Update in Perioperative Medicine

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Topics

Cardiac risk:
- New risk calculator; Preop BNP
- AF, HF, & CAD as predictors of mortality & readmission after noncardiac surgery
- Postop troponin surveillance

Pulmonary risk:
- New risk indices/calculators
- Timing of preoperative smoking cessation
- OSA

Miscellaneous:
- Perioperative transfusion trigger; Anemia
- Statins and AF
SGIM 2012

UPDATE IN PERIOPERATIVE MEDICINE

Cardiac Risk

Steven L. Cohn, MD, FACP, SFHM
Director – Medical Consultation Service
Professor of Clinical Medicine
University of Miami Miller School of Medicine
A 65 year-old man is scheduled for AAA repair. PMH: HTN, hyperlipidemia, prior MI. Denies CP/SOB but has limited exercise capacity. Meds: ASA, BB, statin, ACEI. Exam and labs are unremarkable. RCRI=2. 

You are debating whether or not to get a stress test.

1. What is his risk for postop MACE?
2. Would obtaining a preop BNP help predict postop cardiac complications?
3. Would it change management?
4. Would postop troponins be helpful?
Question
What tools are available to predict perioperative cardiac risk?

Development and Validation of a Risk Calculator for Prediction of Cardiac Risk after Surgery
Existing risk indices:
- Older: Goldman original CRI, Detsky modified CRI
- Current: Lee Revised CRI (RCRI)
- Newer: Vascular Surgery Group CRI (VSG-CRI)

Limitations: single center, type of surgery, underestimate risk in vascular surgery, older, prior to BB/statins
- No recommendations re: management (only ACC)
Methods/Outcomes

2007 ACS NSQIP database for derivation
- Multicenter, prospective
- 211,410 pts: 1371 (0.65%) periop MI/cardiac arrest
- Multivariate logistic regression analysis

2008 NSQIP database for validation
- 257,385 pts: 1401 (0.54%) periop MI/cardiac arrest

Validation for vasc surgery & comparison with RCRI

Endpoints
- Primary: intraop or postop MI or cardiac arrest (MICA)
- Secondary: MICA in vascular surgery

Gupta et al. Circulation 2011
# Predictors of MICA

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>OR</th>
<th>(CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type of surgery</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Breast</td>
<td>0.20</td>
<td>(0.08-0.05)</td>
</tr>
<tr>
<td>Orthopedic</td>
<td>2.22</td>
<td>(1.55-3.17)</td>
</tr>
<tr>
<td>Intestinal</td>
<td>3.12</td>
<td>(2.29-4.24)</td>
</tr>
<tr>
<td>Aortic</td>
<td>4.96</td>
<td>(3.55-6.93)</td>
</tr>
<tr>
<td><strong>Dependent functional status</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Totally</td>
<td>2.79</td>
<td>(2.36-3.30)</td>
</tr>
<tr>
<td>Partially</td>
<td>1.92</td>
<td>(1.65-2.23)</td>
</tr>
<tr>
<td><strong>Abnormal creatinine</strong></td>
<td>1.84</td>
<td>(1.63-2.09)</td>
</tr>
<tr>
<td><strong>ASA class</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>0.01</td>
<td>(0.001-0.02)</td>
</tr>
<tr>
<td>2</td>
<td>0.04</td>
<td>(0.03-0.05)</td>
</tr>
<tr>
<td>3</td>
<td>0.15</td>
<td>(0.11-0.19)</td>
</tr>
<tr>
<td>4</td>
<td>0.39</td>
<td>(0.30-0.49)</td>
</tr>
<tr>
<td><strong>Increasing age</strong></td>
<td>1.02</td>
<td>(1.01-1.02)</td>
</tr>
</tbody>
</table>

Gupta et al. Circulation 2011
## Risk Model Performance

<table>
<thead>
<tr>
<th>C-statistics</th>
<th>MICA</th>
<th>RCRI</th>
<th>VSG-CRI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Training set</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- full</td>
<td>0.892</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- final</td>
<td>0.884</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Validation set</td>
<td>0.874</td>
<td>0.747</td>
<td></td>
</tr>
<tr>
<td>Vascular surgery</td>
<td>0.746</td>
<td>0.59</td>
<td>0.71</td>
</tr>
</tbody>
</table>

Gupta et al. Circulation 2011
### Perioperative Myocardial Infarction or Cardiac Arrest Risk Calculator

<table>
<thead>
<tr>
<th>Age</th>
<th>Enter actual age in years</th>
<th>Estimated risk probability for perioperative MICA: 1.23%</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASA Class</td>
<td>Enter 1-5 for American Society of Anesthesiologists' Class</td>
<td></td>
</tr>
<tr>
<td>Creatinine (preoperative)</td>
<td>Enter 2 for missing value 1 for ≥1.5 mg/dl 0 for &lt;1.5 mg/dl</td>
<td></td>
</tr>
<tr>
<td>Functional Status (preoperative)</td>
<td>Enter 2 for patients with totally dependent functional status 1 for patients who have partially dependent functional status 0 for those who are totally independent</td>
<td></td>
</tr>
<tr>
<td>Procedure:</td>
<td>Enter 1 for Anorectal 2 for Aortic 3 for Bariatric 4 for Brain 5 for Breast 6 for Cardiac 7 for ENT (except thyroid/parathyroid) 8 for Foregut/Hepatopancreatobiliary 9 for Gallbladder, appendix, adrenal and spleen 10 for Hernia (ventral, inguinal, femoral) 11 for Intestinal 12 for Neck (Thyroid and Parathyroid) 13 for Obstetric/Gynecologic 14 for Orthopedic and non-vascular Extremity 15 for Other abdominal 16 for Peripheral Vascular 17 for Skin 18 for Spine 19 for non-esophageal Thoracic 20 for Vein 21 for Urology</td>
<td></td>
</tr>
</tbody>
</table>

Gupta et al. Circulation 2011
Limitations

- Variables limited to NSQIP database
  - No info on preop stress test, ECHO, arrhythmia, valve, known/remote CAD, BB

- Outcomes differed
  - only MICA, not pulm edema, complete heart block
  - MI definition (troponin >3x up normal)

Gupta et al. Circulation 2011
MICA calculator is a readily available tool whose predictive performance surpasses that of RCRI.

Provides risk estimate that may simplify informed consent process.

http://www.surgicalriskcalculator.com/miorcardiacarrest

Gupta et al. Circulation 2011
Mortality and readmission of patients with heart failure, atrial fibrillation, or coronary artery disease undergoing noncardiac surgery

**Methods**

- Population-based cohort study (Canada)
- Administrative data from multiple sources

38,047 pts > age 20 divided into 4 cohorts:
  - Heart failure, ischemic (IHF) – 12,249
  - Heart failure, non-ischemic (NIHF) – 7,700
  - Coronary artery disease (CAD) – 13,786
  - Atrial fibrillation (AF) – 4,312
Primary Outcomes

- 30-day postoperative mortality
- 30-day postoperative readmission

**Figure 3.** Unadjusted 30-day perioperative mortality (blue), rehospitalization (red), and cardiac rehospitalization (green). HF indicates heart failure.
Results

30-day mortality – out-pt or minor procedures:
- IHF: 4.8%
- NIHF: 4.1%
- CAD: 0.8%
- AF: 2.2%

Having surgery within 4 weeks of the initial cardiac diagnosis significantly increases mortality.
Limitations

- Administrative database
- Not necessarily generalizable to all HF patients
  - No data on HF symptoms or EF
  - AF pts required prior hospitalization with AF as the primary diagnosis
- Causes of death not defined making it difficult to know how to employ risk reduction strategies
- No data on perioperative medications
Implications for Practice

- NIHF is likely of similar risk to IHF
- HF may be more important than CAD for risk stratification (underweighted in risk indices)
- Consider AF as a risk factor for periop events
- Consider postponing surgery for pts with a recent hospitalization due to a cardiac Dx (for 4 weeks?)
Question

Does preop BNP predict postop cardiac complications?

