PERIOPERATIVE CARDIAC RISK ASSESSMENT

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Disclosures

- None
Objectives

- Develop a framework for approaching cardiac risk assessment before non-cardiac surgery
  - Review ACC/AHA 2014 guidelines
  - Briefly discuss CCS 2017 guidelines
  - Discuss role of cardiac testing before surgery
  - Identify pearls of perioperative risk assessment prior to urgent urgency
Patient scheduled for surgery with known or risk factors for CAD (Step 1)

- Emergency
- No

ACS (Step 2)

- No

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

- Elevated risk (Step 5)
- Assessment of functional status

- > 4 METs
  - Proceed to surgery
  - Low risk (Step 4)

- Poor (< 4 METs) or unknown (Step 6)
  - Will further testing change management?
    - No further testing
      - Proceed to surgery or non-op management
    - Additional testing
      - Proceed to surgery
Meet your patient

Ms. H is a 68 year-old woman with hemoptysis, found to have a right lung mass. She is scheduled for video-assisted thoracotomy vs. open lung resection.

She has a past medical history of TIA, hypertension, diabetes, and tobacco use.

She presents to your clinic for operative “clearance.”
What is your role as the internist?

- Identify risk factors
- Assess severity & stability of acute & chronic medical issues
- Recommend delay or cancellation of surgery, further intervention, or specialty consultation
- Communicate with surgeons, anesthesiologists, long-term providers
- Practice shared decision-making
Cardiac Risk Assessment Algorithm

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

Yes

Emergency

Yes

Clinical risk stratification & proceed to surgery

No
Your patient

Ms. Hawk is a 68 y/o woman with a lung mass scheduled for VATs vs. open lung resection.

What is the urgency of her surgery?
### Urgency of surgery

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emergent</td>
<td>Life or limb threat if no surgery within <strong>&lt;6 hours</strong></td>
</tr>
<tr>
<td>Urgent</td>
<td>Surgery required within <strong>6 - 24 hours</strong></td>
</tr>
<tr>
<td>Time-sensitive</td>
<td>Surgery required within <strong>6 weeks</strong></td>
</tr>
<tr>
<td>Elective</td>
<td>Surgery could be delayed for <strong>1 year</strong> without harm</td>
</tr>
</tbody>
</table>
Cardiac Risk Assessment Algorithm

1. Patient scheduled for surgery with known or risk factors for CAD (Step 1)
   - Emergency
   - Yes → Also consider
   - No → ACS* (Step 2)

   * ACS = Acute Coronary Syndrome

2. ACS* (Step 2)
   - Yes → Clinical risk stratification & proceed to surgery
   - No → Estimated risk of MACE based on clinical/surgical risk (Step 3)

3. Estimated risk of MACE based on clinical/surgical risk (Step 3)
   - Yes → Evaluate and treat per guidelines (may cause delay or cancellation of surgery)
   - No

Active Cardiac Conditions
- Decompensated heart failure
- Unstable arrhythmia
- Severe valvular disease

* ACS = Acute Coronary Syndrome
Risk of Surgery

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

- **Low risk** (< 1% MACE)
- **Elevated risk** (> 1% MACE)

* MACE = ACS, MI, HF, unstable arrhythmia, death
Surgical risk factors

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

**Elevated risk**
- Vascular surgery
- Intraperitoneal surgery
- Thoracic surgery
- Head & neck surgery
- Orthopedic surgery
- Prostate surgery
Perioperative cardiac complications

**Surgery**
Sympathetic NS stimulation
Bleeding
Inflammation
Hypercoagulability

**Anesthesia**
Sympathetic NS stimulation
Tachycardia
Hypotension

**Post-op factors**
Hypotension
Tachycardia
Bleeding
Hypoxemia

Oxygen supply-demand mismatch

Coronary artery thrombosis

Cardiac complications: Heart failure, MI, arrhythmia, cardiac arrest, death

Quantifying clinical risk

- Revised Cardiac Risk Index (RCRI) score\(^1\)
- MICA (Myocardial infarction and cardiac arrest) risk calculator\(^2\)
- ACS NSQIP Surgical Risk Calculator\(^3\)
- Brain natriuretic peptide (BNP)

