ICU admission after surgery: who benefits?

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Outline

• Introduction
• Incidence
• Specifics elective surgery
• Scoring for ICU admission
• Cost effectiveness
• Alternative to ICU
• Conclusions
Introduction

• Weiser et al. reported a 6% increase in surgical cases over an 8-year period,
• Improvements in perioperative care has led to reductions in perioperative mortality.
• Complication rates are higher, an overall complication rate of 16% following surgery and was associated with a five-fold increase in mortality. (Failure to rescue rate)
• As many as 1.5 million deaths per year following surgery worldwide
Introduction

• ICU admission following major surgery is considered a standard of care in many healthcare systems.
• ICU resources are finite and expensive
• Identifying those most likely to benefit is of great importance
Introduction

• Many patients undergoing major **elective** surgery routine admission to an ICU may not be associated with additional benefit and may, in some settings increase length of hospitalization and costs.
Introduction

• Patients undergoing major emergency surgery, where there is insufficient time to optimize comorbidity or where there is major physiological derangement are still best managed in an ICU setting.
ICU Reservation and Utilization at Two SICUs in Siriraj Hospital

- Prospective observational cohort between June and December 2011
Reasons for reservation

1. Underlying diseases (68.6%)
   - Cardiovascular system (69.7%)
   - Respiratory system (3.8%)

2. Surgical factors (75.7%)
   - Vascular surgery, major surgery
   - Risk of massive bleeding
   - Prolonged operation

3. Both (57.5%)
June – December 2011
24,120 anesthesia services

951 SICU reservations

SICU bed spared
491 (51.7%)

No SICU bed spared
460 (48.3%)
June – December 2011
24,120 anesthesia services

951 SICU reservations

SICU bed spared
491 (51.7%)

Admitted to SICU
261 (27.4%)

Not admitted to SICU
230 (24.1%)

Uneventful operation (79.2%)
Operation postponed (18.2%)
DOT (0.4%)
Others (2.2%)
June – December 2011
24,120 anesthesia services

951 SICU reservations

SICU bed spared
491 (51.7%)

- Admitted to SICU
  261 (27.4%)

- Not admitted to SICU
  230 (24.1%)

0.4% adverse events in 24 hour!!!
June – December 2011
24,120 anesthesia services

951 SICU reservations

No SICU bed spared
460 (48.3%)

Reasons for no SICU bed spared
- Bed limited, less severity (64.5%)
- No indication (10.0%)
- No bed available (10.2%)
- Others (15.3%)
June – December 2011
24,120 anesthesia services

951 SICU reservations

No SICU bed spared
460 (48.3%)

Outcomes of this group of patients
- Proceed with planned operation and uneventful postoperative care at ward (91.3%)
- Operation postponed due to no ICU available (2.6%)
- Operation postponed due to other reason (5.4%)
- Proceed with planned operation but had adverse event within 24 hr postoperatively*** (0.7%)
## Patients with adverse events within 24 hour postoperatively

<table>
<thead>
<tr>
<th>Unit</th>
<th>Sex/age</th>
<th>Diagnosis</th>
<th>Operation</th>
<th>Underlying Events</th>
<th>Events</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gyn</td>
<td>F/30</td>
<td>Ovarian tumor</td>
<td>Tumor removal</td>
<td>HTN, DVT</td>
<td>Dyspnea, chest pain</td>
<td>Admitted to ICU</td>
</tr>
<tr>
<td>Uro</td>
<td>M/67</td>
<td>CA prostate</td>
<td>RALRP</td>
<td>CAD, old CVA</td>
<td>Hypotension</td>
<td>Resuscitation at ward</td>
</tr>
<tr>
<td>ENT</td>
<td>F/68</td>
<td>CA tongue</td>
<td>Tumor removal with maxillectomy</td>
<td>None</td>
<td>Can not be extubated</td>
<td>Need postoperative mechanical ventilation at ward</td>
</tr>
<tr>
<td>Gyn</td>
<td>F/68</td>
<td>Pelvic mass</td>
<td>Explor lap with surgical staging</td>
<td>HTN</td>
<td>Takosubo cardiomyopathy</td>
<td>Admitted to ICU</td>
</tr>
</tbody>
</table>
Conclusions

• 91.3% of patients without SICU bed spared can proceed to surgery and be managed safely at ward.

• 46.8% of patients with SICU bed spared do not require SICU admission and almost all can be managed at ward.