The predictive ability of preoperative B-type natriuretic peptide in vascular patients for major adverse cardiac events: an individual patient data meta-analysis.


The predictive value of preoperative natriuretic peptide concentrations in adults undergoing surgery: a systematic review and meta-analysis.

Ventricular cardiomyocytes secrete BNP (prohormone) and NT-proBNP (inactive cleavage product) in response to atrial/ventricular wall stretch.

- LV dysfunction, myocardial ischemia, arrhythmias, valve abnormalities

Preop elevations of BNP/NT-proBNP have been associated with adverse CV events in noncardiac and vascular surgery.

Rodseth, Anaesthesia 2008
Korthikegan, JACC 2009
Ryding, Anesthesiology 2009
What We Don’t Know

Which test – BNP or NT-proBNP?
Which type of surgery – noncardiac or vascular?
Which patients – low, intermediate, high risk?
Which complication – MI, HF, cardiac death?
What timeframe – immediately postop, 30 day, 6-12 mo?
What cutoff level is predictive?
Will it change management?
Will that improve outcome?
Objectives: individual patient meta-analysis using BNP to predict MI/cardiac death within 30 days of vascular surgery and to determine:

- cut points for Dx, optimal, screening tests
- if preop BNPs improve predictive accuracy of RCRI

5 data sets for BNP: n=632
1 data set for NT-proBNP: n=218
Unadjusted ORs for a Preop BNP Above the Optimal Cut Point (116 pg/ml) in Predicting CV Outcomes 30 Days After Surgery

<table>
<thead>
<tr>
<th>Study</th>
<th>BNP above cut point</th>
<th>BNP below cut point</th>
<th>OR (random) 95%CI</th>
<th>Weight %</th>
<th>OR (random) 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n/N (20%)</td>
<td>n/N (3.8%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gibson</td>
<td>22/33</td>
<td>2/96</td>
<td></td>
<td>20.40</td>
<td>94.0 (19.43, 454.78)</td>
</tr>
<tr>
<td>Cuthbertson</td>
<td>2/57</td>
<td>0/13</td>
<td></td>
<td>10.14</td>
<td>1.22 (0.06, 26.84)</td>
</tr>
<tr>
<td>Mahla</td>
<td>14/85</td>
<td>5/133</td>
<td></td>
<td>25.31</td>
<td>5.05 (1.75, 14.59)</td>
</tr>
<tr>
<td>Bolliger</td>
<td>2/38</td>
<td>2/95</td>
<td></td>
<td>16.79</td>
<td>2.58 (0.35, 19.04)</td>
</tr>
<tr>
<td>Biccard</td>
<td>13/53</td>
<td>13/244</td>
<td></td>
<td>27.36</td>
<td>5.78 (2.50, 13.36)</td>
</tr>
<tr>
<td>Total (95% CI)</td>
<td>266</td>
<td>581</td>
<td></td>
<td>100.00</td>
<td>7.36 (2.23, 24.31)</td>
</tr>
</tbody>
</table>

Total events: 53 (BNP above cut point) 22 (BNP below cut point)
Test for heterogeneity, Chi$^2$=13.37, df=4 (P=0.001), I$^2$=70.1%
Test for overall effect: Z=3.27 (P=0.001)
## Test Characteristics at 3 BNP Cutoff Points in Predicting 30-Day MACEs

<table>
<thead>
<tr>
<th>Cutoff Point</th>
<th>BNP (pg/ml)</th>
<th>Sensitivity (%)</th>
<th>Specificity (%)</th>
<th>+LR</th>
<th>-LR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Screening</td>
<td>30</td>
<td><strong>95</strong></td>
<td>44</td>
<td>1.69</td>
<td>0.11</td>
</tr>
<tr>
<td>General optimal</td>
<td>116</td>
<td><strong>66</strong></td>
<td><strong>82</strong></td>
<td>3.6</td>
<td>0.41</td>
</tr>
<tr>
<td>Diagnostic</td>
<td>372</td>
<td>32</td>
<td><strong>95</strong></td>
<td>6.4</td>
<td>0.71</td>
</tr>
</tbody>
</table>

### NP Threshold (pg/ml)

<table>
<thead>
<tr>
<th>NP Threshold</th>
<th>MACEs (%)</th>
<th>Cardiac Death (%)</th>
<th>Nonfatal MI (%)</th>
<th>OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Below screening (0–29)</td>
<td>1.2</td>
<td>0</td>
<td>1.2</td>
<td>—</td>
</tr>
<tr>
<td>Between screening and general optimal diagnostic (30–115)</td>
<td>6.5</td>
<td>2.8</td>
<td>3.6</td>
<td>5.6 (1.6–19.6)</td>
</tr>
<tr>
<td>Between general optimal and diagnostic (116–370)</td>
<td>20.9</td>
<td>5.5</td>
<td>15.4</td>
<td>21.0 (6.0–72.9)</td>
</tr>
<tr>
<td>Above diagnostic (&gt;372)</td>
<td>36.7</td>
<td>12.2</td>
<td>24.5</td>
<td>45.4 (12.7–162.7)</td>
</tr>
</tbody>
</table>
Addition of preop BNP to RCRI resulted in correct classification of 58% of pts.

- Pt w event moves up to higher risk or
- Pt w/o event moved down to a lower risk category
<table>
<thead>
<tr>
<th>RCRI Risk Category</th>
<th>MACE</th>
<th>No MACE</th>
<th>Total</th>
<th>NP-Reclassified Risk Category</th>
<th>MACE</th>
<th>No MACE</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low risk</td>
<td>19 (5.9%)</td>
<td>301 (94.1%)</td>
<td>320</td>
<td>Low risk</td>
<td>22 (3.7%)</td>
<td>574 (96.3%)</td>
<td>596</td>
</tr>
<tr>
<td>Intermediate risk</td>
<td>45 (9.5%)</td>
<td>431 (90.5%)</td>
<td>476</td>
<td>Intermediate risk</td>
<td>14 (15.1%)</td>
<td>79 (84.9%)</td>
<td>93</td>
</tr>
<tr>
<td>High risk</td>
<td>11 (20.4%)</td>
<td>43 (79.6%)</td>
<td>54</td>
<td>High risk</td>
<td>39 (24%)</td>
<td>122 (76%)</td>
<td>161</td>
</tr>
</tbody>
</table>
RCRI alone has reduced predictive performance in vascular surgery

Preop BNP alone:
  - good at excluding disease in low risk pts
  - may increase proportion of pts in intermediate risk group who may need further risk stratification

RCRI restratified with BNP:
  - Decreases size of subsequent intermediate risk group

Best strategy???: consider BNP in new algorithms
Implications for Practice

- Results may improve accuracy & guide further cardiac testing
  - Identify high-risk pts with RCRI 1-2
  - Make stress test redundant in pts with RCRI ≥3
  - Identify false negative stress tests
    - Adjusting medications (BB, statins)
    - More invasive periop monitoring/postop ICU setting
    - Change procedure (open vs endovascular)

- Evidence-based outcome studies?
  - NONE!
Patient Management

- 65 year-old man scheduled for AAA repair.
- PMH: HTN, hyperlipidemia, prior MI.
- Denies CP/SOB; has limited exercise capacity.
- Meds: ASA, BB, statin, ACEI.
- Exam and labs are unremarkable. RCRI=2.

