Case #1

- 62 y/o woman with no cardiac risk factors scheduled for cataract surgery
- Asymptomatic
- Exercises 45 mins three times a week
- Exam Benign
- Further evaluation needed?
  - No
  - Risk
  - Low (Acceptable)
Case #2
- 89 y/o man admitted with hip fx
- Hx of ICM 0.20, CKD, DM
- Sx of chest pain last week
- Mild CHF on exam
- Further evaluation needed?
  - No
  - Risk
  - High

Case #3
- 65 y/o man s/p CABG 2002 now for AAA repair
- Recent DOE, palpitations, edema
- Exam ectopy, clear lungs
- Further evaluation needed?
  - Yes
  - Risk
  - To be determined

Theme

“…intervention is rarely necessary to simply lower the risk of surgery unless such intervention is indicated irrespective of the preoperative context.”
Purpose of Pre-Op Evaluation

1. To evaluate the patient undergoing noncardiac surgery who is at risk for perioperative morbidity and/or mortality.
2. To perform an evaluation of the patient’s current medical status.
3. To make recommendations on the evaluation, management and risk of cardiac problems during the entire perioperative period.
4. To provide a clinical risk profile that all health care providers can use in making treatment decisions that may influence short- and long-term cardiac outcomes.

What Causes Perioperative Cardiovascular Events?

- Catecholamine Surges
- Prothrombotic Milieu
- Blood Loss
- Volume Shifts
- Coronary Plaque Destabilization
- Fixed Coronary Disease

Pre-Op Assessment

1. Does the patient have risk factors for surgery?
2. What comorbidities does the patient have?
3. Does the patient have cardiac symptoms?
4. What is the functional capacity of the patient?
5. What type and risk of surgery is patient undergoing?
Determinants of Risk

1. Clinical Risk Factors
2. Co-morbid Conditions
3. Active Cardiac Conditions
4. Functional Capacity
5. Type of Surgery

Clinical Risk Factors

- History of:
  - ischemic heart disease
  - compensated or prior heart failure
  - cerebrovascular disease
- Diabetes mellitus
- Renal insufficiency (Cr >2 mg/dL)
Co-morbid Conditions

1. Diabetes Mellitus
   - Increases risk of CAD and insulin therapy is a significant risk factor for mortality
   - Older patients are more likely to develop heart failure postoperatively

2. Renal Insufficiency
   - Anemia is associated with increased risk of cardiovascular events
   - Preoperative creatinine of ≥ 2.5 mg/dl is a risk factor for postoperative renal dysfunction and increased morbidity and mortality

3. Pulmonary Disease
   - Obstructive or restrictive disease increases risk
   - If suspected, ABGs, PFTs, and response to bronchodilators is indicated

4. Hematologic Disorders
   - Anemia may exacerbate ischemia and aggravate heart failure
   - Polycythemia, thrombocytosis, and increased viscosity increase risk of thromboembolism and hemorrhage

5. Peripheral Vascular Disease

Determinants of Risk

1. Clinical Risk Factors
2. Co-morbid Conditions
3. Active Cardiac Conditions
4. Functional Capacity
5. Type of Surgery

Active Cardiac Conditions

<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>Decompenated HF (NYHA functional class IV)</td>
<td>Recent MI*</td>
</tr>
<tr>
<td>Severe valvular disease</td>
<td>Severe aortic stenosis (mean pressure gradient &gt; 40 mm Hg, aortic valve area ≤ 0.8 cm², or symptomatic)</td>
</tr>
</tbody>
</table>

*Greater than 7 but less than 30 days
Determinants of Risk

1. Clinical Risk Factors
2. Co-morbid Conditions
3. Active Cardiac Conditions
4. Functional Capacity
5. Type of Surgery

Functional Capacity

<table>
<thead>
<tr>
<th>MET</th>
<th>Can You...</th>
<th>MET</th>
<th>Can You...</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Take care of yourself?</td>
<td>4</td>
<td>Climbing a flight of stairs or walk up a hill?</td>
</tr>
<tr>
<td></td>
<td>Eat, dress, or use the toilet?</td>
<td></td>
<td>Walking on level ground at 4 mph (6.4 kph)?</td>
</tr>
<tr>
<td></td>
<td>Walk indoors around the house?</td>
<td></td>
<td>Do heavy work around the house like scrubbing floors or lifting or moving heavy furniture?</td>
</tr>
<tr>
<td></td>
<td>Walk a block or 2 on level ground at 2.5 to 3 mph (4.0 to 4.8 kph)?</td>
<td></td>
<td>Participate in moderate recreational activities like golf, bowling, dancing, doubles tennis, or throwing a baseball or football?</td>
</tr>
<tr>
<td>4</td>
<td>Do light work around the house like dusting or washing dishes?</td>
<td>&gt; 10</td>
<td>Participate in strenuous sports like swimming, singles tennis, football, basketball, or skiing?</td>
</tr>
</tbody>
</table>

