Perioperative Medicine 2017
November 3, 2017

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Disclosures

• No conflicts of interest
• Employer: Providence Health & Services
Objectives

- Highlight current understanding of perioperative risks
- Foster understanding of current guideline recommendations for perioperative assessment and management
- Review key points on medication management in perioperative period

Outline

- Background
- Risk Factors
- Evaluation
- Medication Management
Background

48,000,000
2009 US Inpatient Surgical Volume

National Center for Health Statistics
Background- Key Data

• Overall perioperative complication rate low
  < 0.1% for “healthy patients”
• Increase in non-cardiac surgery anticipated
• Migration of “healthy patients” to Ambulatory Surgery Centers (ASC’s)
• Deaths (2001-2006) in ‘approved’ ASC’s
  23/ 1,141,418  (0.002%)

*Ann Int Med. 2016;165(11):ITC81*
*Amer. Assoc. for Accreditation of Ambulatory Surgery Facilities*

Inpatient

• Hospital inpatient population higher/increasing risk (ASC growth)
• Non-standardized perioperative medicine approach → risk not fully mitigated at times
Risk Factors

Determinants of Perioperative Risk

**Procedure Risk**
- Type
- Urgency
- Duration

**Patient Risk**
- Medical Conditions
  - CAD Risk
- Functional Capacity
Perioperative Risk Classification

**Low (<1%)**
- Superficial
- Breast
- Dental
- Cataract
- Endoscopic
- Thyroid
- TURP
- Minor GYN, ortho

**Intermediate (1% - 5%)**
- Intrathoracic; non-major
- Intraperitoneal (splenectomy, cholecystectomy)
- Carotid
- Endovascular aneurysm
- Head & neck
- Neuro, ortho, GYN, Uro major
- Renal Transplant
Perioperative Risk Classification

**High (>5%)**
- Aortic, major vascular
- Major abdominal (esp. with large fluid shifts or blood loss)
- Esophagectomy
- Pneumonectomy
- Lung, liver, pancreas transplant
- adrenalectomy

*Ann Int Med. 2016;165(11):ITC81*

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**Procedure Risk**

- Aortic, peripheral vascular
- Big Cases (↑ blood loss, fluid shifts)
- Emergent major (elderly)
- Endoscopic
- Superficial procedures & minor ortho
- Cataract
- Breast surgery & minor GYN
- Most other procedures
Patient Specific Risk

- Chronic conditions

Chronic Conditions and Perioperative Risk

More comorbid conditions

Higher risk for perioperative complications
American Society of Anesthesiology
ASA Classification of Physical Status

<table>
<thead>
<tr>
<th>Grade</th>
<th>Classification</th>
<th>Perioperative Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Healthy</td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>Mild systemic disease-no functional limitation</td>
<td>&lt; 0.4%</td>
</tr>
<tr>
<td>III</td>
<td>Severe systemic disease-definite functional limitation</td>
<td>0.9%</td>
</tr>
<tr>
<td>IV</td>
<td>Severe systemic disease-constant threat to life</td>
<td></td>
</tr>
<tr>
<td>V</td>
<td>Moribund (not expected to survive despite surgery)</td>
<td></td>
</tr>
</tbody>
</table>
Another Tool- Perioperative Risk

http://riskcalculator.facs.org
### Broad Array of Complications
Estimated (not solely CV)

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>Estimated Risk</th>
<th>Chance of Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serious Complication</td>
<td>6%</td>
<td>Below Average</td>
</tr>
<tr>
<td>Any Complication</td>
<td>6%</td>
<td>Below Average</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>1%</td>
<td>Below Average</td>
</tr>
<tr>
<td>Cardiac Complication</td>
<td>&lt;1%</td>
<td>Below Average</td>
</tr>
<tr>
<td>Surgical Site Infection</td>
<td>3%</td>
<td>Below Average</td>
</tr>
<tr>
<td>Urinary Tract Infection</td>
<td>1%</td>
<td>Below Average</td>
</tr>
<tr>
<td>Venous Thromboembolism</td>
<td>1%</td>
<td>Below Average</td>
</tr>
<tr>
<td>Renal Failure</td>
<td>&lt;1%</td>
<td>Below Average</td>
</tr>
<tr>
<td>Return to OR</td>
<td>1%</td>
<td>Below Average</td>
</tr>
<tr>
<td>Death</td>
<td>&lt;1%</td>
<td>Below Average</td>
</tr>
<tr>
<td>Discharge to Nursing or Rehab Facility</td>
<td>&lt;1%</td>
<td>Below Average</td>
</tr>
</tbody>
</table>

