Perioperative Medicine: Preoperative Cardiac Risk Assessment

Divya Gollapudi, MD

May 2016
Medical Operative Consult Clinic
Harborview Medical Center


Circulation. published online August 1, 2014;
Circulation is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
Copyright © 2014 American Heart Association, Inc. All rights reserved.
Print ISSN: 0009-7322. Online ISSN: 1524-4539

Cardiac Risk Assessment Algorithm


MACE = major adverse cardiac event
MET = metabolic equivalent time
GDMT = guideline directed medical therapy
CPG = clinical practice guideline

Steps 1-3:
- Patient scheduled for surgery with known or risk factors for CAD* (Step 1)
  - Emergency Yes → Clinical risk stratification and proceed to surgery
  - No
    - ACS† (Step 2) Yes → Evaluate and treat according to GDMT†
    - No
      - Estimated perioperative risk of MACE based on combined clinical/surgical risk (Step 3)

Steps 4-7:
- Estimated perioperative risk of MACE based on combined clinical/surgical risk (Step 3)
  - Low risk (<1%) (Step 4)
    - No further testing (Class III-IB)
    - Proceed to surgery
  - Elevated risk (Step 5)
    - Moderate or greater (≥4 METs) functional capacity
      - No or unknown
        - Poor OR unknown functional capacity (<4 METs)
          - Will further testing impact decision making OR perioperative care? (Step 6)
            - Yes → Pharmacologic stress testing (Class III)
            - No → Proceed to surgery according to GDMT OR alternate strategies (noninvasive treatment, palliation) (Step 7)
          - No → Proceed to surgery
      - Moderate/Good (2-4 METs)
        - No further testing (Class IIIb)
        - Proceed to surgery
      - Excellent (>10 METs)
        - No further testing (Class IIa)
        - Proceed to surgery

*CAD: coronary artery disease
†ACS: acute coronary syndrome
‡GDMT: guideline directed medical therapy

References:
Cardiac Risk Assessment Algorithm

Patient scheduled for surgery with known or risk factors for CAD (Step 1)

Who needs risk assessment?

<table>
<thead>
<tr>
<th>Chronic conditions</th>
<th>Acute conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coronary artery disease</td>
<td>Recent acute coronary syndrome</td>
</tr>
<tr>
<td>Peripheral vascular disease</td>
<td>Recent stent placement</td>
</tr>
<tr>
<td>Cerebrovascular disease</td>
<td>Recent stroke</td>
</tr>
<tr>
<td>Diabetes</td>
<td>Acute trauma</td>
</tr>
<tr>
<td>Heart failure</td>
<td>Urgent or emergent surgery</td>
</tr>
<tr>
<td>Renal insufficiency</td>
<td></td>
</tr>
<tr>
<td>Atrial fibrillation</td>
<td></td>
</tr>
<tr>
<td>Hypertension</td>
<td></td>
</tr>
<tr>
<td>Severe aortic stenosis</td>
<td></td>
</tr>
<tr>
<td>CAD risk factors (male, older age,</td>
<td></td>
</tr>
<tr>
<td>tobacco use, HLD, etc)</td>
<td></td>
</tr>
</tbody>
</table>

Pathophysiology of perioperative cardiac complications

**SURGERY**
- SNS stimulation
- Hypercoagulability
- Bleeding
- Inflammation

**ANESTHESIA**
- SNS stimulation
- Hypotension
- Tachycardia
- Hypothermia

**POST-OP FACTORS**
- Hypotension
- Tachycardia
- Hypothermia
- Bleeding
- Pain

Oxygen supply and demand mismatch

Coronary-artery thrombosis

Myocardial infarction

Congestive heart failure

Cardiac arrest

Death from CV causes

What is your role as the preoperative provider?

• Identifying risk factors → assessing severity & stability
  • Often a chance to provide primary care
• Recommending changes in management, further testing, or specialty consultation
• Communication with the surgeons, anesthesiologists, long-term providers
• Informed and shared decision-making

Cohn SL. CCJM 2014 Dec; 81(12):742-751
Cardiac Risk Assessment Algorithm

Patient scheduled for surgery with known or risk factors for CAD (Step 1)

Emergency

Clinical risk stratification & proceed to surgery

Urgency of surgery

- **Emergent**: Life or limb threat if no surgery <6 hours
- **Urgent**: Surgery required within 6 - 24 hours
- **Time-sensitive**: Surgery required within 6 weeks
- **Elective**: Surgery could be delayed for 1 year without harm

Cardiac Risk Assessment Algorithm

1. Patient scheduled for surgery with known or risk factors for CAD (Step 1)
   - Emergency
   - ACS* (Step 2)
     - Estimated perioperative risk of MACE based on clinical/surgical risk (Step 3)
     - Evaluate and treat per guidelines
   - Clinical risk stratification & proceed to surgery

*ACS = Acute Coronary Syndrome

Combined surgical and patient risk factors to predict major adverse cardiac event (MACE)*

- Low risk (< 1% MACE) (Step 4)
- Elevated risk (> 1% MACE) (Step 5)

