Innovations & Guidelines in Perioperative Medicine

Hugo Quinny Cheng, MD
Division of Hospital Medicine
University of California, San Francisco

Disclosures

- No discussion of unapproved medications
- Non-FDA approved indications for medications presented for perioperative anticoagulation
- No financial relationships with pharmaceutical industry
Update on Perioperative Medicine

Tools for Risk Prediction
- Cardiac risk prediction
- Respiratory failure prediction
- Surgical mortality in patients with cirrhosis

New Guidelines for Surgical Patients
- Perioperative anticoagulation
- Transfusion trigger

Estimating & Reporting Cardiac Risk

A 70-y.o. man with progressive arm & leg weakness is diagnosed with severe cervical myelopathy.

The neurosurgeon recommends urgent cervical spine decompression & fusion, and consults you for preoperative medical evaluation.

Past History: remote MI, stroke, and DM type 2 on insulin,
Functional capacity: uses a walker, needs help with some ADLs

How would you report this patient’s cardiac risk?
70-y.o. with remote MI, stroke, IDDM is undergoing cervical spine surgery for arm & leg weakness.

**How would you estimate this patient’s cardiac risk?**

1. I use the Revised Cardiac Risk Index (RCRI), so ~ 10%
2. I use the RCRI, so ~ 5%
3. I use the “NSQIP” prediction tool, so ~ 1%
4. My gut says surgery will be like "death-on-a-stick"

### Revised Cardiac Risk Index

**Predictors:**
- Ischemic heart disease
- Congestive heart failure
- Diabetes requiring insulin
- Creatinine > 2 mg/dL
- Stroke or TIA
- “High Risk” operation
  (intraperitoneal, intrathoracic, or suprainguinal vascular)

<table>
<thead>
<tr>
<th># of RCRI Predictors</th>
<th>Any Complications</th>
<th>Serious Complications</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.5%</td>
<td>0.4%</td>
</tr>
<tr>
<td>1</td>
<td>1.3%</td>
<td>1%</td>
</tr>
<tr>
<td>2</td>
<td>4%</td>
<td>2.4%</td>
</tr>
<tr>
<td>≥ 3</td>
<td>9%</td>
<td>5.4%</td>
</tr>
</tbody>
</table>

Any: MI, cardiac arrest, complete heart block, **pulmonary edema**

Serious: MI & cardiac arrest

New Cardiac Risk Prediction Tool

Derived from National Surgical Quality Improvement Program (NSQIP) database:
• > 400 K patients in derivation & validation cohorts
• Wide range of operations
• “Complication” = 30-day incidence of MI & cardiac arrest

<table>
<thead>
<tr>
<th>Independent Predictors</th>
<th>1. Type of surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2. Age</td>
</tr>
<tr>
<td></td>
<td>3. Serum creatinine &gt; 1.5 mg/dL</td>
</tr>
<tr>
<td></td>
<td>4. Functional status (dependency for ADLs)</td>
</tr>
<tr>
<td></td>
<td>5. American Society of Anesth (ASA) class</td>
</tr>
</tbody>
</table>


ASA Class (a brief digression)

American Society of Anesthesiologists Physical Classification
1. Healthy, normal
2. Mild systemic disease
3. Severe systemic disease
4. Severe systemic disease that is a constant threat to life
5. Moribund patient not expected to survive without surgery

Death-on-a-Stick™
70-y.o. with h/o remote MI, stroke, IDDM undergoing cervical spine surgery. Needs help with some ADLs.

Age 70
Cr < 1.5
ASA Class 3
Partially dependent
Spine surgery

www.qxmd.com/calculate-online/cardiology/gupta-perioperative-cardiac-risk
70-y.o. with h/o remote MI, stroke, IDDM undergoing cervical spine surgery for progressive weakness.

Gupta Perioperative Cardiac Risk

Estimated risk of perioperative myocardial infarction or cardiac arrest: 0.72%

www.qxmd.com/calculate-online/cardiology/gupta-perioperative-cardiac-risk

Other findings:
- Excellent performance (AUC = 0.88)
- MI/Cardiac arrest strongly predicts mortality (61% vs. 1%)

Caveats:
- Didn’t look at all possible variables (e.g., TTE, stress test)

Which Prediction Tool is Better?

<table>
<thead>
<tr>
<th>RCRI</th>
<th>NSQIP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample size</td>
<td>~4000</td>
</tr>
<tr>
<td># of hospitals</td>
<td>1</td>
</tr>
<tr>
<td>Currency of data</td>
<td>’89 −’94</td>
</tr>
<tr>
<td>Possible outcomes</td>
<td>4</td>
</tr>
<tr>
<td>Performance (AUC)</td>
<td>0.75</td>
</tr>
<tr>
<td>Screen for MI?</td>
<td>CK-MB, ECG</td>
</tr>
<tr>
<td>Guideline Adoption</td>
<td>ACC/AHA</td>
</tr>
</tbody>
</table>
Predicting Postoperative Respiratory Failure

What counts as a complication?