Would postop troponin be helpful?

Characteristics and short-term prognosis of perioperative myocardial infarction in patients undergoing noncardiac surgery: a cohort study.

Prognostic value of troponin and creatine kinase muscle and brain isoenzyme measurement after noncardiac surgery: a systematic review and meta-analysis.
What We Know

MI: most common major periop complication

Higher mortality in postop setting
- Different presentation, not in monitored setting, additional stress of surgery

Troponin elevation:
- more common than previously thought
- may predict short or long-term mortality/MACE
  - Preop troponin elevation in 5-34% of vascular surgery pts
  - Meta-analysis – postop 8-52% (Levy et al, Anesthesiology 2011)
  - POISE – postop 13% (Devereaux et al, Ann Intern Med, 2011)
  - VISION – to be reported this year (Devereaux)
What We Don’t Know

- Definition of postop MI?
- Characteristics and prognosis of postop MI?
- Should routine postop troponin surveillance in at-risk patients be performed?
- Will postop troponins alter management or improve outcome?
Elevated cardiac biomarkers or enzymes AND 1 or more of the following:

<table>
<thead>
<tr>
<th>Feature</th>
<th>Proportion of all MIs (n=415)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ischemic symptoms</td>
<td>35%</td>
</tr>
<tr>
<td>New pathologic Q waves</td>
<td>12%</td>
</tr>
<tr>
<td>Ischemic changes on EKG</td>
<td></td>
</tr>
<tr>
<td>STEMI</td>
<td>11%</td>
</tr>
<tr>
<td>NSTEMI (ST depression/T wave inversion)</td>
<td>53%</td>
</tr>
<tr>
<td>PCI or CABG</td>
<td>7%</td>
</tr>
<tr>
<td>MI by cardiac imaging</td>
<td>26%</td>
</tr>
<tr>
<td>MI by autopsy findings</td>
<td>3%</td>
</tr>
</tbody>
</table>
Timing of Perioperative MI: Most Within 48 Hours of Surgery

Study Patients With Events (n = 8351), %

Time After Surgery, d

Isolated Cardiac Biomarker or Enzyme Level Elevation

Asymptomatic MI

Symptomatic MI

Mortality Similar for Symptomatic and Asymptomatic MI

Postop troponin and all-cause mortality

Increased troponin varied from 8-52%
Increased CPK-MB ranged from 7-23%
<table>
<thead>
<tr>
<th>Factor</th>
<th>Adjusted OR</th>
</tr>
</thead>
<tbody>
<tr>
<td>↑ baseline HR by 10*</td>
<td>1.29</td>
</tr>
<tr>
<td>↑ Age per 10 years*</td>
<td>1.53</td>
</tr>
<tr>
<td>Major vascular surgery</td>
<td>2.21</td>
</tr>
<tr>
<td>History of stroke</td>
<td>2.24</td>
</tr>
<tr>
<td>Emergency surgery</td>
<td>2.94</td>
</tr>
<tr>
<td>Serious bleeding*</td>
<td>3.62</td>
</tr>
<tr>
<td>Creatinine &gt; 2.0 mg/dl</td>
<td>4.33</td>
</tr>
</tbody>
</table>

ASA and statin use were associated with reduced risk (OR .54 and .26)

* Not in RCRI

Implications for Practice

IF:
- The majority of periop MIs are asymptomatic (no ischemic Sx)
- Mortality is similar with or without ischemic Sx
- Most MIs occur within first 48 hours of surgery, &
- Most deaths within 48 hrs of MI

MAYBE:
- Recommend routine troponins after high risk surgery to identify and Rx asymptomatic MIs
  - In which patients and in which surgeries?
    - Pts with CAD or multiple risk factors (POISE criteria)
    - Await VISION results
  - What management changes?
More frequent monitoring of vital signs
Observation in a monitored setting (tele, CCU, ICU)
Screening and correction of potential contributing factors - hypoxia, anemia
Optimal intravascular volume management
Cardiac medications - ASA, BB, statin, ACEI
In addition, for confirmed postop MI
  - cardiac cath/revascularization

Will these interventions improve outcome???
New risk calculator (MICA)

HF may be underestimated as a risk factor

Recent cardiac hospitalization may increase risk

Preop BNP predicts postop MACE (>RCRI)

Postop troponins may alter management
Questions?
Update In Perioperative Medicine
SGIM Annual Session 2012
Orlando

Gerald W. Smetana, M.D.
Division of General Medicine
Beth Israel Deaconess Medical Center
Associate Professor of Medicine
Harvard Medical School
Three Questions

1. Does the duration of preoperative cigarette cessation influence postoperative pulmonary complication rates?
2. Which pulmonary risk index is most helpful in estimating PPC risks?
3. What is the impact of OSA on postoperative complication rates and should we screen?
Mr. Salem

- 74 year old man with COPD who you see 2 weeks before a planned hemicolecotmy for colon cancer
- He smokes 2 ppd and has for 30 years
- Should you advise him to quit smoking?
- If he is successful, will this reduce his risk of postoperative pulmonary complications?
Do Recent Quitters Have Higher PPC Rates?

- Many patients note increased cough and sputum in first 1-2 months after cigarette cessation
- Plausible mechanism that recent quitters may be at risk for increased PPCs
- How can we ignore the teachable moment before major surgery?
The Origins of the Controversy: Mayo Clinic 1989

200 Patients Undergoing CABG

- Current Smokers
- Quit < 8 Weeks
- Quit > 8 Weeks
- Nonsmokers

PPC Rates

3 Other Studies Make Same Observation

Could Confounders Bias These Observational Studies?

How about the RCT’s?
RCT’s of Smoking Cessation: Only Two Small Studies of Low Risk Surgery: Inadequate Power for PPCs

<table>
<thead>
<tr>
<th>Trial</th>
<th>n</th>
<th>Rx</th>
<th>#PPC Intervention</th>
<th>#PPC Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moller et al 2002</td>
<td>120</td>
<td>6-8 wks NRT</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>• THR / TKR</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lindstrom et al 2008</td>
<td>117</td>
<td>4 wks NRT</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>• THR / TKR / Lap Chole / Hernia</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

STOPPING SMOKING SHORTLY BEFORE SURGERY AND POSTOPERATIVE COMPLICATIONS

A Systematic Review and Meta-analysis

Katie Myers, MSc, CPsychol; Peter Hajek, PhD; Charles Hinds, FRCP, FRCA; Hayden McRobbie, MBChB, PhD

Arch Intern Med 2011;171:983
Study Design / Eligible Studies

- Recent quitter = < 8 weeks of cessation
- All postoperative complications (as defined by author) pooled together
- All study designs
- Evaluated recent quitters vs. current smokers
- 9 eligible studies (7 were observational data)
- Total n = 889
No Difference in Total Complication Rates