• Overall, 0.4% of patients have adverse events occurred within 24 hrs. postoperatively.
Specifics elective surgery

Why routine intensive care unit admission after elective open infrarenal Abdominal Aortic Aneurysm repair is no longer an evidence based practice

David Ryan*, Gerard McGreal
Department of Vascular Surgery, Mercy University Hospital, Cork, Ireland
Methods

• A retrospective analysis of all elective infrarenal AAA repairs under the care of one Consultant Vascular Surgeon from January 2005 through December 2007.
Methods

• The Estimation of Physiological Ability and Surgical Stress (E-PASS) model was used as risk stratification tool for predicting postoperative morbidity.

• Renal function was also considered as a predictor of outcome, independent of the E-PASS.
Results

• Of all 20 patients, 80% (n=16) were admitted to ICU. Only 30% (n=6) of the total study population developed a complication.

• The E-PASS comprehensive risk score (CRS)/Surgical stress score (SSS) were found to be significantly associated with the presence of a complication \( (p = 0.009)/(p = 0.032) \) respectively.

• Serum creatinine \( (p = 0.013) \) was similarly significantly associated with the presence of a complication.
Specifics elective surgery

ORIGINAL ARTICLE

Is close monitoring in the intensive care unit necessary after elective liver resection?

Sung Hoon Kim, Jae Gil Lee¹, So Young Kwon², Jin Hong Lim¹, Won Oak Kim², Kyung Sik Kim¹

Department of Surgery, Wonju Christian Hospital, Yonsei University Wonju College of Medicine, Wonju, Departments of ¹Surgery and ²Anesthesiology and Pain Medicine, Yonsei University College of Medicine, Seoul, Korea

Activate Windows
Methods

• Retrospective analysis of the medical records of 313 patients with hepatocellular carcinoma who underwent liver resection, as performed by a single surgeon from March 2000 to December 2010.

• The Child-Pugh class of all patients except one was “A” class
Results

• 168 patients (53.7%) were treated in the ICU which 148 patients (88.1%) received only observation during the ICU care.

• The ICU re-admission and intensive medical treatment significantly correlated with major liver resection (odds ratio [OR], 6.481; P = 0.011), and intraoperative transfusions (OR, 7.108; P = 0.016).

• Patients who underwent major liver resection and intraoperative transfusion were significantly associated with need for mechanical ventilator care, longer postoperative stays in the ICU and the hospital, and hospital mortality
Specifics elective surgery

Immediate postoperative of bariatric surgery in the intensive care unit versus an inpatient unit. A retrospective study with 828 patients

Methods

• Retrospective observational study included 828 patients admitted between January 2010 and February 2015 during the immediate postoperative period of bariatric surgery in a hospital.
• Data were collected via electronic medical records.
• The Mann-Whitney test was used to compare continuous variables, and the chi-square was used to compare categorical variables.
Results

• Patients in both groups (ICU admission and postoperative unit admission) had similar demographic characteristics, with no significant differences in physical data and comorbidities.
• No significant difference in the comparison of complications
• The group admitted to the intensive care unit had longer hospitalization times (median of 3 days versus 2 days, $p < 0.05$), and hospital costs were 8% higher.
Conclusion

• In major elective surgery, no direct association was found between perioperative mortality and ICU utilization.

• Did not identify any survival benefit from postoperative admission to critical care, either at the patient level or the hospital level.

• Safe perioperative care remains essential for elective surgical treatment.
Scoring systems

- Low cost
- Easy to perform
- Permit comorbidity adjustment across different populations
- Reduce confounding in comparative audit
- Prediction of individualized risk for patients undergoing surgery
### Scoring systems

- **Preoperative scoring system**
  - the American Society of Anesthetist Physical Status (ASA-PS) score