Soft endpoints:
- Bronchospasm or Hypoxemia
- Atelectasis or effusions (clinical or radiographic)
- Unexplained fever, cough, dyspnea

Hard endpoints:
- Pulmonary-related mortality
- Respiratory failure (prolonged ventilation or re-intubation)
- Pneumonia (diagnostic criteria vary)
Respiratory Failure Prediction Tool

- Derived from National Surgical Quality Improvement Program (NSQIP) database:
  - > 400 K patients in derivation & validation cohorts
  - Wide range of operations
  - “Respiratory Failure” = on vent > 48 hrs or reintubation

<table>
<thead>
<tr>
<th>Independent Predictors</th>
<th>1. American Society of Anesth (ASA) class</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2. Functional status (dependency)</td>
</tr>
<tr>
<td></td>
<td>3. Type / location of surgery</td>
</tr>
<tr>
<td></td>
<td>4. Emergency surgery</td>
</tr>
<tr>
<td></td>
<td>5. Preoperative sepsis or SIRS</td>
</tr>
</tbody>
</table>


70-y.o. man with h/o MI, stroke, IDDM having spine surgery for progressive weakness.

Non-emergent
ASA Class 3
Partially dependent
Spine surgery
No sepsis/SIRS

www.qxmd.com/calculate-online/respirology/postoperative-respiratory-failure-risk-calculator
70-y.o. with h/o remote MI, stroke, IDDM undergoing cervical spine surgery for progressive weakness.

Other findings:
- Excellent performance (AUC = 0.9)
- Respiratory failures strongly predicts mortality (25% vs. 1%)

Caveat:
- Didn’t look at all possible variables (e.g., OSA, VTE, PFTs)

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**Surgical Risk in Cirrhotic Patients**

A 65-y.o. man with cirrhosis from HCV desires a hip arthroplasty. He feels well and has no current signs of ascites or encephalopathy on examination.

Labs: Creatinine = 1.6
- Total Bilirubin = 1.9
- Albumin = 3.5
- INR = 1.6

**How would you advise this patient about his perioperative mortality risk?**
65-y.o. man with cirrhosis from HCV desires a hip arthroplasty. He’s asymptomatic and has no signs of encephalopathy or ascites.

1. Patients with cirrhosis are not candidates for elective surgery
2. Your mild cirrhosis (Childs-Pugh class A) makes you an acceptable surgical candidate
3. Perioperative risk is acceptable, but long-term mortality risk makes surgery unappealing

Surgical Risk in Cirrhotic Patients

**Question:** How does his cirrhosis affect mortality risk?

**Background:**
- Risk traditionally assessed by Childs-Pugh classification [link](http://www.mdcalc.com/child-pugh-score-for-cirrhosis-mortality)
- Mortality after GI surgery:
  - Class A = 10%
  - Class B = 30%
  - Class C = 70%
- **Limitations:** single time point, less known about non-GI surgery; sensitive to minor laboratory result differences
MELD Score as Risk Predictor

MELD Score (Model for Endstage Liver Disease):
- Main use in organ allocation
- Variables: INR, bilirubin, creatinine

Retrospective multivariate analysis of 772 cirrhotic patients undergoing GI, orthopedic, and CV surgery
- Predictors of mortality: Age, MELD Score, ASA Class IV
- Predicts mortality @ 1 wk, 1 mo, 3 mo, 1 yr, 5 yr

www.mayoclinic.org/meld/mayomodel9.html

Teh et al. Gastroenterology, 2007

65 y.o. man with stable HCV-related cirrhosis. He has no current signs of encephalopathy or ascites.

Labs: Creatinine = 1.6
    Total Bilirubin = 1.9
    Albumin = 3.5
    INR = 1.6

Childs-Pugh Class A
MELD Score = 19

Mortality Prediction:
- Childs-Pugh: 10% in-hospital mortality
- MELD Score: 6.5% 1 week mortality
  24% 1 month mortality
  36% 3 month mortality
  50% 1 year mortality
Managing Perioperative Anticoagulation

Your orthopedic colleague asks your advice on how to manage anticoagulation in two patients who had hip fractures.

- One has atrial fibrillation due to HTN
- The other has a mechanical AVR
- Neither has any other relevant comorbidity

1. Heparin bridge for AVR only
2. Heparin bridge for AF only
3. Heparin bridge for both
4. Heparin bridge for neither

Thromboembolic Risks with Atrial Fibrillation

CHADS-2 Score:
- 1 point for CHF, HTN, Age>75, Diabetes
- 2 points for Stroke/TIA

Score 0 - 2: < 5% annual stroke risk
Score 3 - 4: 5-10%
Score 5 - 6: > 10%

Ansell J. Chest. 2004;126:204S-233S.
Thromboembolic Risks with Mechanical Valves

Annual Incidence

Effect of Mechanical Valve Location & Design on Thromboembolic Risk

Valve Location:
- Aortic  RR = 1.0
- Mitral  RR = 1.8

Valve Design:
- Caged Ball  RR = 1.0
- Tilting Disk  RR = 0.7
- Bi-leaflet  RR = 0.6