<table>
<thead>
<tr>
<th>Study</th>
<th>Recent Quitters, No.</th>
<th>Continued Smokers, No.</th>
<th>RR (Random) 95% CI</th>
<th>Weight, %</th>
<th>RR (Random) 99% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warner et al,²⁶ 1984</td>
<td>88/156</td>
<td>60/124</td>
<td>1.17 (0.93-1.46)</td>
<td>19.23</td>
<td></td>
</tr>
<tr>
<td>Warner et al,¹¹ 1989</td>
<td>12/21</td>
<td>6/18</td>
<td>1.71 (0.81-3.63)</td>
<td>9.68</td>
<td></td>
</tr>
<tr>
<td>Glassman et al,² 2000</td>
<td>15/74</td>
<td>14/63</td>
<td>0.91 (0.48-1.74)</td>
<td>11.29</td>
<td></td>
</tr>
<tr>
<td>Møller et al,¹ 2002</td>
<td>4/40</td>
<td>32/68</td>
<td>0.21 (0.08-0.56)</td>
<td>7.16</td>
<td></td>
</tr>
<tr>
<td>Barrera et al,⁵ 2005</td>
<td>9/39</td>
<td>3/13</td>
<td>1.00 (0.32-3.15)</td>
<td>5.61</td>
<td></td>
</tr>
<tr>
<td>Kuri et al,²⁴ 2005</td>
<td>34/54</td>
<td>24/28</td>
<td>0.73 (0.57-0.95)</td>
<td>18.77</td>
<td></td>
</tr>
<tr>
<td>Chan et al,²² 2006</td>
<td>10/19</td>
<td>21/31</td>
<td>0.78 (0.48-1.27)</td>
<td>14.10</td>
<td></td>
</tr>
<tr>
<td>Lindström et al,²⁵ 2008</td>
<td>5/29</td>
<td>27/73</td>
<td>0.47 (0.20-1.09)</td>
<td>8.37</td>
<td></td>
</tr>
<tr>
<td>Groth et al,²² 2009</td>
<td>3/16</td>
<td>10/23</td>
<td>0.43 (0.14-1.32)</td>
<td>5.79</td>
<td></td>
</tr>
<tr>
<td>Total (95% CI)</td>
<td>448</td>
<td>441</td>
<td>0.78 (0.57-1.07)</td>
<td>100.00</td>
<td></td>
</tr>
</tbody>
</table>

Favors Lower Risk in Recent Quitters  
Favors Higher Risk in Recent Quitters
No Difference in PPCs Between Recent Quitters and Current Smokers

<table>
<thead>
<tr>
<th>Recent Quitters, No.</th>
<th>Smokers, No.</th>
<th>RR (Fixed) 95% CI</th>
<th>Weight, %</th>
<th>RR (Random) 99% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warner et al, 1984</td>
<td>88/156</td>
<td></td>
<td>80.76</td>
<td>1.17 (0.93-1.46)</td>
</tr>
<tr>
<td>Warner et al, 1989</td>
<td>12/21</td>
<td></td>
<td>7.81</td>
<td>1.71 (0.81-3.63)</td>
</tr>
<tr>
<td>Barrera et al, 2005</td>
<td>9/39</td>
<td></td>
<td>5.44</td>
<td>1.00 (0.32-3.15)</td>
</tr>
<tr>
<td>Lindström et al, 2008</td>
<td>0/29</td>
<td></td>
<td>1.05</td>
<td>0.82 (0.03-19.62)</td>
</tr>
<tr>
<td>Groth et al, 2009</td>
<td>3/16</td>
<td></td>
<td>4.96</td>
<td>0.86 (0.24-3.11)</td>
</tr>
<tr>
<td>Total (95% CI)</td>
<td>261</td>
<td>251</td>
<td>100.00</td>
<td>1.18 (0.95-1.46)</td>
</tr>
</tbody>
</table>

Caveats

- Primarily observational uncontrolled data
- PPC definitions not described
NSQIP: Current Smokers (< 1 year) Have Higher Morbidity and Mortality Rates

<table>
<thead>
<tr>
<th>Major Morbidity</th>
<th>Odds Ratio and 95% CI</th>
<th>OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Septic Shock</td>
<td>1.40 (1.33, 1.47)</td>
<td></td>
</tr>
<tr>
<td>Sepsis</td>
<td>1.38 (1.11, 1.72)</td>
<td></td>
</tr>
<tr>
<td>Bleeding Transfusions</td>
<td>1.38 (1.20, 1.60)</td>
<td></td>
</tr>
<tr>
<td>Myocardial Infarction</td>
<td>2.09 (1.80, 2.43)</td>
<td></td>
</tr>
<tr>
<td>Cardiac Arrest</td>
<td>1.87 (1.58, 2.21)</td>
<td></td>
</tr>
<tr>
<td>Coma &gt; 24 hours</td>
<td>1.79 (1.64, 2.12)</td>
<td></td>
</tr>
<tr>
<td>Stroke/CVA</td>
<td>1.79 (1.64, 2.12)</td>
<td></td>
</tr>
<tr>
<td>Ventilator &gt; 48 hours</td>
<td>1.53 (1.16, 2.01)</td>
<td></td>
</tr>
<tr>
<td>Pulmonary Embolism</td>
<td>1.98 (1.65, 2.40)</td>
<td></td>
</tr>
<tr>
<td>Unplanned Intubation</td>
<td>1.25 (1.03, 2.56)</td>
<td></td>
</tr>
<tr>
<td>Pneumonia</td>
<td>2.92 (2.00, 4.29)</td>
<td></td>
</tr>
<tr>
<td>Organ Space SSI</td>
<td>2.92 (2.00, 4.29)</td>
<td></td>
</tr>
<tr>
<td>30-day Mortality</td>
<td>1.86 (1.15, 1.42)</td>
<td></td>
</tr>
<tr>
<td>Any Major Morbidity</td>
<td>1.55 (1.29, 1.87)</td>
<td></td>
</tr>
</tbody>
</table>

No Data on Recent Quitters vs. Current Smokers
Editorialists: Still No Consensus

- Chow and Devereaux 2011:
  “The appropriate advice regarding the optimal timing of smoking cessation for patients seen close to their scheduled surgery awaits further research.”

- Shi and Warner 2011:
  “Although it may take several weeks to derive pulmonary benefit from quitting, fear of a increase in pulmonary complications should not be a barrier for clinicians to help their patients quit smoking at any time before surgery.”

- Katznelson and Beattie 2011:
  “We should not ignore the possibility that, in the short-term, smoking cessation may increase pulmonary complications...”

- Cochrane Review of Interventions 2009
  “Interventions that begin four to eight weeks before surgery ... are more likely to have an impact on complications”
How to Reconcile?

- No confident evidence from large randomized trials that brief periods of cessation increase PPC risk
- Consider brief duration to be safe unless disputed by future research
- Longer periods of cessation are better than shorter ones
- However, any time before surgery is a proper teachable moment
What to Advise Mr. Salem?

