Perioperative Cardiovascular Evaluation

Vincent Brinkman, MD
Division of Cardiovascular Medicine
The Ohio State University

Objectives

- Overview of current guidelines on preoperative evaluation.
- Explain the background behind these guidelines.
- Explain the general approach to preoperative cardiac assessment.

Guidelines

ACC Guidelines

ACC/AHA 2017 Guidelines on Perioperative Cardiovascular Evaluation and Care for Noncardiac Surgery

Active Cardiac Conditions

- Unstable Angina
  - Or Recent Myocardial Infarction
- Decompensated heart failure
  - Class IV heart failure
  - Unstable arrhythmias
  - Uncontrolled heart rate, heart block, Ventricular Tachycardia...
- Severe valve disease

ACC Perioperative Guidelines

Step 1

Need for emergency noncardiac surgery?
- Yes: Operating Room
- No: Step 2

Step 2

Active Cardiac Conditions?
- Yes: Evaluate and treat per ACC guidelines
- No: Step 3

Step 3

Evaluate and treat per ACC guidelines

Active Cardiac Conditions

- Treat these according to ACC guidelines
- Cardiology consultation
- In other words:

Does this patient require further treatment of their cardiac condition in the absence of this surgery?
**Risk of Surgery**

<table>
<thead>
<tr>
<th>Risk Stratification</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vascular</td>
<td>Aortic and other major peripheral vascular surgery</td>
</tr>
<tr>
<td>Intermediate Risk</td>
<td>Intraperitoneal or intrathoracic surgery</td>
</tr>
<tr>
<td></td>
<td>Carotid endarterectomy</td>
</tr>
<tr>
<td></td>
<td>Head and Neck Surgery</td>
</tr>
<tr>
<td></td>
<td>Orthopedic surgery</td>
</tr>
<tr>
<td></td>
<td>Prostate surgery</td>
</tr>
<tr>
<td>Low Risk</td>
<td>Endoscopic procedures</td>
</tr>
<tr>
<td></td>
<td>Superficial procedures</td>
</tr>
<tr>
<td></td>
<td>Cataract surgery</td>
</tr>
<tr>
<td></td>
<td>Breast surgery</td>
</tr>
<tr>
<td></td>
<td>Ambulatory surgery</td>
</tr>
</tbody>
</table>

**ACC Perioperative Guidelines**

**Low Risk Surgery**

Major Morbidity and Mortality Within 1 Month of Ambulatory Surgery and Anesthesia
Mark A. Warner, MD; Sondra E. Shields, MD; Christopher G. Chute, MD, DrPH

- 45,000 Procedures
- 14 Myocardial Infarctions
- 2 Cardiac Deaths
- 17.8 Myocardial Infarctions expected
**Functional Capacity**

- Reliable way to determine cardiovascular risk of surgery.
- Can be determined with history

<table>
<thead>
<tr>
<th>1 MET</th>
<th>Getting Dressed</th>
<th>Walking around the house</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 4 METs</td>
<td>Light house work</td>
<td></td>
</tr>
<tr>
<td>&gt; 4 METs</td>
<td>Walk on level ground at 4 mph</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Climb 1-2 flights of stairs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Heavy house work</td>
<td></td>
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</tbody>
</table>

*Based on the Duke Activity Status Index*

**ACC Perioperative Guidelines**

Step 5

- 5 or more risk factors
- 1 or 2 risk factors
- No risk factors

<table>
<thead>
<tr>
<th>No</th>
<th>Proceed with surgery with heart rate control (Class II) or</th>
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<td>Consider testing (Class II) if it will change management</td>
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**Functional Capacity**

Self-reported Exercise Tolerance and the Risk of Serious Perioperative Complications

Dominic F. Reilly, MD, et al. Archives of Internal Medicine 1999

- 600 patients undergoing “major” surgery.
- Poor functional tolerance defined as inability to climb 2 flights of stairs or walk 4 blocks.
- Serious complications inversely related to the number of blocks one could walk.

**Risk Factors**

- History of ischemic heart disease
- Prior history of heart failure
- Diabetes
- Renal Insufficiency
- Cerebrovascular Disease

*Based on the “Revised Cardiac Risk Index”*

Thomas H. Lee, MD, et al., Circulation 1999
Step Five

- No risk factors
  
  ✓ Even among highest risk surgeries, absence of risk factors predicted a low incidence of events.

