td>8.4</td>
<td>7.8</td>
</tr>
</tbody>
</table>
CPET-based risk stratification for elective colo-rectal surgery (680 patients)

<table>
<thead>
<tr>
<th>Risk Level</th>
<th>Anaerobic threshold</th>
<th>Ventilatory efficiency</th>
<th>Number of patients (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>High risk</strong></td>
<td>Higher risk (AT&lt;11)</td>
<td>Higher risk (VE/VCO₂ &gt;34)</td>
<td>223 (33%)</td>
</tr>
<tr>
<td><strong>Medium risk</strong></td>
<td>Higher risk</td>
<td>Lower risk</td>
<td>257 (38%)</td>
</tr>
<tr>
<td></td>
<td>Lower risk</td>
<td>Higher risk</td>
<td></td>
</tr>
<tr>
<td><strong>Low risk</strong></td>
<td>Lower risk</td>
<td>Lower risk</td>
<td>200 (29%)</td>
</tr>
</tbody>
</table>
CPET-based management strategy

Pre-assessment CPET

**Low risk**
(AT / VEVCO₂ normal)
- Intra-op standard care
- PACU Ward

**Medium risk**
(Either AT OR VEVCO₂ abnormal)
- Arterial line
- Intra-op fluid optimisation
- Extended stay PACU
- Level 1 ward bed

**High risk**
(AT / VEVCO₂ abnormal)
- Arterial line
- Intra-op fluid optimisation
- PACU HDU

Elective colo-rectal surgery
CPET-based risk stratification for elective colo-rectal surgery (680 patients)

- Low-risk: 0.5%
- Medium-risk: 1.5%
- High-risk: 4.1%

Hospital mortality (%)

Lee’s-based risk stratification and mortality for elective colo-rectal surgery (680 patients)

- Lees’s Clinical Risk factors present: 3.0%
- Lees’s Clinical Risk factors not present: 1.5%
Lee’s-based risk stratification and mortality for elective colo-rectal surgery (680 patients)

- Lees’s Clinical Risk factors present: 3.0%
  - 211 patients
  - 6 deaths
- Lees’s Clinical Risk factors not present: 1.5%
  - 469 patients
  - 7 deaths
Impaired functional capacity is associated with all-cause mortality after major elective intra-abdominal surgery

Wilson et al. Br J Anaes 2010

<table>
<thead>
<tr>
<th></th>
<th>AT &lt; 11</th>
<th>AT &gt; 11</th>
<th>Relative risk</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Non-survivors</td>
<td>Survivors</td>
<td>Non-survivors</td>
</tr>
<tr>
<td>LCRI</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Present</td>
<td>7</td>
<td>177</td>
<td>1</td>
</tr>
<tr>
<td>Absent</td>
<td>9</td>
<td>264</td>
<td>1</td>
</tr>
</tbody>
</table>
Heart failure or deconditioning?

- 30% of patients have parameters of *reduced functional capacity* on CPET that would put them in a *poor prognosis group* if they had a heart failure diagnosis.
- Most of these 30% do not have a diagnosis of heart failure.
- Whether due to heart failure or deconditioning, *reduced functional capacity matters significantly* when things go wrong after surgery.
The risk of not operating?
Understanding the dynamic nature of surgical risk

Case study 3:
“This case demonstrates the need for all parts of the patient care pathway to participate in optimisation if risk is to be reduced”
Before surgery

During surgery

After surgery

Scoring systems
CPET
Biomarkers

Surgical APGAR score

Physiological measuring:
Lactate
CV O₂ sats%
The surgical APGAR score

- An APGAR score for surgery
- Gawande et al
- J Am Coll Surg 2007;204:201-208
The surgical APGAR score

3.8% patients had a surgical score $\leq 4$ (bad...)
59% had major complications or died within 30 days after surgery
29% patients had a surgical score $\geq 9$ (good...)
4% had major complications or died within 30 days after surgery  RR 16.1 (7.6-34.0)

Table 4. A 10-Point Surgical Outcomes Score*

<table>
<thead>
<tr>
<th></th>
<th>0 points</th>
<th>1 point</th>
<th>2 points</th>
<th>3 points</th>
<th>4 points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated blood loss (mL)</td>
<td>$&gt; 1,000$</td>
<td>$601-1,000$</td>
<td>$101-600$</td>
<td>$\leq 100$</td>
<td>$-$</td>
</tr>
<tr>
<td>Lowest mean arterial pressure (mmHg)</td>
<td>$&lt; 40$</td>
<td>$40-54$</td>
<td>$55-69$</td>
<td>$\geq 70$</td>
<td>$-$</td>
</tr>
<tr>
<td>Lowest heart rate (beats/min)</td>
<td>$&gt; 85$</td>
<td>$76-85$</td>
<td>$66-75$</td>
<td>$56-65$</td>
<td>$\leq 55^f$</td>
</tr>
</tbody>
</table>

Surgical score = sum of the points for each category in the course of a procedure.
*Based on model 1 from cohort 1.
†Occurrence of pathologic bradyarrhythmia, including sinus arrest, atrioventricular block or dissociation, junctional or ventricular escape rhythms, and asystole also receive 0 pts for lowest heart rate.
Critical need for objective assessment of postsurgical patients
Editorial: Gawande. Anesthesiology 2011

• “a major reason the surgical APGAR score is not used is that surgeons and anaesthesiologists(sic) believe that their subjective impressions of patient condition are accurate…”
Conclusion

• “There is a need to introduce a UK wide system that allows rapid and easy identification of patients who are at high-risk of postoperative mortality and morbidity”

• Departments of Health in England, Wales and Northern Ireland
Conclusion

• Dynamic, responsive to evolving situation
• Based on evidence, not just on expert opinion
• Where evidence does not exist, supply funding (from NIHR direct) to gather it through research and audit (grassroots not Ivory Tower)
• Give absolute clarity to what should be considered mandatory