- Brief duration cigarette cessation most likely will not increase your risk of pneumonia
- Let’s use this teachable moment to work on quitting
- Counseling plus NRT most likely to help
- Varenicline unstudied but may be more effective based on studies in non-surgical settings
WHICH PULMONARY RISK PREDICTOR INDEX PERFORMS THE BEST?
Ms. Emerson

- 48 year old woman
- Gold class 2 COPD
- Preparing for hemicolecctomy for cancer
- How can you estimate her risk of PPCs?
History of Pulmonary Risk Indices

1. Arozzullah NSQIP Indices – Respiratory failure and pneumonia separate  
   - 2001 / updated 2007

2. Canet Risk Index – All PPCs  
   - 2010

3. Gupta NSQIP Index – Respiratory failure  
   - 2011
Gupta 2011 NSQIP Respiratory Failure Index

- Derivation (n=211,410) and validation (n=257,385) cohorts
- Included all types of surgery
- Outcome was postop respiratory failure:
  - Unplanned intubation or reintubation with in 30 days
  - Mechanical ventilation for > 48 hours
- Multivariable logistic regression to identify independent predictors
- Mortality 25.6% vs. 0.98% if no respiratory failure

Chest 2011;140;1207
# Impact of Selected Risk Factors on PPC Rates (Derivation Cohort)

<table>
<thead>
<tr>
<th>Risk factor</th>
<th>Adjusted OR</th>
<th>Risk factor</th>
<th>Adjusted OR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependent functional status</td>
<td>4.07</td>
<td>Neurosurgery</td>
<td>2.08</td>
</tr>
<tr>
<td>ASA class</td>
<td></td>
<td>Cardiac</td>
<td>1.32</td>
</tr>
<tr>
<td>• 1</td>
<td>0.03</td>
<td>Intestinal</td>
<td>1.78</td>
</tr>
<tr>
<td>• 2</td>
<td>0.14</td>
<td>ENT</td>
<td>1.11</td>
</tr>
<tr>
<td>• 3</td>
<td>0.54</td>
<td>Hepatobiliary</td>
<td>2.64</td>
</tr>
<tr>
<td>• 4</td>
<td>1.28</td>
<td>OB/GYN</td>
<td>0.29</td>
</tr>
<tr>
<td>Preop sepsis</td>
<td>1.32</td>
<td>Thoracic</td>
<td>1.96</td>
</tr>
<tr>
<td>Emergency</td>
<td>0.56</td>
<td>Bariatric</td>
<td>0.36</td>
</tr>
<tr>
<td>Aortic</td>
<td>2.94</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Five Independent Predictors

1. Procedure type
2. ASA classification
3. Emergency surgery
4. Functional status
5. Preoperative sepsis
Final 5-Factor Risk Index Performs Well

Observed vs. Expected PRF - Calibration of Predictions in the Training Set - "Final" Model
# Risk Calculator

**Postoperative Respiratory Failure (PRF) Risk Calculator**

<table>
<thead>
<tr>
<th>Procedure:</th>
<th>Enter</th>
<th>Estimated risk probability for PRF:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 for Anorectal</td>
<td>2</td>
<td>6.60%</td>
</tr>
<tr>
<td>2 for Aortic</td>
<td>12 for Neck (Thyroid and Parathyroid)</td>
<td></td>
</tr>
<tr>
<td>3 for Bariatric</td>
<td>13 for Obstetric/Gynecologic</td>
<td></td>
</tr>
<tr>
<td>4 for Brain</td>
<td>14 for Orthopedic and non-vascular Extremity</td>
<td></td>
</tr>
<tr>
<td>5 for Breast</td>
<td>15 for Other abdominal</td>
<td></td>
</tr>
<tr>
<td>6 for Cardiac</td>
<td>16 for Peripheral Vascular</td>
<td></td>
</tr>
<tr>
<td>7 for ENT (except thyroid/parathyroid)</td>
<td>17 for Skin</td>
<td></td>
</tr>
<tr>
<td>8 for Foregut/Hepatopancreatobiliary</td>
<td>18 for Spine</td>
<td></td>
</tr>
<tr>
<td>9 for Gallbladder, appendix, adrenal and spleen</td>
<td>19 for non-esophageal Thoracic</td>
<td></td>
</tr>
<tr>
<td>10 for Hernia (ventral, inguinal, femoral)</td>
<td>20 for Vein</td>
<td></td>
</tr>
<tr>
<td>11 for Intestinal</td>
<td>21 for Urology</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ASA Class</th>
<th>Enter 1 - 5 for ASA Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Emergency case</th>
<th>Enter 1 for emergent case 0 for without</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Functional Status</th>
<th>Enter 2 for patients with totally dependent functional status 1 for patients who have partially dependent functional status 0 for those who are totally independent</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sepsis</th>
<th>Enter 3 for patients with preoperative systemic inflammatory response syndrome (SIRS) 2 for patients with preoperative septic shock 1 for patients with preoperative sepsis 0 for without</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>
Canet Risk Index: How Does It Compare?

<table>
<thead>
<tr>
<th>Factor</th>
<th>Adjusted OR</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Age: 51-80</td>
<td>1.4</td>
<td>3</td>
</tr>
<tr>
<td>&gt;80</td>
<td>5.1</td>
<td>16</td>
</tr>
<tr>
<td>2. Preop O(_2) saturation: 91-95 %</td>
<td>2.2</td>
<td>8</td>
</tr>
<tr>
<td>≤ 90 %</td>
<td>10.7</td>
<td>24</td>
</tr>
<tr>
<td>3. Respiratory infection &lt; month</td>
<td>5.5</td>
<td>17</td>
</tr>
<tr>
<td>4. Hb ≤ 10</td>
<td>3.0</td>
<td>11</td>
</tr>
<tr>
<td>5. Surgical site</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upper abdominal</td>
<td>4.4</td>
<td>15</td>
</tr>
<tr>
<td>Thoracic</td>
<td>11.4</td>
<td>24</td>
</tr>
<tr>
<td>6. Duration of surgery 2-3 hours</td>
<td>4.9</td>
<td>16</td>
</tr>
<tr>
<td>&gt; 3 hours</td>
<td>9.7</td>
<td>23</td>
</tr>
<tr>
<td>7. Emergency surgery</td>
<td>2.2</td>
<td>8</td>
</tr>
</tbody>
</table>
Canet Risk Index Performance

- Low Risk < 26
- Interim Risk 26 - 44
- High Risk > 44

Derivation vs. Validation
Gupta vs. Canet Index

- **GUPTA**
  - Broad array of procedures including cardiac
  - Respiratory failure as only outcome
  - Simple 5 factor index
  - Requires downloadable calculator
  - Performs well

- **CANET**
  - Studied all PPCs
  - Included minor events
  - 7 factors
  - All factors readily available in clinical setting
  - Performs well
1. WHAT IS THE IMPACT OF OSA ON PPC RATES?
2. SHOULD WE SCREEN BEFORE SURGERY?
Mr. Pickwick

- You see Mr. Pickwick
- 58 year old man
- Planning elective cholecystectomy
- He sleeps in a separate room as snoring keeps his wife awake
- BMI is 40
- Should we screen for OSA before surgery?
- If present, what risk does OSA confer?
Cleveland Clinic IMPACT Study of OSA

- 39,771 patients seen in preop internal medicine clinic over 4 year period
- Studied patients who had a PSG within 3 years of surgical date
- Identified patients with AHI > 5 on PSG
- Matched to control patients by propensity score adjustment for age, gender, race, BMI, general anesthesia, ASA class, # of comorbidities
# Substantial Between Group Differences Well Balanced after Propensity Score Adjustment

<table>
<thead>
<tr>
<th>Variable</th>
<th>AHI ≥ 5 %</th>
<th>AHI &lt; 5 %</th>
<th>p value</th>
<th>Propensity adjusted p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>55.9</td>
<td>46.3</td>
<td>&lt; 0.0001</td>
<td>0.68</td>
</tr>
<tr>
<td>Female</td>
<td>55.3</td>
<td>80.4</td>
<td>0.12</td>
<td>0.74</td>
</tr>
<tr>
<td>BMI</td>
<td>38.3</td>
<td>33.0</td>
<td>&gt; 0.0001</td>
<td>0.78</td>
</tr>
<tr>
<td>General anesthesia</td>
<td>80.9</td>
<td>82.6</td>
<td>0.65</td>
<td>0.35</td>
</tr>
<tr>
<td>ASA class 1-2</td>
<td>39.1</td>
<td>66.0</td>
<td>&lt; 0.0001</td>
<td>0.42</td>
</tr>
<tr>
<td>≥ 1 cormorbidity</td>
<td>81.8</td>
<td>55.0</td>
<td>&lt; 0.0001</td>
<td>0.99</td>
</tr>
<tr>
<td>COPD</td>
<td>11.7</td>
<td>3.7</td>
<td>0.002</td>
<td>0.50</td>
</tr>
<tr>
<td>Cigarette use</td>
<td>30.1</td>
<td>20.1</td>
<td>0.02</td>
<td>0.78</td>
</tr>
</tbody>
</table>
Higher PPC and Overall Complication Rates if AHI ≥ 5