**Outcomes:**
- Serious Complications
- Any Complication
- Pneumonia
- Cardiac Complication
- Surgical Site Infection
- Urinary Tract Infection
- Venous Thromboembolism
- Renal Failure
- Return to OR
- Death

**Predicted Length of Hospital Stay:** 1.0 day
Patient Specific Risk

• Chronic conditions
• Lifestyle factors

– Exercise capacity: 4 METS (4 blocks or 2 flights of stairs) a threshold effect
– Smoking

Arch Int Med 1999;159:2185
Patient Specific Risk

- Chronic conditions
- Lifestyle factors
  - Exercise capacity: 4 METS (4 blocks or 2 flights of stairs) a threshold effect
  - Smoking
- Functional status

Arch Int Med 1999;159:2185

Evaluation
Our Patient

- 65 y/o woman with isolated left colon cancer
- Hemicolecctomy planned
- PMH:
  - Hypertension
  - Borderline lipids

Pre-operative Consultation
Continued...

- Meds:
  - ASA, lisinopril, hydrochlorothiazide
- Walks 3 miles/day
- No CHF/angina
- Exam:
  - HR 74, BP 138/80
  - Cardiopulmonary unremarkable

- ECG: NSR, LVH
- CBC, lytes, Creat Nl
Chest X-rays before surgery
When you need them—and when you don’t

“Usually not helpful for low-risk patients without symptoms”

http://www.choosingwisely.org/doctor-patient-lists/chest-x-rays-before-surgery/

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2014 ACC/AHA Guideline on Perioperative Cardiovascular Evaluation and Management of Patients Undergoing Noncardiac Surgery

 ✓ Core algorithm
 ✓ Tools for clinical practice
First Principles

- If surgical emergency → proceed to surgery

- If acute coronary syndrome: treat per guidelines, anticipating need/urgency for surgery
How do we estimate perioperative risk?

1) ACS NSQIP Surgical Risk Calculator
2) Revised Cardiac Risk Index OR
3) MI or cardiac arrest tool
1. American College of Surgeons National Surgical Quality Improvement Program (NSQIP) Surgical Risk Calculator

NSQIP Surgical Risk Calculator Provides Point Estimate of Risk

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<td>Urinary Tract Infection</td>
<td>1%</td>
<td>Average</td>
</tr>
<tr>
<td>Venous</td>
<td>1%</td>
<td>Below Average</td>
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<tr>
<td>Thromboembolism</td>
<td></td>
<td></td>
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<tr>
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<td>Below Average</td>
</tr>
<tr>
<td>Death</td>
<td>&lt;1%</td>
<td>Below Average</td>
</tr>
<tr>
<td>Discharge to Nursing or Rehab Facility</td>
<td>4%</td>
<td>Average</td>
</tr>
</tbody>
</table>

Predicted Length of Hospital Stay: 1.0 day
2. Revised Cardiac Risk Index (RCRI)

- Six independent predictors of cardiovascular complications
  - History of ischemic heart disease
  - History of CHF
  - History of cerebrovascular disease
  - Preoperative treatment with insulin
  - Preoperative creatinine >2.0 mg/dL
  - High risk surgery

