Perioperative Assessment

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Goals

• Understand how to estimate peri-operative CV risk
• Know when to perform stress testing preoperatively
• Learn how to reduce risk perioperatively in those at higher risk
Key Points

1. Extensive testing is rarely needed to determine risk

2. Evaluation/Testing **not** needed if:
   a. Low risk surgery
   b. Good functional capacity and no cardiac symptoms
   c. No clinical risk factors
4. Revascularization (surgery or PCI) should be considered only if standard indications are present

5. If PCI to be done, delay before non-cardiac surgery should be as follows:

- POBA: 14 days
- BMS: 30-45 days
- DES: > 365 days
Key Points

6. Cardiac complications (both ischemia and infarction) are often manifested by:
   a. Confusion, other MS changes
   b. Hypotension
   c. Dyspnea, heart failure

7. Cardiac complications tend to occur postoperatively and not intraoperatively, with a peak incidence on POD # 2-3
Key Points

ST Depression

Key Points

8. Outcomes in high risk patients optimized with:
   a. Beta blockers
   b. Aggressive pain control
   c. Avoidance of severe anemia
   d. Normothermia
   d. Vigilant monitoring
Perioperative Risk

• Patient
  – Underlying disease
  – Physiologic Reserve

• Procedure
  – Risk Classification

• Anesthetic Risk

• Environment
Patient-associated Factors

- Underlying (comorbid) conditions
  - More comorbidity = greater risk
  - Ischemic heart disease
  - CHF
  - Diabetes
  - Renal Insufficiency
  - Low serum albumin
Patient-associated Factors (cont.)

- Undiagnosed hypothyroidism
- Hepatitis
  - Acute, 10% mortality
- Cirrhosis
- Obesity
Diabetes

- “Heroic” efforts to control BS
- Decreased postop M&M significantly in cardiac surgery
- Must be aware of hypoglycemia
- Poor wound healing
- Postop infections
- Diabetic comorbidities
Cerebral Vascular Disease

- Stroke Risk
- Hypertensive vascular disease
- Associated comorbidities
Obesity

• BMI (wt/ht)(m²)
  – BMI < 25 normal
  – BMI 25-30 overweight
  – BMI 31-40 obese
  – BMI > 40 morbidly obese
Obesity

- Decreased pulmonary reserve
  - Decreased FRC
- Wound infections
- Anesthesia difficulties:
  - Intubation
  - Venous access
  - Aspiration
- Thrombophlebitis
- Association with DM, CV disease and HTN
Patient Factors

• Renal function:
  – Approximately 1% decline in functional nephrons per year after age 40

• Pulmonary function:
  – refer to text
Overview

- Epidemiology
- Risk Assessment
- Preoperative Testing
- Postoperative Management to Reduce Risk
- Frequently asked questions
- Case studies
Epidemiology

- 43.9 million inpatient procedures annually
- CV complications are the leading cause of morbidity and mortality following surgery
  - Rates among all comers: 2%
  - >3 risk factors: 11%
- 20 Billion dollar annual cost

Source: CDC 2003 National Hospital Discharge Survey - Published July 8, 2005
Epidemiology

Source: CDC 2003 National Hospital Discharge Survey - Published July 8, 2005
Distribution of Procedure by Gender

Women

Digestive, 18.0%
Musculoskeletal, 7.0%
Obstetrical, 25.0%
All Others, 19.0%
Cardiovascular, 11.0%
Diagnostic & Therapeutic, 26.0%

Men

Digestive, 14.0%
Musculoskeletal, 7.0%
All Others, 17.0%
Cardiovascular, 23.0%
Diagnostic & Therapeutic, 36.0%

Source: CDC 2003 National Hospital Discharge Survey - Published
July 8, 2005
Triggers