<table>
<thead>
<tr>
<th>Complication</th>
<th>AHI ≥ 5</th>
<th>AHI &lt; 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypoxemia</td>
<td>7.9</td>
<td>2</td>
</tr>
<tr>
<td>Resp failure</td>
<td>4.3</td>
<td>2</td>
</tr>
<tr>
<td>Reintubation</td>
<td>9.2</td>
<td>1.1</td>
</tr>
<tr>
<td>ICU transfer</td>
<td>5.7</td>
<td>1.3</td>
</tr>
<tr>
<td>Any complication</td>
<td>6.9</td>
<td>2.0</td>
</tr>
</tbody>
</table>

Propensity adjusted OR
Comparison to Administrative Database Study: Aspiration and Intubation More Common among Patients with OSA

**Orthopedic Surgery**

<table>
<thead>
<tr>
<th>Incidence (%)</th>
<th>Aspiration</th>
<th>ARDS</th>
<th>PE</th>
<th>Intubation</th>
</tr>
</thead>
<tbody>
<tr>
<td>no SA (matched sample)</td>
<td>0.84</td>
<td>0.45</td>
<td>0.42</td>
<td>0.79</td>
</tr>
<tr>
<td>SA (matched sample)</td>
<td>1.18</td>
<td>1.06</td>
<td>0.51</td>
<td>3.99</td>
</tr>
</tbody>
</table>

**OR 1.95**

**General Surgery**

<table>
<thead>
<tr>
<th>Incidence (%)</th>
<th>Aspiration</th>
<th>ARDS</th>
<th>PE</th>
<th>Intubation</th>
</tr>
</thead>
<tbody>
<tr>
<td>no SA (matched sample)</td>
<td>2.05</td>
<td>2.279</td>
<td>2.44</td>
<td>0.49</td>
</tr>
<tr>
<td>SA (matched sample)</td>
<td>5.94</td>
<td>10.8</td>
<td>0.45</td>
<td>0.45</td>
</tr>
</tbody>
</table>

**OR 5.20**

*Anesth Analg 2011;112:113*
<table>
<thead>
<tr>
<th></th>
<th>Should We Screen Before Surgery? Which Screening Tool?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ASA</td>
</tr>
<tr>
<td>2</td>
<td>STOP</td>
</tr>
<tr>
<td>3</td>
<td>STOP - BANG</td>
</tr>
<tr>
<td>4</td>
<td>Berlin</td>
</tr>
</tbody>
</table>
Number of Elements: STOP is Simplest to Use in Practice

<table>
<thead>
<tr>
<th>12-14</th>
<th>• ASA</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>• STOP</td>
</tr>
<tr>
<td>8</td>
<td>• STOP - BANG</td>
</tr>
<tr>
<td>11</td>
<td>• Berlin</td>
</tr>
</tbody>
</table>
WHAT DOES THE ASA SAY ABOUT SLEEP APNEA?
ASA Practice Guideline 2006

- Limited evidence
- Based on expert opinion
- Screen all patients by history and physical
- Presume diagnosis of OSA if
  - Features present in at least 2 categories

1. History
   - Snoring
   - Observed apneas
   - Frequent arousals

2. Exam
   - BMI > 35
   - Neck size
   - Facial characteristics
   - Tonsils nearly touching

3. Somnolence

Anesthesiology 2006;104:1081
What is STOP?

1. Do you **snore** loudly?
2. Do you often feel **tired**, fatigued, or sleepy?
3. Has anyone **observed** you stop breathing during sleep?
4. Do you have high blood **pressure**?
Test Characteristics: Three Screening Tools Are Comparable

<table>
<thead>
<tr>
<th>%</th>
<th>STOP</th>
<th>Berlin</th>
<th>ASA</th>
</tr>
</thead>
<tbody>
<tr>
<td>AHI &gt; 15</td>
<td>74</td>
<td>79</td>
<td>79</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>53</td>
<td>51</td>
<td>37</td>
</tr>
<tr>
<td>Specificity</td>
<td>51</td>
<td>51</td>
<td>45</td>
</tr>
<tr>
<td>PPV</td>
<td>31</td>
<td>32</td>
<td>28</td>
</tr>
<tr>
<td>AHI &gt;30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensitivity</td>
<td>80</td>
<td>87</td>
<td>87</td>
</tr>
<tr>
<td>Specificity</td>
<td>49</td>
<td>46</td>
<td>36</td>
</tr>
<tr>
<td>PPV</td>
<td>31</td>
<td>32</td>
<td>28</td>
</tr>
</tbody>
</table>

Anesthesiology 2008;108:822
Only STOP and ASA Checklist Predict PPCs

* P < 0.05

Anesthesiology 2008;108:822
Summary

- Brief period < 8 weeks of cigarette cessation is probably not harmful
- Longer durations of cessation more effective than brief durations
- Canet or Gupta indices comparable as tools for initial PPC risk stratification
- OSA is an important risk factor
- Consider screening for OSA; still unresolved
Perioperative Blood Transfusions

An 81 year old female presents with an acute right hip fracture after a fall. Following surgical repair, at which Hgb level would you recommend blood transfusion?

A. < 7 g/dL
B. < 8 g/dL
C. < 9 g/dL
D. < 10 g/dL
Background

- Impact of blood transfusions on outcomes of anemic patients undergoing non-cardiac surgery not well characterized.

- Indications for post-operative transfusions remain controversial.

- Current recommendations regarding perioperative blood transfusion are mostly based on expert consensus, and not controlled studies.
Liberal or Restrictive Transfusion in High-Risk Patients after Hip Surgery

Jeffrey L. Carson, M.D., Michael L. Terrin, M.D., M.P.H., Helaine Noveck, M.P.H.,
David W. Sanders, M.D., Bernard R. Chaitman, M.D., George G. Rhoads, M.D., M.P.H.,
George Nemo, Ph.D., Karen Dragert, R.N., Lauren Beaupre, P.T., Ph.D.,
Kevin Hildebrand, M.D., William Macaulay, M.D., Courtland Lewis, M.D.,
Donald Richard Cook, B.M.Sc., M.D., Gwendolyn Dobbin, C.C.R.P.,
Khwaja J. Zakriya, M.D., Fred S. Apple, Ph.D., Rebecca A. Horney, B.A.,
and Jay Magaziner, Ph.D., M.S.Hyg., for the FOCUS Investigators*

“A higher threshold for blood transfusion (Hgb <10g/dl) would improve functional recovery and reduce morbidity and mortality, as compared with a more restrictive transfusion strategy (Hgb<8g/dl or symptoms)”

Patient Selection

- Patients > 50 years of age undergoing primary surgical repair for acute hip fracture.
- Have clinical evidence of cardiovascular disease.
- Hgb of < than 10 g per dL within 3 days after surgery.