_Circulation_ 1999;100:1043
RCRI Score & Risk of Major Cardiac Event*

<table>
<thead>
<tr>
<th>Points</th>
<th>Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.4 – 0.5%</td>
</tr>
<tr>
<td>1</td>
<td>0.9 – 1.3%</td>
</tr>
<tr>
<td>2</td>
<td>4 – 7%</td>
</tr>
<tr>
<td>3 or more</td>
<td>9 – 11%</td>
</tr>
</tbody>
</table>

* Major cardiac event: MI, pulmonary edema, v. fibrillation, cardiac arrest, and complete heart block

3. MI or Cardiac Arrest Tool

ORIGINAL ARTICLES
Development and Validation of a Risk Calculator for Prediction of Cardiac Risk After Surgery
Circulation
www.surgicalriskcalculator.com/micardiacarrest

Circ 2011;124(4):381
How do we estimate perioperative risk?
1) ACS NSQIP Surgical Risk Calculator ✔
2) Revised Cardiac Risk Index OR ✔
3) MI or cardiac arrest tool
Preoperative Patient without ACS
If risk estimate < 1% → Proceed to surgery
Estimated perioperative risk of MACE based on combined clinical/surgical risk (Step 3)

Low risk (<1%) (Step 4)  Elevated risk (Step 5)
For ≥ 1% Risk: Assessment of Function

Diagram:

- Elevated risk (Step 5)
  - Moderate or greater (>4 METs) functional capacity
    - Excellent (>10 METs)
      - No further testing (Class Ila)
    - Moderate/Good (24–10 METs)
      - Proceed to surgery
  - No or unknown

- Elevated risk (Step 5)
  - Moderate or greater (>4 METs) functional capacity
    - Excellent (>10 METs)
      - No further testing (Class Ila)
    - Moderate/Good (24–10 METs)
      - No further testing (Class IIb)
  - No or unknown
No or unknown

Poor OR unknown functional capacity (<4 METs): Will further testing impact decision making OR perioperative care? (Step 6)

No

Yes
Poor OR unknown functional capacity (<4 METs): Will further testing impact decision making OR perioperative care? (Step 6)

Yes → Pharmacologic stress testing (Class IIa)

If normal

If abnormal

No or unknown

Poor OR unknown functional capacity (<4 METs): Will further testing impact decision making OR perioperative care? (Step 6)

Yes →

No
Our patient

- NSQIP Am College of Surgeons calculator
- Serious complication 13.1% (ave = 18.6%)
- Cardiac complication 0.7% (ave = 1.1%)
- Cardiac complication rate below 1% (Low) risk → proceed to OR without further cardiac testing
Our patient

- NSQIP Am College of Surgeons calculator
- Serious complication 13.1% (ave = 18.6%)
- Cardiac complication 0.7% (ave = 1.1%)
- Below 1% (Low) risk → proceed to OR without further cardiac testing

2014 ACC Guideline Key Points

- Use validated risk assessment tool (3 options) to estimate perioperative CV risk
- Low Risk (< 1%) proceed with surgery without preoperative cardiac testing
- Higher Risk → assess functional capacity
  - 4 METS key (4 blocks walking; 2 flights of stairs)
- “Indications for noninvasive cardiac testing generally the same as for patients not undergoing surgery” (S Cohn, MD)
The Future of Preoperative Risk Assessment: biomarkers?

• N-terminal BNP; BNP
• Multiple studies
• Challenges:
  – Variable testing timeframe
  – Observational with irregular enrollment & uncontrolled
  – Lack of connection to therapy
• Canadian Cardiology Society Guideline adoption
  – Monitoring guidance post-op
• Stay tuned

*Canadian J Cardiol 2017(33):17*

Medication Management
Perioperative MI - Mechanisms

Subendocardial Ischemia/Infarction

30+ % of Peri-op Events

Unstable CAD

Beta blockers
Evolving Perioperative Beta-Blocker Science

2000 2+ trials → great enthusiasm
## Evolving Perioperative Beta-Blocker Science

<table>
<thead>
<tr>
<th>Year</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>2+ trials ⇒ great enthusiasm</td>
</tr>
<tr>
<td>2001 – 2011</td>
<td>trials: variable outcomes</td>
</tr>
<tr>
<td></td>
<td>POISE: significant risk</td>
</tr>
<tr>
<td>2012 – 2017</td>
<td>Discredited Research</td>
</tr>
<tr>
<td></td>
<td>New findings</td>
</tr>
</tbody>
</table>