*MET indicates metabolic equivalent; mph, miles per hour; kph, kilometers per hour. Modified from Hlatky et al., copyright 1989, with permission from Elsevier, and adapted from Fletcher et al.
**Type of Surgery**

<table>
<thead>
<tr>
<th>Risk Stratification</th>
<th>Procedure Examples</th>
</tr>
</thead>
</table>
| Vascular (Cardiac risk > 5%) | • Aortic and other vascular surgery  
  • Peripheral vascular surgery |
| Intermediate (Cardiac risk 1-5%) | • Intraperitoneal and intrathoracic surgery  
  • Carotid endarterectomy  
  • Head and neck surgery, Orthopedic surgery  
  • Prostate surgery |
| Low (Cardiac risk <1%) | • Endoscopic procedure  
  • Superficial procedure, Breast surgery  
  • Cataract surgery  
  • Ambulatory surgery |

Cardiac risk = cardiac death or nonfatal MI

**Additional Considerations**

Coronary Artery Disease
- continue beta blockade therapy
- preoperative testing is limited to those in whom coronary revascularization may be of benefit independent of noncardiac surgery

Age and Gender
- intraop or periop MI mortality is higher in elderly
- mortality in women is greater than men

**Applying Classification of Recommendations and Level of Evidence**

- **Class I**
  - Benefit >>> Risk
  - Procedure/Treatment SHOULD be performed/delivered

- **Class IIa**
  - Benefit >> Risk  
  - Additional studies needed: Additional studies needed: Additional studies needed:  
  - Procedure/Treatment MAY BE CONSIDERED

- **Class IIb**
  - Benefit ≥ Risk  
  - Additional studies needed: Additional studies needed: Additional studies needed:  
  - Procedure/Treatment MAY BE CONSIDERED

- **Class III**
  - Risk ≥ Benefit  
  - Procedure/Treatment SHOULD NOT be performed SINCE IT IS NOT HELPFUL AND MAY BE HARMFUL

**Level of Evidence**

- **Level A**
  - Data derived from multiple randomized clinical trials or meta-analyses  
  - Multiple populations evaluated

- **Level B**
  - Data derived from a single randomized trial or nonrandomized studies  
  - Limited populations evaluated

- **Level C**
  - Only consensus of experts opinion, case studies, or standard of care  
  - Very limited populations evaluated
Recommendations for Preoperative Resting 12-Lead ECG

Preoperative resting 12-lead ECG is recommended for patients with:

- At least 1 clinical risk factor* who are undergoing vascular surgical procedures
- Known CHD, peripheral arterial disease, or cerebrovascular disease who are undergoing intermediate-risk surgical procedures

* Clinical risk factors include history of ischemic heart disease, history of compensated or prior HF, history of cerebrovascular disease, diabetes mellitus, and renal insufficiency.

Recommendations for Noninvasive Stress Testing Before Noncardiac Surgery

Patients with active cardiac conditions in whom noncardiac surgery is planned should be evaluated and treated per ACC/AHA guidelines before noncardiac surgery.

Noninvasive stress testing of patients with 3 or more clinical risk factors and poor functional capacity (< 4 METs) who require vascular surgery is reasonable if it will change management.
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 or vascular surgery if it will change management.

Noninvasive testing is NOT useful for patients:
• With no clinical risk factors undergoing intermediate-risk noncardiac surgery.
• Undergoing low-risk noncardiac surgery.