<table>
<thead>
<tr>
<th>ASA PS Classification</th>
<th>Definition</th>
<th>Examples, including, but not limited to:</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASA I</td>
<td>A normal healthy patient</td>
<td>Healthy, non-smoking, no or minimal alcohol use</td>
</tr>
<tr>
<td>ASA II</td>
<td>A patient with mild systemic disease</td>
<td>Mild diseases only without substantive functional limitations. Examples include (but not limited to): current smoker, social alcohol drinker, pregnancy, obesity (30&lt;BMI&lt;40), well-controlled DM/HTN, mild lung disease</td>
</tr>
<tr>
<td>ASA III</td>
<td>A patient with severe systemic disease</td>
<td>Substantive functional limitations; One or more moderate to severe diseases. Examples include (but not limited to): poorly controlled DM or HTN, COPD, morbid obesity (BMI ≥40), active hepatitis, alcohol dependence or abuse, implanted pacemaker, moderate reduction of ejection fraction, ESRD undergoing regularly scheduled dialysis, premature infant PCA &lt; 60 weeks, history (&gt;3 months) of MI, CVA, TIA, or CAD/stents</td>
</tr>
<tr>
<td>ASA IV</td>
<td>A patient with severe systemic disease that is a constant threat to life</td>
<td>Examples include (but not limited to): recent (&lt;3 months) MI, CVA, TIA, or CAD/stents, ongoing cardiac ischemia or severe valve dysfunction, severe reduction of ejection fraction, sepsis, DIC, ARD or ESRD not undergoing regularly scheduled dialysis</td>
</tr>
<tr>
<td>ASA V</td>
<td>A moribund patient who is not expected to survive without the operation</td>
<td>Examples include (but not limited to): ruptured abdominal/thoracic aneurysm, massive trauma, intracranial bleed with mass effect, ischemic bowel in the face of significant cardiac pathology or multiple organ/system dysfunction</td>
</tr>
<tr>
<td>ASA VI</td>
<td>A declared brain-dead patient whose organs are begin removed for donor purposes</td>
<td></td>
</tr>
</tbody>
</table>

Scoring systems

- Scoring systems for comparative audit to predict risk in individual surgical patients
  - Acute Physiology and Chronic Health Evaluation (APACHE) II
### Scoring systems

– Portsmouth Physiological and Operative Severity Score for enumeration of Morbidity and Mortality (P-POSSUM)

<table>
<thead>
<tr>
<th>Score</th>
<th>1</th>
<th>2</th>
<th>4</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age (years)</strong></td>
<td>≤60</td>
<td>61-70</td>
<td>≥71</td>
<td></td>
</tr>
<tr>
<td><strong>Cardiac signs</strong></td>
<td>Normal</td>
<td>Diuretic, digoxin antianginal or antihypertensive therapy</td>
<td>Peripheral edema, warfarin therapy</td>
<td>Raised jugular venous pressure</td>
</tr>
<tr>
<td><strong>Chest radiograph</strong></td>
<td>Normal</td>
<td>Dyspnea on exertion</td>
<td>Borderline cardiomegaly</td>
<td>Cardiomegaly</td>
</tr>
<tr>
<td><strong>Respiratory history</strong></td>
<td>Normal</td>
<td>—</td>
<td>Limiting dyspnea (one flight of stairs)</td>
<td>Dyspnea at rest</td>
</tr>
<tr>
<td><strong>Chest radiograph</strong></td>
<td>Normal</td>
<td>Mild chronic obstructive airway disease</td>
<td>Moderate COAD</td>
<td>Fibrosis or consolidation</td>
</tr>
<tr>
<td><strong>Systolic blood pressure (mmHg)</strong></td>
<td>110-130</td>
<td>131-170</td>
<td>≥171</td>
<td>≤89</td>
</tr>
<tr>
<td><strong>Pulse (beats/min)</strong></td>
<td>50-80</td>
<td>81-100</td>
<td>101-120</td>
<td>≥121</td>
</tr>
<tr>
<td><strong>Glasgow coma scale</strong></td>
<td>15</td>
<td>12-14</td>
<td>9-11</td>
<td>≤39</td>
</tr>
<tr>
<td><strong>Hemoglobin (g/dl)</strong></td>
<td>13-16</td>
<td>11.5-12.9</td>
<td>10-11.4</td>
<td>≤8</td>
</tr>
<tr>
<td><strong>White cell count (×10^12/l)</strong></td>
<td>4-10</td>
<td>10.1-20</td>
<td>≥20.1</td>
<td>≤8</td>
</tr>
<tr>
<td><strong>Blood urea (mmol/l)</strong></td>
<td>≤7.5</td>
<td>7.6-10</td>
<td>10.1-15</td>
<td>≥15.1</td>
</tr>
<tr>
<td><strong>Sodium (mmol/l)</strong></td>
<td>≥136</td>
<td>131-135</td>
<td>126-130</td>
<td>≤125</td>
</tr>
<tr>
<td><strong>Potassium (mmol/l)</strong></td>
<td>3.5-5</td>
<td>3.2-3.4</td>
<td>2.9-3.1</td>
<td>≤2.8</td>
</tr>
<tr>
<td><strong>Electrocardiogram</strong></td>
<td>Normal</td>
<td>Atrial fibrillation (rate 60-90)</td>
<td>Any other change</td>
<td></td>
</tr>
</tbody>
</table>
Cost of ICU care

