Perioperative Cardiovascular Evaluation and Care for Noncardiac Surgery


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Goldman Criteria

- Age > 70 yrs (5)
- CAD: MI within 6 months (10)
- CHF, 53 or JVE (11)
- Rhythm:
  - other than NSR/PACs on most recent ECG (7)
  - >3 PVCs/min any time preoperatively (7)
- Valvular Disease: Important aortic stenosis (5)
- General Medical condition (5)
  - PaO2 <60 or PaCO2 >50, K <3.0, or HCO3 <20, BUN >50 or Cr >3.0, abnormal AST, signs of chronic liver disease, bedridden from noncardiac causes
- Surgery: intraperitoneal, thoracic, aortic surgery (3)

Emergent surgery (4)

Goldman Criteria

<table>
<thead>
<tr>
<th>Class</th>
<th>Total Score</th>
<th>No or Minor Complications</th>
<th>Life Threatening</th>
<th>Cardiac Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>0-5</td>
<td>99%</td>
<td>0.7%</td>
<td>0.2%</td>
</tr>
<tr>
<td>II</td>
<td>6-12</td>
<td>93%</td>
<td>5%</td>
<td>2%</td>
</tr>
<tr>
<td>III</td>
<td>13-25</td>
<td>86%</td>
<td>11%</td>
<td>2%</td>
</tr>
<tr>
<td>IV</td>
<td>&gt;25</td>
<td>22%</td>
<td>22%</td>
<td>56%</td>
</tr>
</tbody>
</table>

Revised Goldman Criteria

- High risk type of surgery
- History of ischemic heart disease
- History of heart failure
- History of CVA
- Preoperative treatment with insulin
- Preoperative serum creatinine > 2.0 mg/dL

Rates: 0.4% with no risk; 0.9% with 1 risk; 7% with 2 risks; 11% with 3 or more risks

Detsky Criteria

- Age > 70 yrs (5)
- CAD:
  - MI within 6 months (10)
  - MI 6-12 months (5)
  - CCS class III (10)
  - CCS class IV (20)
  - Unstable angina within 3 months (10)
- CHF:
  - Pulmonary edema within 1 week (10)
- Rhythm:
  - other than NSR/PACs on last preop ECG (5)
  - >5 PVCs/min any time preoperatively (5)
- Valvular Disease: suspected critical aortic stenosis (5)
- General Medical condition (5)
  - PaO2 <60 or PaCO2 >50, K <3.0, or HCO3 <20, BUN >50 or Cr >3.0, abnormal AST, signs of chronic liver disease, bedridden from noncardiac causes
- Surgery: emergent surgery (10)

Revised Detsky Criteria

- High risk type of surgery
- History of ischemic heart disease
- History of heart failure
- History of CVA
- Preoperative treatment with insulin
- Preoperative serum creatinine > 2.0 mg/dL
- unstable angina within 3 months of surgery or stable angina occurring with minimal exertion or recent pulmonary edema (HIGH RISK)

Rates: 0.4% with no risk; 0.9% with 1 risk; 7% with 2 risks; 11% with 3 or more risks or HIGH RISK
Goldman and Detsky Criteria

- May UNDERESTIMATE the Cardiac Risk in Vascular Patients …

Eagle Criteria

- Access 5 significant clinical predictors
  1. Q waves on EKG
  2. History of angina
  3. History of ventricular ectopy requiring treatment
  4. Diabetes mellitus requiring therapy other than diet
  5. Age > 70

- Rate of postoperative ischemic events: 3.1% if no predictors, 15% if 1-2 predictors and up to 50% if 3 or more predictors.

Applying Classification of Recommendations and Level of Evidence

Level A
Multiple (> 5) predictors or complex evaluation
- General consistency of direction and magnitude of effect
- Multiple randomized trials or meta-analyses
- Greater efficacy less well established
- Greater conflicting evidence from multiple randomized trials or meta-analyses

Level B
Multiple (3-5) predictors or complex evaluation
- Sufficient evidence from single randomized trials or meta-analyses
- Moderate magnitude of effect
- Moderate consistency of direction and meta-analyses

Level C
Limited (1-2) predictors or simple evaluation
- Limited evidence from single randomized trials or meta-analyses
- Limited magnitude of effect
- Limited consistency of direction and meta-analyses

Level D
Very limited (1-2) predictors or simple evaluation
- Limited evidence from single randomized trials or meta-analyses
- Limited magnitude of effect
- Limited consistency of direction and meta-analyses
Active Cardiac Conditions for Which the Patient Should Undergo Evaluation and Treatment Before Noncardiac Surgery