<table>
<thead>
<tr>
<th>Class</th>
<th>Events/Patients, n/n</th>
<th>Event Rate (95% CI), %</th>
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</thead>
<tbody>
<tr>
<td>I (0 risk factors)</td>
<td>2/488</td>
<td>0.4 (0.05-1.5)</td>
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<tr>
<td>II (1 risk factor)</td>
<td>5/607</td>
<td>0.8 (0.3-2.1)</td>
</tr>
<tr>
<td>III (2 risk factors)</td>
<td>17/258</td>
<td>6.6 (3.9-10.3)</td>
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<tr>
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<td>11.0 (5.8-18.4)</td>
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ROC curve area = 0.806†

Step Five

- 1–3 risk factors had increasing cardiac events during surgery.

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ROC curve area = 0.806†
Why Vascular Surgery?

- Highest cardiovascular risk
- Most studied in terms of cardiac risk
- High risk patient population
- Older patient population

Intermediate Risk Patients

- 1,500 patients undergoing vascular surgery (700 intermediate risk).
- All patients received beta blockers with goal of heart rate less than 65 bpm.
- Patients randomized to stress testing or proceeding with surgery.
- If extensive ischemia found, patients underwent revascularization.

Stress Tests

Functional assessment
- Multiple studies show that risk of cardiac events increases as the extent of ischemia increases.
- Fixed defects (ie. Prior scar with no inducible ischemia) confer no additional increased risk.

Intermediate Risk

- No significant difference between stress testing and beta blocker treatment groups
Step Five

3 or more risk factors

1 or 2 risk factors

Vascular Surgery?

Yes. Class Ila

No.

Proceed with surgery with heart rate control (Class Ila) or,

Consider testing (Class IIb) if it will change management.

Can the surgery be delayed?

Does Revascularization Help?

Timing of Surgery

CABG

PCI

Balloon Angioplasty

Bare Metal Stent

Drug Eluting Stent

Two Weeks of Aspirin and Plavix

One Month of Aspirin and Plavix

One Year of Aspirin and Plavix

CARP Trial

- 510 patients with “stable,” significant CAD randomized to CABG or medical therapy before vascular surgery.
- No difference in survival.
Revascularization Before Surgery

- Does not appear to offer any significant benefit except in those patients that would require it independent of surgery.
- However, jury is still out . . .

<table>
<thead>
<tr>
<th>Class I Indications for Revascularization</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;3 vessel disease</td>
</tr>
<tr>
<td>Left main disease or left main equivalent</td>
</tr>
<tr>
<td>High risk unstable angina</td>
</tr>
<tr>
<td>ST elevation MI</td>
</tr>
</tbody>
</table>

Beta Blockers

- Controversial
  - Historically, studies have shown benefit in reducing mortality and cardiovascular events.
  - Wide variation in type, dose and timing of beta blockers in previous studies.
  - May not be class effect

Medical Therapy

- Statins
- Aspirin
  - Probably does not need held for surgery.
  - May increase bleeding, but not mortality or severity of bleeding
- Plavix
  - Conflicting evidence
  - Some evidence that stopping 5 days before surgery may reduce risk of major bleeding events.

POISE Trial

- 8351 patients with or at risk for CAD undergoing non-cardiac surgery.
- Randomized to metoprolol or placebo.
- Decreased incidence of myocardial infarctions, but increased stroke and mortality.
- Criticisms
  - Beta blockers started immediately before surgery
  - Single dosing (100mg of sustained release metoprolol).
    - No titration
  - Sepsis / hypotension / stroke

POISE Trial

Summary

- Beta blockers are not indicated for everyone undergoing surgery
- Dose titration and initiation prior to surgery may be necessary

Pre-op Beta Blockers

- Class I Indications:
  - Beta blockers should be continued in patients who are receiving beta blockers to treat angina, arrhythmias, or hypertension.
- Class II Indications:
  - Beta blockers titrated to heart rate and blood pressure control are reasonable in high risk patients

Preoperative Pulmonary Evaluation

Jennifer McCallister, MD
Assistant Professor
The Ohio State University Medical Center
Objectives

• Review types of postoperative pulmonary complications (PPC)
• Describe risk factors for PPC
• Discuss strategies for risk factor assessment

Types of post-op pulmonary complications (PPC)

• Atelectasis
• Pneumonia
• Respiratory failure/prolonged mechanical ventilation
• Exacerbation of chronic underlying pulmonary disease
• Death

Importance of PPC

• Incidence 2-19% in non-thoracic surgery¹
• Morbidity & mortality similar to cardiac complications²
• Better predict mortality³
• May double hospital length of stay⁴

Preoperative Pulmonary Evaluation

• “Preoperative clearance”
  ✓ Implied permission, all-or-none
• Identification of risk factors
  ✓ Patient-related
  ✓ Procedure-related
• Risk assessment
• Post-operative risk reduction or modification