- Surgical Trauma
- Anesthesia/analgesia

Inflammatory State

- ↑ TNF-α
- ↑ IL-1
- ↑ IL-6
- ↑ CRP

- Plaque fissuring

Hypercoagulable State

- ↑ PAI-1
- ↑ Factor VII
- ↑ Platelet reactivity
- ↓ antithrombin III

- Coronary artery shear stress
- Plaque fissuring

Stress State

- ↑ catecholamine and cortisol levels

- Coronary artery shear stress

Hypoxic State

- ↓ oxygen delivery

- ↑ BP
- ↑ HR
- ↑ FFAs
- ↑ relative insulin deficiency
- ↑ Oxygen demand

Acute Coronary Thrombus

Myocardial Ischemia

Perioperative Myocardial Infarction
Men and woman are not the same
Gender Differences in Heart Disease

• Woman get it at a later age
• Woman are less likely to manifest with “typical” symptoms
• Women have worse outcomes in cardiac intervention
• Women (most) don’t have wives to take care of them!
Overview

• Epidemiology
• **Risk Assessment**
• Preoperative Testing
• Postoperative Management to Reduce Risk
• Frequently Asked Questions
• Case Studies
Approaches to Risk Assessment

1. ASA/Dripps
2. Goldman Multifactorial Index
3. Detsky Modified Index
4. Revised Risk Index
5. ACC/AHA Task Force Recommendations

Quantitative

Strategic
# Dripps/ASA Classification

<table>
<thead>
<tr>
<th>Class</th>
<th>Systemic Disturbance</th>
<th>Mortality*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Healthy patient with no disease outside of the surgical process</td>
<td>&lt;0.03%</td>
</tr>
<tr>
<td>2</td>
<td>Mild-to-moderate systemic disease caused by the surgical condition or by other pathologic processes</td>
<td>0.2%</td>
</tr>
<tr>
<td>3</td>
<td>Severe disease process which limits activity but is not incapacitating</td>
<td>1.2%</td>
</tr>
<tr>
<td>4</td>
<td>Severe incapacitating disease process that is a constant threat to life</td>
<td>8%</td>
</tr>
<tr>
<td>5</td>
<td>Moribund patient not expected to survive 24 hours with or without an operation</td>
<td>34%</td>
</tr>
<tr>
<td>E</td>
<td>Suffix to indicate an emergency surgery for any class</td>
<td>Increased</td>
</tr>
</tbody>
</table>
Goldman Risk Index

<table>
<thead>
<tr>
<th>Condition</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Third heart sound ($S_3$)</td>
<td>11</td>
</tr>
<tr>
<td>Elevated jugulocephalic pressure</td>
<td>11</td>
</tr>
<tr>
<td>Myocardial infarction in past 6 months</td>
<td>10</td>
</tr>
<tr>
<td>EKG: premature arterial contractions or any rhythm other than sinus</td>
<td>7</td>
</tr>
<tr>
<td>EKG shows &gt;5 premature ventricular contractions per minute</td>
<td>7</td>
</tr>
<tr>
<td>Age &gt;70 yrs</td>
<td>5</td>
</tr>
<tr>
<td>Emergency procedure</td>
<td>4</td>
</tr>
<tr>
<td>Intra-thoracic surgery</td>
<td>3</td>
</tr>
<tr>
<td>Thoracic, intra-abdominal, or aortic surgery</td>
<td></td>
</tr>
<tr>
<td>Poor general status, metabolic or bedridden</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Class</th>
<th>Point Total</th>
<th>None/Minor Complication</th>
<th>Life-Threatening Complication</th>
<th>Cardiac Death</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class I</td>
<td>0-5</td>
<td>99%</td>
<td>0.7%</td>
<td>0.2%</td>
</tr>
<tr>
<td>Class II</td>
<td>6-12</td>
<td>93%</td>
<td>5%</td>
<td>2%</td>
</tr>
<tr>
<td>Class III</td>
<td>13-25</td>
<td>88%</td>
<td>11%</td>
<td>2%</td>
</tr>
<tr>
<td>Class IV</td>
<td>≥26</td>
<td>22%</td>
<td>22%</td>
<td>56%</td>
</tr>
</tbody>
</table>