# RCRI score

<table>
<thead>
<tr>
<th>Point</th>
<th>Risk factor</th>
<th>Odds Ratio (OR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>History of CHF</td>
<td>4.3</td>
</tr>
<tr>
<td>1</td>
<td>Known CAD</td>
<td>3.8</td>
</tr>
<tr>
<td>1</td>
<td>History of TIA/CVA</td>
<td>3</td>
</tr>
<tr>
<td>1</td>
<td>DM on insulin</td>
<td>2.6</td>
</tr>
<tr>
<td>1</td>
<td>Renal insufficiency</td>
<td>1.0</td>
</tr>
<tr>
<td>1</td>
<td>High risk surgery</td>
<td>0.9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th># of 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, complete heart block

### MICA Risk Calculator

**Estimate risk of perioperative myocardial infarction or cardiac arrest.**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>68</td>
</tr>
<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>Preoperative Function</td>
<td>Partially Dependent</td>
</tr>
<tr>
<td>Procedure</td>
<td>Non-esophageal Thoracic</td>
</tr>
</tbody>
</table>

ASA 1 = Normal healthy patient  
ASA 2 = Patients with mild systemic disease  
ASA 3 = Patients with severe systemic disease  
ASA 4 = Patients with severe systemic disease that is a constant threat to life  
ASA 5 = Moribund patients who are not expected to survive without the operation

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## ACS NSQIP Risk Calculator


### ACS NSQIP Risk Calculator

**Procedure:** 12100 - Thoracotomy: with exploration

**Risk Factors:**
- Age: 65-74 years, Partially dependent functional status, ASA III, Diabetes (insulin), HTN, Dyspnea with exertion, Smoker, Overweight

### Outcomes

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Estimated Risk</th>
<th>Chance of Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serious Complication</td>
<td>16%</td>
<td>Below Average</td>
</tr>
<tr>
<td>Any Complication</td>
<td>29%</td>
<td>Above Average</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>6%</td>
<td>Above Average</td>
</tr>
<tr>
<td>Cardiac Complication</td>
<td>3%</td>
<td>Above Average</td>
</tr>
<tr>
<td>Surgical Site Infection</td>
<td>2%</td>
<td>Above Average</td>
</tr>
<tr>
<td>Urinary Tract Infection</td>
<td>3%</td>
<td>Above Average</td>
</tr>
<tr>
<td>Venous Thromboembolism</td>
<td>2%</td>
<td>Below Average</td>
</tr>
<tr>
<td>Renal Failure</td>
<td>2%</td>
<td>Above Average</td>
</tr>
<tr>
<td>Return to OR</td>
<td>6%</td>
<td>Above Average</td>
</tr>
<tr>
<td>Death</td>
<td>4%</td>
<td>Above Average</td>
</tr>
<tr>
<td>Discharge to Nursing or Rehab Facility</td>
<td>19%</td>
<td>Above Average</td>
</tr>
</tbody>
</table>

**Predicted Length of Hospital Stay:** 4.0 days

http://www.riskcalculator.facs.org/
Perioperative use of BNP

- ↑ BNP associated with periop morbidity & mortality
  - No standard cut-offs, benefit of BNP-guided management unclear

- 2017 Canadian Cardiovascular Society perioperative guidelines recommend checking BNP pre-op to risk stratify and guide post-op management
  - If elevated → daily troponins, EKG, medical co-management
Your patient

Ms. Hawk’s RCRI score is 3 for insulin therapy, CVA, and high risk surgery.

RCRI score suggests 11% risk for cardiac events.

Her MICA risk calculation was 0.83% risk for cardiac arrest and MI.

ACS NSQIP calculator suggest 3% risk for cardiac events.
Cardiac Risk Assessment Algorithm

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

Emergency

No

ACS (Step 2)

No

Estimated 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
Your patient

She can walk around her small house without chest pain. She becomes easily winded after prolonged housework or with 1 block. Stairs are difficult for her.

What is her functional status?
Functional Status

**METs**

Poor 1
- Watching television
- Eating, dressing, cooking, using the toilet
- Walking 1-2 blocks on level ground
- Doing light housework
- Climbing a flight of stairs

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

Excellent >10
- 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)
  - No
  - Estimated 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?
      - Yes
      - Additional testing
      - No
      - Proceed to surgery or non-op management
  - > 4 METs
    - Proceed to surgery
Diagnostics and management options

- Electrocardiogram
- Echocardiogram
- Stress testing (usually pharmacologic)
- Cardiac catheterization and revascularization
- Medication management
# 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>
Your patient

Ms. Hawk is a 68 y/o woman with a lung mass scheduled for VATS vs. open lung resection.