* MACE = ACS, MI, HF, unstable arrhythmia, death

Surgical risk factors

Low risk
- Breast surgery
- Dermatologic procedures
- Ophthalmologic surgery
- Dental / oral surgery
- Endoscopy
- Angiography

Elevated risk
- Vascular surgery
- Intraperitoneal
- Intrathoracic
- Head & neck surgery
- Orthopedic surgery
- Prostate surgery
Clinical risk factors

• Revised Cardiac Risk Index (RCRI) score\(^1\)
• Brain Natriuretic Peptide (BNP)\(^2\)
• MICA (Myocardial infarction and cardiac arrest) risk calculator\(^3\)
• ACS NSQIP Surgical Risk Calculator\(^4\)

2. Rodseth et al J Am Coll Cardiol 2011; 58:522-9
RCRI score

• History of CHF (OR 4.3)
• Known CAD (OR 3.8)
• History of TIA or CVA (OR 3)
• High risk surgery (OR 2.6)
• DM, on insulin (OR 1.0)
• Renal insufficiency, Cr >2 (OR 0.9)

### RCRI score

<table>
<thead>
<tr>
<th>Risk Factors</th>
<th>% Major Cardiac Complications*</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.4 (0.05-1.5)</td>
</tr>
<tr>
<td>1</td>
<td>0.9 (0.3-2.1)</td>
</tr>
<tr>
<td>2</td>
<td>6.6 (3.9-10.3)</td>
</tr>
<tr>
<td>&gt;3</td>
<td>11 (5.8-18.4)</td>
</tr>
</tbody>
</table>

* Major Cardiac Complications = MI, cardiac arrest, pulmonary edema, heart block

## BNP & RCRI Score

<table>
<thead>
<tr>
<th>RCRI Score</th>
<th>Total Sample Size</th>
<th>MACE Rate (%)</th>
<th>Reclassified Sample Size</th>
<th>MACE Rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low (0)</td>
<td>320</td>
<td>5.9</td>
<td>596 ↑</td>
<td>3.7 ↓</td>
</tr>
<tr>
<td>Intermediate (1-2)</td>
<td>476</td>
<td>9.5</td>
<td>93 ↓</td>
<td>15.1 ↑</td>
</tr>
<tr>
<td>High (3-5)</td>
<td>54</td>
<td>20.4</td>
<td>161 ↑</td>
<td>24 ↑</td>
</tr>
</tbody>
</table>

Rodseth et al J Am Coll Cardiol 2011; 58:522-9
Perioperative use of BNP

• ↑ BNP appears to be associated with short and long-term perioperative morbidity and mortality

• Patients with ↑ pre-op BNP could potentially undergo further cardiac testing to determine source of subclinical cardiac stress (ie. valve disease, low EF, diastolic dysfunction)

• No current standard cutoffs; patients have different baselines

Rodseth et al J Am Coll Cardiol 2011; 58:522-9
MICA Risk Calculator

Estimate risk of perioperative myocardial infarction or cardiac arrest.

<table>
<thead>
<tr>
<th>Age</th>
<th>58</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creatinine</td>
<td>&lt;1.5 mg/dL / 133 µmol/L</td>
</tr>
<tr>
<td>ASA Class</td>
<td>ASA 3</td>
</tr>
<tr>
<td></td>
<td>ASA 1 = Normal healthy patient</td>
</tr>
<tr>
<td></td>
<td>ASA 2 = Patients with mild systemic disease</td>
</tr>
<tr>
<td></td>
<td>ASA 3 = Patients with severe systemic disease</td>
</tr>
<tr>
<td></td>
<td>ASA 4 = Patients with severe systemic disease that is a constant threat to life</td>
</tr>
<tr>
<td></td>
<td>ASA 5 = Moribund patients who are not expected to survive without the operation</td>
</tr>
<tr>
<td>Preoperative Function</td>
<td>Partially Dependent</td>
</tr>
<tr>
<td>Procedure</td>
<td>Non-esophageal Thoracic</td>
</tr>
</tbody>
</table>

Submit
Cardiac Risk Assessment Algorithm

Patient scheduled for surgery with known or risk factors for CAD (Step 1)

   Emergency

   ACS (Step 2)

Estimated perioperative risk of MACE based on clinical/surgical risk (Step 3)

Elevated risk (Step 5)  
Assessment of functional status

Low risk (Step 4)  
No further testing

Proceed to Surgery
**Functional Status**

### METs

**Poor**
- Watching television
- Eating, dressing, cooking, using the toilet
- Walking 1-2 blocks on level ground
- Doing light housework

**Good**
- Climbing a flight of stairs
- Walking on level ground at 4 miles per hour
- Running a short distance
- Doing heavy chores around the house
- Playing moderately strenuous sports

**Excellent**
- Playing strenuous sports (tennis, basketball)
Cardiac Risk Assessment Algorithm

Patient scheduled for surgery with known or risk factors for CAD (Step 1)

- Emergency

ACS (Step 2)

Estimated perioperative risk of MACE based on clinical/surgical risk (Step 3)

Elevated risk (Step 5)

Assessment of functional status

- Poor (< 4 METs) or unknown (Step 6)
  - Will further testing change management?
    - No
    - Yes

- > 4 METs
  - Proceed to surgery
  - Additional testing
  - Proceed to surgery or non-op mgmt

Cardiac Risk Assessment: Diagnostics/Management

• Electrocardiogram
• Echocardiogram (LV function, valvular disease)
• Exercise stress testing
• Pharmacologic stress testing
• Cardiac catherization
• Medication management – another module
Don’t perform routine pre-operative testing before low-risk surgical procedures.