ACC/AHA 2007 Guidelines on Perioperative Cardiovascular Evaluation and Care for Noncardiac Surgery


J Am Coll Cardiol, 2007; 50:1707-1732
Stepwise Approach to the Pre-operative Evaluation
Stepwise Approach to Preoperative Cardiac Assessment

1. **Need for emergency noncardiac surgery**
   - Yes → **Operating room**
   - No → **Active cardiac conditions**

2. **Active cardiac conditions**
   - Yes → **Evaluate and treat per ACC/AHA Guidelines**
   - No → **Low Risk Surgery**

3. **Low Risk Surgery**
   - Yes → **Proceed with planned surgery**
   - No → **Asymptomatic and good functional capacity**

4. **Asymptomatic and good functional capacity**
   - Yes → **Proceed with planned surgery**
   - No → **Manage based on clinical risk factors**

5. **Manage based on clinical risk factors**
   - Yes → **Consider Operating Room**
   - No → **Vigilant perioperative and postoperative management**
Manage based on clinical risk factors

3 or more clinical risk factors*
- Vascular Surgery
  - Consider Testing

1 or 2 clinical risk factors*
- Intermediate risk surgery
  - Proceed with planned surgery with HR control or consider non-invasive testing

No clinical risk factors*
- Vascular Surgery
  - Intermediate risk surgery
  - Proceed with planned surgery

*Clinical risk factors = known ischemic heart disease, compensated or prior HF, diabetes, renal insufficiency, cerebrovascular disease
Importance of Surgical Urgency

**Elective Surgery:** Carried out at a time to suit the patient and surgeon

**Urgent Surgery:** Carried out within 24-hrs of admission

**Emergency Surgery:** Carried out within 2-hrs of admission or in conjunction with resuscitation

**Non-Cardiac Surgery**

<table>
<thead>
<tr>
<th>Type</th>
<th>Complications (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elective</td>
<td>12.8</td>
</tr>
<tr>
<td>Urgent</td>
<td>17.2</td>
</tr>
<tr>
<td>Emergent</td>
<td>20</td>
</tr>
</tbody>
</table>

Source: Evaluation of National Confidential Enquiry into Perioperative Deaths (NCEPOD)
Surgical Urgency?

**Key Point:** Patients undergoing urgent or emergent surgery are at higher risk of postoperative complications and require closer surveillance postoperatively.
Functional Capacity

1. Correlates with maximum oxygen uptake on treadmill testing
2. Demonstrated predictor of future cardiac events
2. Poor functional capacity may hide low threshold cardiac symptoms
Duke Activity Status Index

1 MET
- Can you take care of yourself?
- Eat, dress, or use the toilet?
- Walk indoors around the house?
- Walk a block or two on level ground at 2-3 mph or 3.2-4.8 km/h?

4 METs
- Do light work around the house like dusting or washing clothes?

4 METs
- Climb a flight of stairs or walk up a hill?
- Walk on level ground at 4 mph or 6.4 km/h?
- Run a short distance?
- Do heavy work around the house like scrubbing floors or lifting or moving heavy objects?
- Participate in moderate recreational activities like golf, bowling, dancing, doubles tennis, or throwing a baseball or football?

10 METs
- Participate in strenuous sports like swimming, singles tennis, football, baseball, or skiing?

MET = metabolic equivalent
Assessing Risk
Active Cardiac Conditions

High Risk:

- Acute or recent MI (7-30 d)
- Unstable coronary syndrome
- Decompensated CHF
- Significant Arrhythmias
- Severe Valvular Disease

Surgery
Clinical Risk Factors

Proceed Cautiously with:

- History of heart disease
- Compensated or prior CHF
- Cerebrovascular disease
- Diabetes Mellitus
- Renal Insufficiency

3 or more risk factors & Vascular surgery
Consider testing

1 – 2 risk factors
Proceed with surgery or consider testing
Low Risk Situations

Low Risk:

- Low risk surgery
- Good functional capacity
- No cardiac symptoms
- No "active cardiac conditions"
- No clinical risk factors