## Perioperative β-Blockade: Retrospective Analysis

- Cohort analysis
- 136,745 VA patients
- Aim: define association between perioperative beta blocker therapy and 30-day mortality and cardiovascular morbidity

*JAMA* 2013;309(16):1704
From: Association of Perioperative β-Blockade With Mortality and Cardiovascular Morbidity Following Major Noncardiac Surgery


Date of download: 5/6/2013  Copyright © 2012 American Medical Association. All rights reserved.
Where does this leave us?

2014 ACC/AHA Beta Blocker Recommendations

<table>
<thead>
<tr>
<th>RECOMMENDATION</th>
<th>CLASS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beta blockers should be continued in patients undergoing surgery who have been on beta blockers chronically</td>
<td>Class I</td>
</tr>
<tr>
<td>Management of beta blockers after surgery guided by clinical circumstances, independent of when the agent was started</td>
<td>Class IIa</td>
</tr>
</tbody>
</table>

*JACC 2014; 64(22): e77-e137*
### 2014 ACC/AHA Beta Blocker Recommendations

<table>
<thead>
<tr>
<th>RECOMMENDATION</th>
<th>CLASS</th>
</tr>
</thead>
<tbody>
<tr>
<td>In patients with intermediate- or high-risk myocardial ischemia noted in pre-op risk stratification tests, it may be reasonable to begin periop beta blockers</td>
<td><strong>Class IIb</strong></td>
</tr>
<tr>
<td>Beta-blocker therapy should not be started on the day of surgery</td>
<td><strong>Class III</strong></td>
</tr>
</tbody>
</table>

*JACC 2014; 64(22): e77-e137*

### Antiplatelet
The Incremental Risk of Noncardiac Surgery on Adverse Cardiac Events Following Coronary Stenting

- Retrospective matched cohort study
- VA Medical Centers, 2000 – 2010
- Composite endpoint: MI and/or cardiac revascularization for 30-day interval post-surgery calculated
- 20,590 surgical patients matched to 41,180 nonsurgical patients

*J Am Coll Cardiol* 2014;64(25):2730

Decreasing Risk to 6 Months post-stent
Added Risk of Surgery post-PCI with Stent Plateaus at 6 Months

Surgery 6 weeks - 6 months after Stenting Higher Risk for Most Inpatient Procedure Types
### ACC/AHA Focused Update

**2016 ACC/AHA Guideline Focused Update on Duration of Dual Antiplatelet Therapy in Patients With Coronary Artery Disease**

A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Class of Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elective noncardiac surgery should be delayed 30 days after Bare Metal Stent (BMS) implantation &amp; optimally 6 months after Drug Eluting Stent (DES) implant</td>
<td>Class I</td>
</tr>
</tbody>
</table>

*Circulation* 2016;134:e123-e155

### ACC Guideline Rec’s Continued

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Class of Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>In patients treated with Dual Antiplatelet Therapy (DAPT) after stenting who must undergo surgical procedures mandating discontinuation of P2Y\textsubscript{12} platelet receptor inhibitor therapy, it is recommended that ASA be continued if possible &amp; the P2Y\textsubscript{12} platelet receptor inhibitor be restarted as soon as possible after surgery</td>
<td>Class I</td>
</tr>
</tbody>
</table>

*Circulation* 2016;134:e123-e155
ACC Guideline Rec’s Continued

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Class of Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elective noncardiac surgery should not be performed within 30 days after BMS implantation or within 3 months after DES implantation in patients in whom DAPT will need to be discontinued perioperatively</td>
<td>Class III</td>
</tr>
</tbody>
</table>

*Circulation* 2016;134:e123-e155

Thanks

Questions?