Don’t obtain baseline diagnostic cardiac testing (trans-thoracic/esophageal echocardiography – TTE/TEE) or cardiac stress testing in asymptomatic stable patients with known cardiac disease (e.g., CAD, valvular disease) undergoing low or moderate risk non-cardiac surgery.

Don’t perform stress cardiac imaging or advanced non-invasive imaging as a pre-operative assessment in patients scheduled to undergo low-risk non-cardiac surgery.
## Strength of recommendation

<table>
<thead>
<tr>
<th>Class of Recommendation</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class I</td>
<td>Benefit &gt;&gt;&gt; Risk, should be done</td>
</tr>
<tr>
<td>Class IIa</td>
<td>Benefit &gt;&gt; Risk, reasonable</td>
</tr>
<tr>
<td>Class IIb</td>
<td>Benefit &gt; Risk, consider</td>
</tr>
<tr>
<td>Class III</td>
<td>Risk &gt; Benefit, not recommended</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Level of Evidence</th>
<th>Data Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level A</td>
<td>Multiple RCT or meta-analyses</td>
</tr>
<tr>
<td>Level B</td>
<td>Single RCT or several non-RCT</td>
</tr>
<tr>
<td>Level C</td>
<td>Consensus opinion, case report, “standard of care”</td>
</tr>
</tbody>
</table>
Recommendations for pre-operative EKG

**Reasonable**
Patients with known CAD, arrhythmia, PVD, CVD, or other structural heart disease (*Class IIa, LOE = B*)

**Consider**
Asymptomatic patients without known CAD, + cardiac risk factors (*Class IIb, LOE = B*)

**No Benefit**
Asymptomatic patients undergoing low-risk procedures (*Class III, LOE = B*)

Recommendations for pre-operative echocardiogram

**Obtain**
When moderate to severe valvular stenosis or regurgitation is suspected, if change in symptoms or exam and/or no echo in last 1 year (*Class I, LOE=C*)

**Reasonable**
Patients with dyspnea of unknown etiology or known CHF with change in symptoms (*Class IIa, LOE=C*)

**Consider**
Patients with stable CHF if no echo within last year (*Class IIb, LOE=C*)

**No Benefit**
Routine preoperative evaluation (*Class III, LOE=B*)

Recommendations for pre-operative stress testing

If it will change management, then:

**Consider**

- Stress testing with imaging in patients with <4 METs or unknown functional capacity (*Class IIb, LOE=C*)
- Exercise testing in patients with unknown functional capacity (*Class IIb, LOE=B*)

**No Benefit**

Routine evaluation or if functional capacity > 4 METs (*Class III, LOE=B*)

Stress testing

• Cardiology referral
• Moderate to large reversible defects $\rightarrow$ ↑ risk of perioperative MI and/or death
• Normal study has high negative predictive value
Pre-operative cardiac catheterization: CARP trial

Revascularization group experienced significant delays before surgery (54 days vs. 18 days, $p<0.001$)

Pre-operative cardiac catherization

- Indications for pre-operative PCI:
  - Left main disease who cannot undergo CABG
  - Unstable CAD (ACS)
  - Similar to nonoperative scenarios

- Coronary revascularization not recommended to exclusively decrease perioperative cardiac events *(Class III, LOE B)*
Pre-operative cardiac catherization

• Refer to Cardiology

• Some considerations:
  • Confirm stress testing results and provide appropriate risk assessment
  • Will delay from PCI or CABG increase risk of surgical condition?
  • Can surgery be done safely with anti-platelet therapy?
Management of patients with cardiac stents

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Delay in surgery</th>
<th>Class/LOE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Balloon angioplasty</td>
<td>14 days</td>
<td>Class I, LOE C</td>
</tr>
<tr>
<td>Bare Metal Stent (BMS)</td>
<td>30 days</td>
<td>Class I, LOE B</td>
</tr>
<tr>
<td>Drug Eluting Stent (DES)</td>
<td>1 year&lt;br&gt;Consider after 6 months</td>
<td>Class I, LOE B&lt;br&gt;Class IIb, LOE B</td>
</tr>
</tbody>
</table>

Warrants discussion between patient, cardiologist, and surgeon regarding risks of ischemia (stent thrombosis) and bleeding

References


5. Cohn SL. Updated guidelines on cardiovascular evaluation before noncardiac surgery: A view from the trenches. CCJM 2014 Dec; 81(12):742-751

6. Rodseth et al. The Predictive Ability of Pre-Operative B-Type Natriuretic Peptide in Vascular Patients for Major Adverse Cardiac Events J Am Coll Cardiol 2011; 58:522-9