• Intensive care unit (ICU) costs account for a great part of a hospital’s expenses.
• The total costs obtained for individual patients
<table>
<thead>
<tr>
<th>Item</th>
<th>Total cost (€)</th>
<th>Cost per patient (€)</th>
<th>Percentage of total cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medication</td>
<td>825,158.48</td>
<td>1628 (243.70–116,355)</td>
<td>56.50%</td>
</tr>
<tr>
<td>Antibiotics</td>
<td>413,229.05</td>
<td>799 (6.9–26,145)</td>
<td>28.29%</td>
</tr>
<tr>
<td>Blood products</td>
<td>156,605.96</td>
<td>752 (22–16558)</td>
<td>10.72%</td>
</tr>
<tr>
<td>Cardiology</td>
<td>126,555.89</td>
<td>485 (1.2–11723)</td>
<td>8.66%</td>
</tr>
<tr>
<td>Inotropes&lt;sup&gt;a&lt;/sup&gt;</td>
<td>6468.50</td>
<td>13 (3.7–96)</td>
<td>0.44%</td>
</tr>
<tr>
<td>Vasoactives&lt;sup&gt;b&lt;/sup&gt;</td>
<td>3226.57</td>
<td>25 (1.3–288)</td>
<td>0.22%</td>
</tr>
<tr>
<td>Antiarrhythmics&lt;sup&gt;c&lt;/sup&gt;</td>
<td>109,366.08</td>
<td>675 (96–9640)</td>
<td>7.49%</td>
</tr>
<tr>
<td>Other cardiology drugs&lt;sup&gt;d&lt;/sup&gt;</td>
<td>7494.74</td>
<td>31 (5.2–653)</td>
<td>0.51%</td>
</tr>
<tr>
<td>Fluids</td>
<td>37,896.90</td>
<td>104 (1–3795)</td>
<td>2.59%</td>
</tr>
<tr>
<td>Sedatives&lt;sup&gt;e&lt;/sup&gt;</td>
<td>35,364.61</td>
<td>122 (0.20–5487)</td>
<td>2.42%</td>
</tr>
<tr>
<td>Nutrition</td>
<td>20904.67</td>
<td>98 (0.92–3187)</td>
<td>1.43%</td>
</tr>
<tr>
<td>Gastroprophylaxis</td>
<td>12529.83</td>
<td>42 (0.96–835)</td>
<td>0.86%</td>
</tr>
<tr>
<td>Thromboprophylaxis</td>
<td>6960.92</td>
<td>21 (1.2–515)</td>
<td>0.48%</td>
</tr>
<tr>
<td>Psychiatric</td>
<td>6440.31</td>
<td>31 (0.20–2318)</td>
<td>0.45%</td>
</tr>
<tr>
<td>Respiratory</td>
<td>3276.84</td>
<td>25 (0.40–375)</td>
<td>0.23%</td>
</tr>
<tr>
<td>Other&lt;sup&gt;f&lt;/sup&gt;</td>
<td>5393.50</td>
<td>13 (0.21–766)</td>
<td>0.37%</td>
</tr>
<tr>
<td>Consumables</td>
<td>310,553.21</td>
<td>532 (21–44183)</td>
<td>21.26%</td>
</tr>
<tr>
<td>Diagnostic tests</td>
<td>324,753.56</td>
<td>910 (13–22,830)</td>
<td>22.24%</td>
</tr>
<tr>
<td>Imaging&lt;sup&gt;g&lt;/sup&gt;</td>
<td>24,407</td>
<td>69 (4.05–1517)</td>
<td>1.67%</td>
</tr>
<tr>
<td>Haematology</td>
<td>28,322</td>
<td>102 (4.1–1842)</td>
<td>1.94%</td>
</tr>
<tr>
<td>Biochemistry</td>
<td>142,446</td>
<td>430 (4.5–9738)</td>
<td>9.75%</td>
</tr>
<tr>
<td>Microbiology</td>
<td>7498</td>
<td>41 (5.2–503)</td>
<td>0.51%</td>
</tr>
<tr>
<td>ABGs</td>
<td>122,080.56</td>
<td>334 (25–9174)</td>
<td>8.37%</td>
</tr>
<tr>
<td><strong>Total variable cost</strong></td>
<td><strong>1,460,465.26</strong></td>
<td><strong>3443 (243.70–116355)</strong></td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup> Including dobutamine, adrenaline and levosimendan.
<sup>b</sup> Including noradrenaline and dopamine.
<sup>c</sup> Esmolol was used in almost 100% of cases.
<sup>d</sup> Including iv and per os formulations.
<sup>e</sup> Including analgesics and neuromuscular blockers as well.
<sup>f</sup> Including hormones, ointments, eye drops, etc.
<sup>g</sup> Including radiology, computed tomography and magnetic resonance imaging.