Methods

- Patients were randomly assigned to the liberal-strategy group or the restrictive-strategy group
Outcomes

- **Primary Outcome:**
  - Death
  - Inability to walk 10 ft without human assistance at 60 day follow up

- **Secondary Outcomes:**
  - Combined outcome of in-hospital myocardial infarction, unstable angina, or death for any reason
  - Functional measures

- **Tertiary Outcomes:**
  - In-hospital morbidity up to 30 days after randomization
Study Population

- 2,016 patients randomly assigned
- 1,007 patients assigned to liberal-strategy
- Mean age 81.6 years
- 94% white
- 75% female
- Cardiovascular disease in 62.9%
Results

- **Primary Outcome**: No difference
  - Liberal-strategy group = 35.2%
  - Restrictive-strategy group = 34.7% (p=0.90)

- **Secondary Outcomes**: No difference
  - Liberal-strategy group = 5.2%
  - Restrictive-strategy group = 4.3% (p=0.15)

- **Tertiary Outcomes**: No difference
  - Liberal-strategy group = 4.3%
  - Restrictive-strategy group = 5.2% (p=0.17)
Conclusions

There was no difference between a liberal transfusion strategy compared to a restrictive transfusion strategy in mortality or ability to walk 10 feet unassisted.

More than half the patients in the restrictive transfusion group did not receive a blood transfusion.

It is reasonable to withhold transfusion unless Hgb falls below 8 g/dL if the patient is without symptoms.
Association between Intraoperative Blood Transfusion and Mortality and Morbidity in Patients Undergoing Noncardiac Surgery

Laurent G. Glance, M.D.,* Andrew W. Dick, Ph.D.,† Dana B. Mukamel, Ph.D.,‡ Fergal J. Fleming, M.D.,§ Raymond A. Zollo, M.D.,* Richard Wissler, M.D.,* Rabih Salloum, M.D.,|| U. Wayne Meredith, M.D.,# Turner M. Osler, M.D.**

Aim

Determine whether noncardiac surgery patients with hematocrits < 30% who receive 1-2 PRBCs intraoperatively are less likely to survive and experience complications:

- Cardiac arrest or MI
- Pulmonary
- Renal failure
- CNS
- Sepsis
- Wound complication
- Thromboembolic
Patient Selection

- Data from American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP) from 2005-2007
- 10,100 general, vascular, and orthopedic patients

Outcomes

30 day mortality and major 30 day complications
Results

- Patients receiving 1 or 2 PRBCs intraoperatively were older, female, outside hospital transfers, or dependent status

- 21.4% of patients transfused intraoperatively

- 30-day mortality rate
  - 6.44% for those transfused
  - 4.26% for those not transfused

- Blood transfusion associated with increased risk of death (OR 1.29; 95% CI, 1.03-1.62)
## Results

### Table 3. Impact of Intraoperative Transfusion on 30-Day Mortality and 30-Day Complications

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Transfusion Group, Outcome Rate (%)</th>
<th>No Transfusion Group, Outcome Rate (%)</th>
<th>Unadj OR Txf vs. No Txf (95% CI)</th>
<th>Adj OR Txf vs. No Txf (95% CI)</th>
<th>Adj OR Txf vs. No Txf (PS Method) (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortality</td>
<td>6.44</td>
<td>4.26</td>
<td>1.55 (1.24, 1.90)</td>
<td>1.29 (1.03, 1.62)</td>
<td>1.21 (0.96, 1.52)</td>
</tr>
<tr>
<td>Cardiac complications</td>
<td>2.08</td>
<td>1.40</td>
<td>1.50 (1.06, 2.12)</td>
<td>1.40 (0.97, 2.03)</td>
<td>1.31 (0.88, 1.95)</td>
</tr>
<tr>
<td><strong>Pulmonary complications</strong></td>
<td><strong>12.6</strong></td>
<td><strong>6.03</strong></td>
<td><strong>2.24 (1.92, 2.63)</strong></td>
<td><strong>1.76 (1.48, 2.09)</strong></td>
<td><strong>1.75 (1.47, 2.08)</strong></td>
</tr>
<tr>
<td>Renal complications</td>
<td>2.69</td>
<td>1.85</td>
<td>1.46 (1.08, 1.99)</td>
<td>1.32 (0.93, 1.88)</td>
<td>1.29 (0.91, 1.84)</td>
</tr>
<tr>
<td>CNS complications</td>
<td>0.69</td>
<td>0.58</td>
<td>1.20 (0.67, 2.15)</td>
<td>0.84 (0.43, 1.64)</td>
<td>0.68 (0.34, 1.38)</td>
</tr>
<tr>
<td>Sepsis complications</td>
<td>16.4</td>
<td>9.81</td>
<td>1.81 (1.58, 2.07)</td>
<td>1.43 (1.21, 1.68)</td>
<td>1.46 (1.24, 1.72)</td>
</tr>
<tr>
<td>Wound complications</td>
<td>9.17</td>
<td>4.65</td>
<td>2.07 (1.73, 2.48)</td>
<td>1.87 (1.47, 2.37)</td>
<td>1.89 (1.49, 2.41)</td>
</tr>
<tr>
<td>Thromboembolic complications</td>
<td>4.07</td>
<td>1.89</td>
<td>2.20 (1.69, 2.88)</td>
<td>1.77 (1.32, 2.38)</td>
<td>1.81 (1.34, 2.45)</td>
</tr>
</tbody>
</table>

Adj = adjusted; CI = confidence interval; CNS = central nervous system; OR = odds ratio; PS method = propensity score method; Txf = transfusion; Unadj = unadjusted.
Conclusions

Blood transfusion in noncardiac surgery associated with:

- Increased risk of 30-day mortality
- Increased risk of pulmonary, septic, wound and thromboembolic complications
- 29% increased odds of death
- 40-90% increased odds of 4 postoperative complications
Take Home on Blood Transfusions and Noncardiac Surgery

- For hip fractures, transfuse for Hgb < 8 g/dL or if signs and symptoms of anemia.

- Intraoperative blood transfusion is associated with increased mortality and morbidity.

- Patients with lesser degrees of anemia or blood loss, adverse effects of transfusion may outweigh benefits.
Atrial Fibrillation and Statins

70 yo man with HTN and hyperlipidemia with right colon mass admitted for right hemicolecotony. Current medications include HTCZ, lisinopril, and atorvastatin. What is the patient’s clinical risk of postoperative atrial fibrillation and does atorvastatin prevent it?
Statin use and postoperative atrial fibrillation after major noncardiac surgery

Prashant D. Bhave, MD,* L. Elizabeth Goldman, MD,† Eric Vittinghoff, PhD,‡ Judith H. Maselli, MSPH,§ Andrew Auerbach, MD, MPH§

From the *Division of Cardiology, Northwestern University Feinberg School of Medicine, Chicago, Illinois; †Division of General Internal Medicine, ‡Department of Epidemiology and Biostatistics, and §Division of Hospital Medicine, University of California San Francisco, San Francisco, California.

Bhave PD, Goldman LE, Vittinghoff E, et al.
Aim

“To examine the association between treatment with statin medications and clinically significant postoperative atrial fibrillation following major noncardiac surgery.”

Outcome Measures

In-hospital mortality, length of stay, actual hospitalization costs, 15 and 30 day readmission rate

Methods

- Patients included >18 yo; major surgical procedures excluding cardiovascular and obstetrics.