<table>
<thead>
<tr>
<th>Condition</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unstable coronary syndromes</td>
<td>• Unstable or severe angina* (CCS class III or IV)†</td>
</tr>
<tr>
<td></td>
<td>• Recent MI</td>
</tr>
<tr>
<td>Decompensated HF</td>
<td>• NYHA functional class IV</td>
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<tr>
<td></td>
<td>• Worsening or new-onset HF</td>
</tr>
<tr>
<td>Significant arrhythmias</td>
<td>• High-grade atrioventricular block</td>
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<tr>
<td></td>
<td>• Mobitz II atrioventricular block</td>
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<tr>
<td></td>
<td>• Third-degree atrioventricular heart block</td>
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<tr>
<td></td>
<td>• Symptomatic ventricular arrhythmias (including atrial fibrillation)</td>
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<tr>
<td></td>
<td>• Worsening or new-onset HF</td>
</tr>
<tr>
<td></td>
<td>• Symptomatic bradycardia</td>
</tr>
<tr>
<td></td>
<td>• Newly recognized ventricular tachycardia</td>
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<tr>
<td>Severe valvular disease</td>
<td>• Severe aortic stenosis (mean pressure gradient greater than 40 mm Hg, aortic valve area less than 1.0 cm², or symptomatic)</td>
</tr>
<tr>
<td></td>
<td>• Symptomatic mitral stenosis (progressive dyspnea on exertion, exertional arrhythmias, or HF)</td>
</tr>
</tbody>
</table>

CCS indicates Canadian Cardiovascular Society; HF, heart failure; MI, myocardial infarction; NYHA, New York Heart Association. *According to Campeau. †May include stable angina in patients who are unusually sedentary. ‡The ACC National Database Library defines recent MI as more than 7 days but within 30 days.

Estimated Energy Requirements for Various Activities

<table>
<thead>
<tr>
<th>Can You…</th>
<th>1 Met</th>
<th>4 Met</th>
</tr>
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<tbody>
<tr>
<td>Take care of yourself?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Walk indoors around the house?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Walk a block or 2 on level ground at 2 to 3 mph (3.2 to 4.8 kph)?</td>
<td></td>
<td>≥ 10 Mts</td>
</tr>
<tr>
<td>Light work around the house like dusting or washing dishes?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Cardiac Risk Stratification for Noncardiac Surgical Procedures

<table>
<thead>
<tr>
<th>Risk Stratification</th>
<th>Procedure Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vascular (reported cardiac risk factor &gt; 5%)</td>
<td>Aortic and other major vascular surgery</td>
</tr>
<tr>
<td>Intermediate (reported cardiac risk generally 1%-5%)</td>
<td>Peripheral vascular surgery</td>
</tr>
<tr>
<td>Low† (reported cardiac risk generally &lt;1%)</td>
<td>Endoscopic procedures</td>
</tr>
</tbody>
</table>

†Low risk includes cardiac surgery risk <1%.

Recommendations for Preoperative Noninvasive Evaluation of LV Function

- **Class I (none)**
- **Class Ila**
  - It is reasonable for patients with dyspnea of unknown origin to undergo preoperative evaluation of LV function. (C)
  - It is reasonable for patients with current or prior HF with worsening dyspnea or other change in clinical status to undergo preoperative evaluation of LV function if not performed within 12 months. (C)

- **Class IIb**
  - Reassessment of LV function in clinically stable patients with previously documented cardiomyopathy is not well established. (C)
  - Routine perioperative evaluation of LV function in patients is not recommended. (B)

Recommendations for Preoperative Resting 12-Lead ECG

- **Class I**: Preoperative resting 12-lead ECG is recommended for pts with:
  - At least 1 clinical risk factor* who are undergoing vascular surgical procedures. (B)
  - Known CHD, peripheral arterial disease, or cerebrovascular disease who are undergoing intermediate-risk surgical procedures. (C)
- **Class Ila**: Preoperative resting 12-lead ECG is reasonable in persons with no clinical risk factors who are undergoing vascular surgical procedures. (B)
- **Class IIb**: Preoperative resting 12-lead ECG may be reasonable in patients with at least 1 clinical risk factor who are undergoing intermediate-risk operative procedures. (B)
- **Class III**: Preoperative and postoperative resting 12-lead ECGs are not indicated in asymptomatic persons undergoing low-risk surgical procedures. (B)

*Clinical risk factors include history of ischemic heart disease, history of documented or prior life-threatening cerebrovascular disease, diabetes mellitus, and renal insufficiency.