ABGs: arterial blood gases
<table>
<thead>
<tr>
<th></th>
<th>Survivors</th>
<th>Non-survivors</th>
<th>( p )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( n )</td>
<td>112 (male 67)</td>
<td>26 (male 17)</td>
<td></td>
</tr>
<tr>
<td>Age (years)</td>
<td>68.52 ± 1.36</td>
<td>69.77 ± 2.32</td>
<td>0.92</td>
</tr>
<tr>
<td>LOS (days)</td>
<td>7 (1–199)</td>
<td>13.5 (2–68)</td>
<td>0.04</td>
</tr>
<tr>
<td>APACHE II</td>
<td>16.89 ± 0.61</td>
<td>26.15 ± 0.98</td>
<td>(&lt;0.0001)</td>
</tr>
<tr>
<td>Total cost (euro)</td>
<td>2605 (243.70–116,355)</td>
<td>10829 (575.60–69620)</td>
<td>0.0004</td>
</tr>
<tr>
<td>Medication cost (euro)</td>
<td>1451 (18.40–58,559)</td>
<td>7558 (199.5–37,198)</td>
<td>0.0003</td>
</tr>
<tr>
<td>Cosnumables cost (euro)</td>
<td>408.80 (20.60–44,183)</td>
<td>1257 (173.90–30,631)</td>
<td>0.0004</td>
</tr>
<tr>
<td>Exams cost (euro)</td>
<td>840.80 (12.62–22,830)</td>
<td>2227 (202.20–10,814)</td>
<td>0.0026</td>
</tr>
</tbody>
</table>
Alternatives to ICU

• Step-down unit (SDU)
  – high dependency unit (HDU)
  – Intermediate or transitional care unit (IMCUs)
  – Post anesthesia care units (PACU)
  – Over night intensive recovery (OIR) or 23- h recovery
Alternatives to ICU: HDU, IMCUs

- ‘Step-down’ patients who were being cared for in an ICU but no longer require full ICU support
- ‘Step-up’ patients who were being cared for on a standard ward but who now require an increased level of monitoring or support, or who are at risk of deterioration
- Postoperative patients who are admitted from the operating room or recovery room and who require enhanced care and monitoring due to the nature of their surgery or comorbidity.
Alternatives to ICU: PACU, OIR

• Short periods of extended recovery care, typically up to 1 day
• Correction of abnormal physiology, short periods of postoperative ventilation, interventions such as goal-directed hemodynamic therapy, or components of an enhanced recovery after surgery (ERAS) intervention
• Patients are typically stepped down to lower levels of care following this
Alternatives to ICU

**FIGURE 1.** Old and new models for postoperative care after high-risk surgery.
Does intermediate care improve patient outcomes or reduce costs?
Effects on outcomes?

• The presence of an IMCU in the hospital was associated with a significantly reduced adjusted hospital mortality for adults admitted to the ICU.

• Less than 25% of the ICU patients actually received treatment in an IMCU either before or after their ICU admission.
Effects on costs?

• Assessing cost differences occurring as a result of introducing IMCU beds can be difficult.

• The cost savings achieved by shifting patients from one bed to another (from an ICU to a long-term acute care facility or an ICU to the ward a few days earlier) need to be calculated as the total cost of care, not just the ICU costs.
Conclusions

• The best way to improve surgical outcomes is preoperative assessment and optimization and safe perioperative care

• No association between ICU admission and improved outcome in many types of elective major noncardiac surgery.
Conclusions

• ICU admission should still be considered for very high-risk patients and those having complex or emergency surgery.