She has DM, h/o TIA, and HTN. Her functional status is poor.

Do you recommend a pre-operative EKG?
Recommendations for pre-operative EKG

**Reasonable**

Patients with known CAD, arrhythmia, PVD, CVD, or other structural heart disease (*IIa, B*) or cardiac risk factors (*IIb, B*)

- May be useful as pre-operative baseline
- EKG within 12 months of surgery okay

**No Benefit**

Asymptomatic patients undergoing low-risk procedures (*III, B*)
Your patient

Ms. Hawk would not want surgery if it is too high risk. She adds that her exercise tolerance has worsened in last 3 months. Physical exam demonstrates a 3/6 systolic murmur heard best at the RUSB. EKG has non-specific ST-T changes.

What is your next step in management?
Recommendations for pre-operative echocardiogram

- **Obtain**
  - When moderate to severe valvular stenosis or regurgitation is suspected or change in symptoms or exam if known valve disease (*I, C*)

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

- **No Benefit**
  - Routine preoperative evaluation (*III, B*)
Recommendations for pre-operative stress testing

If it will change management, then:

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

Routine evaluation or functional capacity > 4 METs (*III, B*)
Stress testing results

- Moderate to large reversible defects $\rightarrow$ $\uparrow$ risk of perioperative MI and/or cardiac death

- Negative testing has high negative predictive value\(^1\)

- Presence of an old MI on rest imaging $\rightarrow$ poor predictive value

“We recommend against performing preoperative pharmacological stress echo to enhance perioperative cardiac risk estimation (Strong Recommendation; Low-Quality Evidence).”

“We recommend against performing preoperative pharmacological stress radionuclide imaging (Strong Recommendation; Moderate-Quality Evidence)”

Pre-operative stress testing

Diagnostic study in symptomatic patients

vs.

Screening test in asymptomatic patients

Grant P. CCJM. 2014;81(12)::752-754
Your patient

Dobutamine stress echo + inducible ischemia in mid-to-distal posterolateral and mid-anteroseptal regions. No severe valvular disease.

What is your next step in management?
Pre-operative cardiac revascularization

Surgical delay: 54 days vs. 18 days

P < 0.001

Pre-operative cardiac revascularization

- Pre-operative revascularization should be performed only in patients with a pre-existing indication for revascularization

- Coronary revascularization not recommended to exclusively decrease perioperative cardiac events (III,B)

Your patient

- Refer to Cardiology
- Medical management of CAD – beta-blocker, ASA, statin

Some considerations:
- Address goals of care
- Will delay from PCI or CABG increase risk of surgical condition?
- Can surgery be done safely with anti-platelet therapy?
## Timing of surgery after cardiac intervention

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Minimum delay in surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Balloon angioplasty</td>
<td>14 days</td>
</tr>
<tr>
<td>Bare Metal Stent (BMS)</td>
<td>30 days</td>
</tr>
<tr>
<td>Drug Eluting Stent (DES)</td>
<td>6 months(^1)</td>
</tr>
<tr>
<td></td>
<td>(consider at 3-6 months if risk of delayed surgery &gt; stent thrombosis)</td>
</tr>
</tbody>
</table>

Warrants discussion between patient, cardiologist, and surgeon regarding risks of in-stent thrombosis and bleeding

Pre-operative cardiac assessment prior to urgent surgery

- **History, physical exam, and functional status** are the most important!

- **Looking for:**
  - Acute coronary syndrome
  - Severe and/or symptomatic valvular disease
  - Volume overload
  - Unstable arrhythmia (SVT, RVR, high-grade block, etc)
  - Hypertensive urgency
  - Cardiac device management

- **Medication reconciliation**
Questions to ask before ordering testing for urgent surgery

- Will testing change management?
- Will surgery be cancelled (risks>benefits)?
- Can surgery be delayed?
- Will timely treatment of cardiac issue change perioperative outcomes?
- Will results change intra-op or post-op monitoring or disposition (acute care, ICU)?

If ordering testing, anticipate results and have a plan!
QUESTIONS?

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

• Grant P. Perioperative medicine: Combining the science and the art. CCJM. 2014;81(12):752-754


References


- Roshanov PS, et al. Withholding versus continuing angiotensin-converting enzyme inhibitors or angiotensin II receptor blockers before noncardiac surgery: an analysis of the Vascular events In noncardiac Surgery patients c0hort evaluatioN prospective cohort. Anesthesiology. 2017;126, 16-27