Scott.Marsal@Providence.org
Statins should be continued in patients currently taking statins & scheduled for noncardiac surgery

Perioperative initiation of statin use is reasonable in patients undergoing vascular surgery

Perioperative initiation of statins may be considered in patients with clinical indications according to Guidelines who are undergoing elevated-risk procedures

Class I

Class IIa

Class IIb

JACC 2014; 64(22): e77-e137
ACC Guideline on Perioperative ACEI Management

<table>
<thead>
<tr>
<th>Guideline Recommendation</th>
<th>Class of Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuation of ACE inhibitors or ARBs perioperatively is reasonable</td>
<td>Class IIa</td>
</tr>
<tr>
<td>If ACE inhibitors are held before surgery, it is reasonable to restart as soon as clinically feasible post-operatively</td>
<td>Class IIa</td>
</tr>
</tbody>
</table>

*JACC 2014; 64(22): e77-e137*

Obstructive Sleep Apnea (OSA): Perioperative Morbidity

**Intraoperative**
- Difficult airway
- Aspiration
- Hypoxemia
- Airway rescue (sedation)
- Opioid-related respiratory depression

**Postoperative**
- Hypoxemia, Hypercarbia
- Airway obstruction
- Atelectasis
- Aspiration pneumonia
- Reintubation
- Mechanical Ventilation
- ARDS
- Arrhythmia
- ICU Transfer
- Encephalopathy

*Chest 2012;141(2):436-41*
Assessment/Management of OSA

- Clinic: consider screening
- Hospital: pathways in development
- Summary: protocols on optimal management of OSA in perioperative setting need validation

*Curr Opinion Pulm Med* 2012, 18:588

### Preoperative OSA Screen

**STOP-BANG**
- Snoring- Y/N
- Tired
- Observed apnea
- Blood Pressure
- BMI (> 35 kg/m²)
- Age (> 50 yr old)
- Neck Circumference (> 40 cm)
- Gender (male)

**Threshold**
- High risk for OSA ≥ 3

*Anesthesiology* 2008; 108:812
### Table 2. Guideline-Directed Laboratory Testing Before Elective Noncardiac Surgery

<table>
<thead>
<tr>
<th>Laboratory Test</th>
<th>Indication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hemoglobin</td>
<td>Anticipated major blood loss or symptoms of anemia</td>
</tr>
<tr>
<td>Leukocyte count</td>
<td>Symptoms suggesting infection, myeloproliferative disorder, or myelotoxic medications</td>
</tr>
<tr>
<td>Platelet count</td>
<td>History of bleeding diathesis, myeloproliferative disorder, or myelotoxic medications; liver disease</td>
</tr>
<tr>
<td>Prothrombin time</td>
<td>History of bleeding diathesis, liver disease, malnutrition, recent or long-term antibiotic use, warfarin use</td>
</tr>
<tr>
<td>Partial thromboplastin time</td>
<td>History of bleeding diathesis, heparin use</td>
</tr>
<tr>
<td>Electrolytes</td>
<td>Known renal insufficiency, congestive heart failure, medications that affect electrolytes</td>
</tr>
<tr>
<td>Creatinine, blood urea nitrogen</td>
<td>Chronic kidney disease, hypertension, diabetes, cardiac disease, major surgery, medications that may affect renal function</td>
</tr>
<tr>
<td>Glucose</td>
<td>Known diabetes, obesity</td>
</tr>
<tr>
<td>Liver function tests</td>
<td>Cirrhosis</td>
</tr>
<tr>
<td>Urinalysis</td>
<td>Symptoms suggestive of urinary tract infection, instrumentation of the genital-urinary tract (not indicated before total joint replacement)</td>
</tr>
<tr>
<td>Electrocardiography</td>
<td>Known coronary artery disease, diabetes, uncontrolled hypertension, chronic kidney disease</td>
</tr>
<tr>
<td>Chest radiography</td>
<td>Symptoms or examination findings suggestive of active pulmonary disease</td>
</tr>
</tbody>
</table>