Recommendations for Noninvasive Stress Testing Before Noncardiac Surgery

### Recommendations for Perioperative Beta-Blocker Therapy

<table>
<thead>
<tr>
<th>Surgery</th>
<th>No Clinical Risk Factors</th>
<th>CAD or High Risk (1 or more clinical risk factors)</th>
<th>Patients Currently Taking Beta Blockers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vascular</td>
<td>Class Ila, Level of Evidence: B</td>
<td>Class Ila, Level of Evidence: B</td>
<td>Class Ia, Level of Evidence: B</td>
</tr>
<tr>
<td>Intermediate risk</td>
<td>...</td>
<td>Class Ila, Level of Evidence: B</td>
<td>Class Ia, Level of Evidence: C</td>
</tr>
<tr>
<td>Low risk</td>
<td>...</td>
<td>...</td>
<td>Class Ia, Level of Evidence: C</td>
</tr>
</tbody>
</table>

Preoperative Coronary Revascularization with CABG or PCI

Coronary revascularization before noncardiac surgery is useful in patients with stable angina who have:
• significant left main coronary artery stenosis
• 3-vessel disease (survival benefit is greater when LVEF <0.50)
• 2-vessel disease with significant proximal LAD stenosis & either EF <0.50 or demonstrable ischemia on noninvasive testing

Coronary revascularization before noncardiac surgery is recommended for patients with:
• high-risk UA/NSTEMI
• acute STEMI
Preoperative Coronary Revascularization with CABG or PCI

It is not recommended that routine prophylactic coronary revascularization be performed in patients with stable CAD before noncardiac surgery.

Elective noncardiac surgery is not recommended within:
- 4-6 weeks of bare metal coronary stent implantation
- or within 12 months of drug-eluting coronary stent implantation in patients in whom thienopyridine therapy, or ASA & thienopyridine therapy, will need to be discontinued perioperatively
- 4 weeks of coronary revascularization with balloon angioplasty

Drug Eluting Stents (DES) and Stent Thrombosis

- BMS or PTCA should be considered over DES in patients who are undergoing PCI and who are likely to require invasive or surgical procedures within the next 12 months.
- Elective procedures with bleeding risk should be deferred until patients have completed an appropriate course of thienopyridine therapy (12 months after DES and a minimum of 1 month for bare-metal stent implantation).
- Continue aspirin when required to hold thienopyridine for patients with DES who are to undergo subsequent procedures. Restart thienopyridine as soon as possible after the procedure because of concerns about late stent thrombosis.

Proposed Approach to the Management of Patients with Previous PCI Who Require Noncardiac Surgery

- Delay for elective or nonurgent surgery <14 days
- Proceed to the operation room with aspirin
- Delay for elective or nonurgent surgery >30-45 days
- <30-45 days
- >365 days
- Previous PCI
- Time since PCI
- <365 days
- >14 days
- PCI, percutaneous coronary intervention
Disease Specific Approaches

Hypertension

- Stage 1 or 2 is not an independent risk factor for periop cardiovascular complications and surgery need not be delayed
- In patients with Stage 3 hypertension IV agents should be used preop and surgery may proceed if no significant comorbidities
- Preop control may help reduce the tendency to periop ischemia
- Continue antihypertensives and avoid withdrawal of beta blockers and clonidine (rebound effect). Use parenteral or transdermal preparations
- Patients receiving ACE-Is and ARBs are more likely to develop periop hypotension. Consider beta blockers
- If pheochromocytoma is suspected, surgery should be delayed

Cardiomyopathy

- Little information available
- Hx or signs of heart failure should undergo LV function assessment to quantify severity of systolic or diastolic dysfunction

Hypertrophic Cardiomyopathy

- Reduction of blood volume, decreased SVR, and increased venous capacitance may cause a reduction in LV volume and increase outflow obstruction
- Beta adrenergic agonists should be avoided

Recommendations for Preoperative Noninvasive Evaluation of LV Function

Ia It is reasonable for patients with dyspnea of unknown origin to undergo preoperative evaluation of LV function.

IIa 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.
Recommendations for Preoperative Noninvasive Evaluation of LV Function

Reassessment of LV function in clinically stable patients with previously documented cardiomyopathy is not well established.

Routine perioperative evaluation of LV function in patients is NOT recommended.

Disease Specific Approaches

Valvular Heart Disease

Aortic Stenosis
- Severe aortic stenosis poses greatest risk (10%).
  - If symptomatic, postpone or cancel elective surgery.
  - If asymptomatic should be evaluated if last evaluation greater than one year.
  - If patient not operative candidate or refuses evaluation or surgery, consider BAV.