High Risk 12-Lead ECG
Extensive Antero-lateral MI

Inferior MI, high grade AV block and PVC

AMI (inferio-lateral?) With RBBB

Pacemaker rhythm with AMI (inferior)

Aortic Valve Stenosis

HOCM
Recommendations for Noninvasive Stress Testing Before Noncardiac Surgery

- **Class I**: Patients with active cardiac conditions in whom noncardiac surgery is planned should be evaluated and treated per ACC/AHA guidelines before noncardiac surgery. (B)
- **Class IIa**: Noninvasive stress testing of patients with 3 or more clinical risk factors and poor functional capacity (less than 4 METs) who require noncardiac surgery is reasonable if it will change management. (B)
- **Class IIb**: Noninvasive stress testing may be considered for patients:
  - With at least 1 to 2 clinical risk factors and poor functional capacity (less than 4 METs) who require intermediate-risk noncardiac surgery if it will change management. (II)
  - With at least 1 to 2 clinical risk factors and good functional capacity (greater than or equal to 4 METs) who are undergoing vascular surgery. (II)
- **Class III**: Noninvasive testing is not useful for patients:
  - With no clinical risk factors undergoing intermediate-risk noncardiac surgery. (C)
  - Undergoing low-risk noncardiac surgery. (C)
Prognostic Gradient of Ischemic Responses During an ECG-Monitored Exercise Test in Patients With Suspected or Proven CAD

High Risk Ischemic Response

Ischemia induced by low-level exercise* (less than 4 METs or heart rate < 100 bpm or < 70% of age-predicted heart rate) manifested by 1 or more of the following:

- Horizontal or downsloping ST depression > 0.1 mV
- ST-segment elevation > 0.1 mV in noninfarct lead
- Five or more abnormal leads
- Persistent ischemic response > 3 minutes after exertion
- Typical angina
- Exercise-induced decrease in systolic BP by 10 mm Hg

Intermediate:

Ischemia induced by moderate-level exercise (4 to 6 METs or HR 100 to 130 bpm (70% to 85% of age-predicted heart rate)) manifested by > 1 of the following:

- Horizontal or downsloping ST depression > 0.1 mV
- Persistent ischemic response greater than 1 to 3 minutes after exertion
- Three to 4 abnormal leads

Low

No ischemia or ischemia induced at high-level exercise (> 7 METs or HR > 130 bpm (greater than 85% of age-predicted heart rate)) manifested by:

- Horizontal or downsloping ST depression > 0.1 mV
- One or 2 abnormal leads

Inadequate test

Inability to reach adequate target workload or heart rate response for age without an ischemic response. For patients undergoing noncardiac surgery, the inability to exercise to at least the intermediate-risk level without ischemia should be considered an inadequate test.

Preoperative Coronary Revascularization With CABG or Percutaneous Coronary Intervention

- Class I: Patients with active cardiac conditions in whom noncardiac surgery is planned should be evaluated and treated per ACC/AHA guidelines before noncardiac surgery. (B)
- Class IIa: Noninvasive stress testing of patients with 3 or more clinical risk factors and poor functional capacity (less than 4 METs) who require vascular surgery is reasonable if it will change management. (B)
- Class IIb: Noninvasive stress testing may be considered for patients:
  - With at least 1 to 2 clinical risk factors and poor functional capacity (less than 4 METs) who require intermediate-risk noncardiac surgery if it will change management. (B)
  - With at least 1 to 2 clinical risk factors and good functional capacity (greater than or equal to 4 METs) who are undergoing vascular surgery. (B)
- Class III: Noninvasive testing is not useful for patients:
  - With no clinical risk factors undergoing intermediate-risk noncardiac surgery. (C)
  - Undergoing low-risk noncardiac surgery. (C)

Cardiac evaluation and care algorithm for noncardiac surgery (1)

Proposed approach to the management of patients with previous PCI who require noncardiac surgery
Treatment for patients requiring PCI who need subsequent surgery

Drug Eluting Stents (DES) and Stent Thrombosis

3. A greater effort by healthcare professionals must be made before patient discharge to ensure that patients are properly and thoroughly educated about the reasons they are prescribed thienopyridines and the significant risks associated with prematurely discontinuing such therapy.

4. Patients should be specifically instructed before hospital discharge to contact their treating cardiologist before stopping any antiplatelet therapy, even if instructed to stop such therapy by another healthcare provider.