Benefits & Harm of Bridging Perioperative Anticoagulation

Death or disability from thromboembolism averted by bridging

Death or disability from perioperative bleeding caused by bridging

Benefits & Risks

No randomized trials
Review of cohort studies:

<table>
<thead>
<tr>
<th></th>
<th>Thrombosis (95% CI)</th>
<th>Total Bleeding (95% CI)</th>
<th>Serious Bleeding (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bridged</td>
<td>1.1%</td>
<td>11%</td>
<td>3.7%</td>
</tr>
<tr>
<td>Not Bridged</td>
<td>0.9%</td>
<td>2%</td>
<td>0.9%</td>
</tr>
<tr>
<td>Odds Ratio</td>
<td>0.8 (0.4-1.5)</td>
<td>5.4 (3.0-9.7)</td>
<td>3.6 (1.5-8.5)</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Atrial Fib.</th>
<th>Mechanical Valve</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHADS2 = 5-6; recent CVA; rheumatic AF</td>
<td>Any MVR; older (caged-ball or tilting disc) AVR; recent CVA</td>
<td>Bridge with heparin</td>
</tr>
<tr>
<td>CHADS2 = 3-4</td>
<td>Bileaflet AVR plus other stroke risk factor(s)</td>
<td>???</td>
</tr>
<tr>
<td>CHADS2 = 0-2</td>
<td>Bileaflet AVR without AF or other stroke risk factor</td>
<td>No heparin bridge</td>
</tr>
</tbody>
</table>

*All recommendations are weak, based on low quality evidence*

Perioperative Transfusion Threshold

Your ortho colleague then asks for your advice on when a hip fracture patient should have a blood transfusion. The patient is a 72 y.o. woman with diabetes and a remote MI. She has no complaints except hip pain. BP & pulse are normal.

1. Keep Hemoglobin > 10
2. Keep Hemoglobin > 9
3. Keep Hemoglobin > 8
4. Keep Hemoglobin > 7
5. Only if she has symptoms
FOCUS* Trial
(*Functional Outcomes in Cardiovascular Patients Undergoing Surgical Hip Fracture Repair)

Patients: 2016 patients undergoing hip fracture repair.
  • Mean age = 82
  • 63% with CV disease (CAD (40%); CVA (24%); CHF(17%))

Treatment: Randomized to 2 transfusion triggers:
  1. Hemoglobin < 10 g/dL
  2. Symptoms of anemia (chest pain, CHF, hypotension or tachycardia unresponsive to fluids) or at physician discretion for Hgb < 8 g/dL

Carson JL et al. NEJM, 2011; 365

FOCUS Trial: Utilization

<table>
<thead>
<tr>
<th>PRBC Units Transfused Median (IQR)</th>
<th>Total Units Transfused</th>
<th>Hgb level prior to transfusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 g/dL Trigger</td>
<td>2 (1,2)</td>
<td>1866</td>
</tr>
<tr>
<td>Symptomatic Trigger (or 8 g/dL)</td>
<td>0 (0,1)</td>
<td>652</td>
</tr>
</tbody>
</table>

Carson JL et al. NEJM, 2011; 365
FOCUS Trial: Outcomes

<table>
<thead>
<tr>
<th></th>
<th>In-hospital mortality</th>
<th>In-hospital mortality, MI, or UA</th>
<th>60-day mortality</th>
<th>60-day mortality + disability</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 g/dL Trigger</td>
<td>2.0%</td>
<td>4.3%</td>
<td>7.6%</td>
<td>35%</td>
</tr>
<tr>
<td>Symptom Triggered</td>
<td>1.4%</td>
<td>5.2%</td>
<td>6.5%</td>
<td>35%</td>
</tr>
</tbody>
</table>

All comparisons non-significant

Caveats to FOCUS Trial

- Small difference in hemoglobin levels may not be clinically significant
- Inadequate power to determine if presence of CV disease affects outcome
- Restrictive transfusion strategy leads to more symptomatic anemia (mostly ↑HR or ↓BP)

Carson JL et al. NEJM, 2011: 365
AABB Transfusion Guidelines

The society formerly known as the American Association of Blood Banks:

- "In postoperative surgical patients, transfusion should be considered at a hemoglobin concentration of 8 g/dL or less or for symptoms (chest pain, orthostatic hypotension or tachycardia unresponsive to fluid resuscitation, or congestive heart failure)."  
  *Strong recommendation*

- Same recommendation if patient has pre-existing CV disease  
  *Weak recommendation*


Take Home Points

1. Pick hard end-points when evaluating & communicating risk
2. New prediction tools for assessing cardiac & pulmonary risk
3. Use MELD score to assess surgical risk in cirrhotic patients
4. Individualize management of perioperative anticoagulation based on patient-specific risk
5. Restrictive transfusion trigger seems safe in surgical patients
Thank You

quinny@medicine.ucsf.edu

www.qxmd.com/calculate-online/cardiology/gupta-perioperative-cardiac-risk

www.qxmd.com/calculate-online/respirology/postoperative-respiratory-failure-risk-calculator

www.mayoclinic.org/meld/mayomodel9.html