References:
Health & Functional Status

- American Society of Anesthesiologists (ASA) Classification of Preoperative Risk correlates with post-operative pulmonary complications

- Functional dependence (ADLs)
  - Partial: OR 1.65 (1.36-2.01)
  - Total: OR 2.51 (1.99-3.15)

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### Age

<table>
<thead>
<tr>
<th>Age (yr)</th>
<th>OR for post-op pulmonary complications (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>50-59</td>
<td>1.50 (1.31-1.71)</td>
</tr>
<tr>
<td>60-69</td>
<td>2.28 (1.86-2.80)</td>
</tr>
<tr>
<td>70-79</td>
<td>3.90 (2.70-5.65)</td>
</tr>
<tr>
<td>≥80</td>
<td>5.63 (4.63-6.85)</td>
</tr>
</tbody>
</table>

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### ASA Classification

<table>
<thead>
<tr>
<th>ASA class</th>
<th>Systemic Disease</th>
<th>Mortality (%)</th>
<th>PPC (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Healthy</td>
<td>&lt;0.03</td>
<td>1.2</td>
</tr>
<tr>
<td>II</td>
<td>Mild/moderate</td>
<td>0.2</td>
<td>5.4</td>
</tr>
<tr>
<td>III</td>
<td>Severe, limits activity but not incapacitating</td>
<td>1.2</td>
<td>11.4</td>
</tr>
<tr>
<td>IV</td>
<td>Severe, incapacitating</td>
<td>8.0</td>
<td>10.9</td>
</tr>
<tr>
<td>V</td>
<td>Moribund</td>
<td>34</td>
<td>Not applicable</td>
</tr>
</tbody>
</table>

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### Chronic Lung Disease

- OR for PPC 2.36 (1.90-2.93) in COPD
- Varies depending on severity of disease and evidence of active symptoms in some series
- NO LEVEL of lung function is an absolute contraindication to surgery

**Lung resection a separate topic**

### Other Factors

- CHF
  - OR 2.93
- Albumin < 3.5 g/dL
  - OR 2.53 in single study

### Smoking

- Pooled OR for postoperative pulmonary complications 1.40 (CI 1.17-1.68)
- Risk greatest
  - ≥40 pack-yrs
  - smoking within 8 weeks prior to surgery
- Rates similar to nonsmokers with 6 months cessation

### Patient-Related Risk Factors

- Age > 60 yrs
- ASA Class > II
- Functional Dependence
- COPD
- CHF
- Albumin < 3.5 g/dL

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Patient-Related Factors

- Not significant
  - Obesity
  - Asthma
  - Severity of COPD
- Need more data
  - OSA
  - Exercise Capacity

Procedure-Related Risk Factors

- Surgical Site
  - Most important surgical factor
  - Inversely related to distance from diaphragm
- Duration of Surgery
  - 3 hours or longer
- Anesthesia
  - General anesthesia?
  - Long acting neuromuscular blockers

Post-op complications and decreased ability to climb flights of stairs

Risk Assessment

- No universally accepted method
- ASA probably best
- Others--Arozullah Indices
  - Postoperative Pneumonia Risk Index
  - Postoperative Respiratory Failure Index


### Pulmonary Function Testing

- Not indicated in routine pre-operative evaluation
- Debate continues
  - COPD and Asthma
- No universally accepted ability to predict PPC
- No definitive lower limit for surgery
  - Lung resection surgery exception

### Pulmonary Function Testing

- No numbers predict risk
  - FEV1 <40% < 1.0 L often quoted
- Clinically useful?
  - Assess control in obstructive disease
  - Undiagnosed lung diseases
  - Differential diagnosis
- Essential in evaluation for lung resection

### Arterial Blood Gas

- Old data suggested pCO2 > 45 mm Hg higher risk
- PaO2 NOT predictive
- Helpful with diagnosis & post-operative management
- Less useful for risk stratification

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### Chest X-Ray

- Everyone gets one
- No data to support this
- May be indicated
  - >50 years with symptoms of cardiac or pulmonary disease
  - known underlying cardiopulmonary disease

### Conclusions

- Post-operative pulmonary complications are common & important
- Pre-operative risk assessment depends on identification of patient specific risk factors
- Focus on modification of post-operative risk factors and risk reduction

### Post-Operative Risk Reduction

- Lung expansion maneuvers
- Early mobilization
- Aggressive pulmonary toilet
- Aggressive pain control
- Therapeutic bronchoscopy for secretions?
- Deep venous thrombosis prophylaxis

### Questions?