5. Healthcare providers who perform invasive or surgical procedures and who are concerned about periprocedural and postprocedural bleeding must be made aware of the potentially catastrophic risks of premature discontinuation of thienopyridine therapy. Such professionals who perform these procedures should contact the patient’s cardiologist if issues regarding the patient’s antiplatelet therapy are unclear, to discuss optimal patient management strategy.

Recommendations for Beta-Blocker Medical Therapy

CLASS I
1. Beta blockers should be continued in patients undergoing surgery who are receiving beta blockers to treat angina, symptomatic arrhythmias, hypertension, or other ACC/AHA class I guideline indications. (C)

2. Beta blockers should be given to patients undergoing vascular surgery who are at high cardiac risk owing to the finding of ischemia on preoperative testing. (B)

CLASS IIa
1. Beta blockers are probably recommended for patients undergoing vascular surgery in whom preoperative assessment identifies CHD. (B)

2. Beta blockers are probably recommended for patients in whom preoperative assessment for vascular surgery identifies high cardiac risk, as defined by the presence of more than 1 clinical risk factor. (B)

3. Beta blockers are probably recommended for patients in whom preoperative assessment identifies CHD or high cardiac risk, as defined by the presence of more than 1 clinical risk factor, who are undergoing intermediate-risk or vascular surgery. (B)

CLASS IIb
1. The usefulness of beta blockers is uncertain for patients who are undergoing intermediate-risk procedures or vascular surgery, in whom preoperative assessment identifies a single clinical risk factor. (C)

2. The usefulness of beta blockers is uncertain in patients undergoing vascular surgery with no clinical risk factors who are not currently taking beta blockers. (B)

CLASS III
1. Beta blockers should not be given to patients undergoing surgery who have absolute contraindications to beta blockade. (C)
Recommendations for Perioperative Beta-Blocker Therapy

**CLASS I**
1. For patients currently taking statins and scheduled for noncardiac surgery, statins should be continued. (B)

**CLASS IIa**
1. For patients undergoing vascular surgery with or without clinical risk factors, statin use is reasonable. (B)

**CLASS IIb**
1. For patients with at least 1 clinical risk factor who are undergoing intermediate-risk procedures, statins may be considered. (C)

Recommendations for Alpha-2 Antagonists and TE Echo

**CLASS IIb**
1. Alpha-2 agonists for perioperative control of hypertension may be considered for patients with known CAD or at least 1 clinical risk factor who are undergoing surgery. (B)

**CLASS III**
1. Alpha-2 agonists should not be given to patients undergoing surgery who have contraindications to this medication. (C)

**CLASS IIa**
1. The emergency use of intraoperative or perioperative TEE is reasonable to determine the cause of an acute, persistent, and life-threatening hemodynamic abnormality. (Level of Evidence: C)

Recommendations for PA Catheters and IV Nitro

**CLASS IIb**
1. Preoperative intensive care monitoring with a pulmonary artery catheter for optimization of hemodynamic status might be considered; however, it is rarely required and should be restricted to a very small number of highly selected patients whose presentation is unstable and complex and who have multiple comorbid conditions. (B)

2. The usefulness of intraoperative nitroglycerin as a prophylactic agent to prevent myocardial ischemia and cardiac morbidity is unclear for high-risk patients undergoing noncardiac surgery, particularly those who have required nitrate therapy to control angina. The recommendation for prophylactic use of nitroglycerin must take into account the anesthetic plan and patient hemodynamics and must recognize that vasodilation and hypovolemia can readily...

Intraoperative and Postoperative Use of ST-Segment Monitoring

**CLASS IIa**
1. Intraoperative and postoperative ST-segment monitoring can be useful to monitor patients with known CAD or those undergoing vascular surgery, with computerized ST-segment analysis, when available, used to detect myocardial ischemia during the perioperative period. (B)

**CLASS IIb**
1. Intraoperative and postoperative ST-segment monitoring may be considered in patients with single or multiple risk factors for CAD who are undergoing noncardiac surgery. (B)

Surveillance for Perioperative MI

**CLASS I**
1. Postoperative troponin measurement is recommended in patients with ECG changes or chest pain typical of acute coronary syndrome. (C)

**CLASS IIb**
1. The use of postoperative troponin measurement is not well established in patients who are clinically stable and have undergone vascular and intermediate-risk surgery. (C)

**CLASS III**
1. Postoperative troponin measurement is not recommended in asymptomatic stable patients who have undergone low-risk surgery. (C)