Mitral Stenosis
- Mild to moderate, control heart rate to increase diastolic filling period
- Severe, may benefit from BMV or surgical repair before high risk surgery

Severe Aortic Regurgitation
- Attention to volume control and afterload reduction is recommended
- Limit bradycardia to decrease regurgitant time

Severe Mitral Regurgitation
- Preop diuretics and diuretics to maximize hemodynamic stabilization before high risk surgery

Disease Specific Approaches

Mechanical Prosthetic Valves
- SBE Px where indicated
- Patients undergoing minimally invasive procedures should reduce INR to low or subtherapeutic and resume oral anticoagulation immediately after procedure
- Preop UFH recommended in patients with high risk of bleeding on oral anticoagulation and high risk of thromboembolism without
- e.g. Mitral mechanical valve, Bjork-Shiley valve, recent (<1yr) embolic or thrombotic event. OR 3 or more of the following risk factors:
  - Atrial fibrillation
  - Hx embolic event at any time
  - Hypercoagulable condition
  - LVEF < 35%
Arrhythmias and Conduction Defects

- Both supraventricular and ventricular arrhythmias are independent risk factors for coronary events in the periop period
- Presence should elicit evaluation for cardiopulmonary disease
- Low threshold to institute beta blockade therapy
- High grade conduction abnormalities can increase operative risk and may require temporary or permanent pacing

Disease Specific Approaches

Pulmonary Vascular Disease
- No major studies available
- In patients with severe PHTN and shunts, hypotension may lead to increased right to left shunting, acidosis, and further decreases in SVR

Congenital Heart Disease
- After surgical correction, pulmonary vasoreactivity remains abnormal with resultant high pulmonary pressures and hypoxia

Recommendations for Statin Therapy

- For patients currently taking statins and scheduled for noncardiac surgery, statins should be continued.
- For patients undergoing vascular surgery with or without clinical risk factors, statin use is reasonable.
- For patients with at least 1 clinical risk factor who are undergoing intermediate-risk procedures, statins may be considered.
Recommendations for IV Nitro

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 occur during anesthesia and surgery.

Use of TEE and Maintenance of Body Temperature

The emergency use of intraoperative or perioperative TEE is reasonable to determine the cause of an acute, persistent, and life-threatening hemodynamic abnormality.

Maintenance of body temperature in a normothermic range is recommended for most procedures other than during periods in which mild hypothermia is intended to provide organ protection (e.g., during high aortic cross-clamping).

Perioperative Control of Blood Glucose Concentration

It is reasonable that blood glucose concentration be controlled during the perioperative period in patients with diabetes mellitus or acute hyperglycemia who are at high risk for myocardial ischemia or who are undergoing vascular and major surgical procedures with planned ICU admission.

The usefulness of strict control of blood glucose concentration during the perioperative period is uncertain in patients with diabetes mellitus or acute hyperglycemia who are undergoing noncardiac surgical procedures without planned ICU admission.
Surveillance for Perioperative MI

Postoperative troponin measurement is recommended in patients with ECG changes or chest pain typical of acute coronary syndrome.

The use of postoperative troponin measurement is not well established in patients who are clinically stable and have undergone vascular and intermediate-risk surgery.

Postoperative troponin measurement is NOT recommended in asymptomatic stable patients who have undergone low-risk surgery.

Pre-Op Assessment

1. Does the patient have risk factors for surgery?
2. What comorbidities does the patient have?
3. Does the patient have cardiac symptoms?
4. What is the functional capacity of the patient?
5. What type and risk of surgery is patient undergoing?

Cardiac Evaluation and Care Algorithm for Noncardiac Surgery
Cardiac Evaluation and Care Algorithm for Noncardiac Surgery

**1 or 2 clinical risk factors?**
- Vascular Surgery
- Intermediate risk surgery
- Class IIa, LOE B
- Proceed with planned surgery with HR control (Class IIa, LOE B)
- or consider noninvasive testing (Class IIb, LOE B) if it will change with management

**3 or more clinical risk factors?**
- Consider testing if it will change management
- Proceed with planned surgery with HR control (Class IIa, LOE B)
- or consider noninvasive testing (Class IIb, LOE B) if it will change with management

**No clinical risk factors?**
- Vascular Surgery
- Intermediate risk surgery
- Class I, LOE B

Any Questions?

Thank you