- Atrial fibrillation diagnosis with secondary diagnosis ICD-9-CM code of 427.31 and one of the following:
  - Procedure code for electrical cardioversion
  - Pharmacy charges for iv BBs, iv calcium channel blockers, iv amiodarone
  - New prescription for digoxin, in the postoperative period.
Results

- 370,477 patients met criteria
  - 79,871 patients (21.6%) received a statin in the perioperative period.
  - Patients who received statin more likely to be white, older, and taking beta-blockers.
  - 10,957 (3.0%) had significant atrial fibrillation.
  - More frequent in thoracic and ENT surgeries.

- Protective effect of statin use for the development of postoperative atrial fibrillation (adjusted OR=0.79; 95% CI = 0.71-0.89; p<0.001)
# Statin Use and outcomes in patients developing Postoperative Atrial Fibrillation

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Statin (n= 2,114, 20% total with POAF)</th>
<th>No statin (n= 8,843, 80% total with POAF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortality (1,549 deaths, 14.1%)</td>
<td>203 (9.6%)</td>
<td>1,346 (15.2%)</td>
</tr>
<tr>
<td>Readmission 15d (1,066, 9.7%)</td>
<td>207 (9.8%)</td>
<td>859 (9.7%)</td>
</tr>
<tr>
<td>Readmission 30d (1,584, 14.5%)</td>
<td>323 (15.3%)</td>
<td>1,261 (14.3%)</td>
</tr>
<tr>
<td>Cost ($)</td>
<td>$14,598-$29,819</td>
<td>$15,617-$34,634</td>
</tr>
<tr>
<td>LOS (d)</td>
<td>5-16 days</td>
<td>7-20 days</td>
</tr>
</tbody>
</table>

POAF = Postoperative Atrial Fibrillation
Conclusions

- Overall, showed protective effect of statin use (Adjusted OR = 0.79; CI= 0.71-0.89; p< 0.01)
- Larger protective effect in diabetics
- No difference across surgery type
- Small absolute effect size of 0.4% reduction.
- Did not improve outcomes in patients who did develop significant postoperative atrial fibrillation
Aim

“Assess the influence of perioperative statin treatment on the risk of death, myocardial infarction, atrial fibrillation, and hospital and intensive care unit length of stay in statin-naive patients undergoing cardiac or noncardiac surgery.”

Methods

- Meta-analysis: 15 RCT studies included, 2,292 patients
- Trials with 40-533 patients each
- 11 cardiac, 2 non-cardiac, 2 vascular studies
- Subgroup analysis of surgery type, potency of or duration of statin treatment affected outcomes
- Preoperative statin treatment for 2-37 days
Results

- **Perioperative MI** - 10/15 studies
  - Incidence of perioperative MI in patients with statins 4.5% versus 8.9% in controls.
  - Absolute risk reduction in MI attributed to statin 4.4%, NNT of 23.

- **Perioperative Atrial Fibrillation** - 9/15 studies
  - Incidence of perioperative atrial fibrillation in patients with statin 19.9% versus 36.3% in controls.
Conclusions

- Perioperative statin use reduces the risk of atrial fibrillation and MI and decreases LOS in statin-naive patients undergoing cardiac and noncardiac surgery.

- A trend towards reduction in death, but not statistically significant.

- Authors advocate for perioperative use of statins in high-risk surgical patients.
Take Home Message

Statin medications likely offer anti-inflammatory-pleiotropic- benefits as well as direct anti-arrhythmic benefits.

Patients who take statin medications should be continued on them through surgery.

Not enough evidence to yet recommend initiating statins in all in the preoperative period as of yet, but consider for high-risk and cardiac surgery patients.
Final Take Home Points

Optimize patient’s anemia preoperatively!

Continue statins through the perioperative period for additional benefits and consider starting high-risk patients preoperatively.
Questions?
Update in Perioperative Medicine

Steven L. Cohn, MD, FACP, SFHM
Gerald W. Smetana, MD, FACP
Geraldine Menard, MD, FACP, FHM
SUPPLEMENT

Postoperative Delirium and Functional Decline After Noncardiac Surgery

Nicky Quinlan, MB, MRCPI,*† and James L. Rudolph, MD, SM*††

Quinlan N and Rudolph JL. J Amer Geriatr Soc. 2011Nov; Suppl 2: S301-4
Aim

- Multi-site, international study of intraoperative events and cognitive dysfunction 1 week and 3 months postoperatively.

- Determine whether there was an association between postoperative delirium and functional decline at 3 months in cohort of older surgical patients.
Methods

- 948 patients included; 270 patients did not complete 3 month follow up.

- Trained testers examined patients on operative day, daily for 3 days to assess for delirium.

- Functional performance assessed through 6 question yes-or-no questions regarding ADLs.
Table 1. Characteristics of Participants with and without Functional Decline

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Preserved or Improved Function (n = 759)</th>
<th>Functional Decline (n = 189)</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean ± SD</td>
<td>68.2 ± 5.8</td>
<td>70.3 ± 5.8</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Male, n (%)</td>
<td>417 (55)</td>
<td>67 (35)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Education, years, mean ± SD</td>
<td>10.3 ± 3.9</td>
<td>9.5 ± 3.1</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Mini Mental State Examination, score, mean ± SD</td>
<td>27.9 ± 1.5</td>
<td>27.6 ± 1.7</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Preoperative functional impairment, n (%)</td>
<td>142 (19)</td>
<td>33 (17)</td>
<td>.68</td>
</tr>
<tr>
<td>Surgery type, n (%)</td>
<td>–</td>
<td>–</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Abdominal (n = 324)</td>
<td>243 (32)</td>
<td>81 (43)</td>
<td>–</td>
</tr>
<tr>
<td>Genitourinary (n = 212)</td>
<td>188 (25)</td>
<td>24 (13)</td>
<td>–</td>
</tr>
<tr>
<td>Orthopedic (n = 148)</td>
<td>107 (14)</td>
<td>41 (22)</td>
<td>–</td>
</tr>
<tr>
<td>Vascular (n = 139)</td>
<td>115 (15)</td>
<td>24 (13)</td>
<td>–</td>
</tr>
<tr>
<td>Thoracic (n = 25)</td>
<td>18 (2)</td>
<td>7 (4)</td>
<td>–</td>
</tr>
<tr>
<td>Other (n = 100)</td>
<td>88 (12)</td>
<td>12 (6)</td>
<td>–</td>
</tr>
<tr>
<td>Surgery duration, minutes, mean ± SD</td>
<td>143.8 ± 77.9</td>
<td>163.6 ± 99.5</td>
<td>.03</td>
</tr>
<tr>
<td>Delirium, n (%)</td>
<td>39 (5)</td>
<td>22 (12)</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Delirium duration, n (%)</td>
<td>–</td>
<td>–</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>No delirium</td>
<td>720 (81)</td>
<td>167 (19)</td>
<td>–</td>
</tr>
<tr>
<td>1–2 days</td>
<td>34 (68)</td>
<td>16 (32)</td>
<td>–</td>
</tr>
<tr>
<td>≥ 3 days</td>
<td>5 (45)</td>
<td>6 (55)</td>
<td>–</td>
</tr>
</tbody>
</table>

Results

- Delirium was significantly associated with functional decline at 3 months
  
- Adjusted OR = 2.1 (95% CI 1.2-3.8) (p = .01)
  
- 20% of total group experienced decline in function.
  - More likely to be older, female, and had longer operative procedures.
  
- More prolonged delirium was associated with greater functional decline (55%) (p < .001)
  
- Delirium was twice as prevalent in the group with functional decline (12% versus 5%)
Conclusions

- Delirium in the postoperative setting is associated with functional decline.

- Male patients and those who do not follow up are more likely to have experienced delirium.