Reasonable to proceed with surgery
Surgery Related Risk

**High Risk** (Risk > 5%):
- Emergent major operations
- Aortic and other major vascular
- Peripheral vascular
- Anticipated prolonged or associated with large fluid shifts and/or blood loss

**Intermediate Risk** (Risk < 5%):
- Carotid endarterectomy
- Endovascular AAA repair
- Head and neck
- Intraperitoneal and intrathoracic
- Orthopedic
- Prostate

**Low Risk Surgery** (Risk < 1%):
- ✓ Endoscopic procedures
- ✓ Superficial procedure
- ✓ Cataract surgery
- ✓ Breast surgery

**Endoscopic procedures**

**Superficial procedure**

**Cataract surgery**

**Breast surgery**
Overview

• Epidemiology
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• Preoperative Testing
• Postoperative Management to Reduce Risk
• Frequently Asked Questions
• Case Studies
Preoperative Testing

Negative Predictive Value

<table>
<thead>
<tr>
<th>Test</th>
<th>Freedom from MI or Death</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stress ECG</td>
<td>96.3%</td>
</tr>
<tr>
<td>Dipyramadole Tl</td>
<td>98.6%</td>
</tr>
<tr>
<td>Dobutamine Echo</td>
<td>99.4%</td>
</tr>
</tbody>
</table>

Preoperative Testing

Positive Predictive Value

MI or Death

<table>
<thead>
<tr>
<th>Test</th>
<th>Predictive Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stress ECG</td>
<td>18.6</td>
</tr>
<tr>
<td>Dipyramidamole Tl</td>
<td>13.1</td>
</tr>
<tr>
<td>Dobutamine Echo</td>
<td>14.8</td>
</tr>
</tbody>
</table>
ACC/AHA Recommendations

• Echocardiography:
  – Dyspnea of unknown origin (Class IIa)
  – Current or hx of HF and no echo in 12 months (Class IIa)

• 12 Lead ECG
  – Vascular surgery and 1 CRF (class I)
  – CRFs and intermediate risk surgery (class I)
  – All vascular surgery (class IIa)
ACC/AHA Recommendations

• Treadmill stress testing
  – High cardiac risk conditions
  – 3 CRFs, poor functional capacity & vascular surgery (class IIa)

• Nuclear stress testing
Which test to choose?

Most ambulatory patients
- Treadmill Stress Test

Abnormal resting ECG (dig, LVH)
- Exercise echo or sestamibi

LBBB
- Unable to exercise
- DSE
  - Adenosine sestamibi
dipyridamole sestamibi
Overview

- Epidemiology
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Perioperative Management

- Revascularization
- Beta blockers
- Statins
- Alpha-2 agonists
- Calcium channel blockers
PCI before anticipated surgery

- Acute MI
- High Risk ACS
- High risk anatomy

Bleeding risk of anticipated surgery

- Low
  - Stent and continued Dual-antiplatelet rx

- Not low
  - 14 to 29 Days
    - Balloon angioplasty
  - 30 – 365 Days
    - Bare-metal stent
  - > 365 Days
    - Drug-eluting stent
Timing of Surgery After PCI

- **Balloon angioplasty**
  - < 14 days: Delay
  - > 14 days: Surgery with ASA

- **Bare-metal stent**
  - < 30-45 days: Delay
  - > 30-45 days: Surgery with ASA

- **Drug-eluting stent**
  - < 365 days: Delay
  - > 365 days: Surgery with ASA
Postoperative Mortality Reduction
Beta-Blockers

• 200 pts undergoing non-cardiac surgery
• Random assignment to:
  – IV followed by oral atenolol or
  – Placebo
• Double-blind follow-up over 2 years

Postoperative Cardiac Events In High Risk Patients

Beta-Blockade

• 173 patients undergoing vascular surgery with positive DSE
• Randomized to BB 1 week pre-op or placebo
• Followed for 30 days

Poldermans et al. NEJM 1999;341:1789.
Perioperative Beta Blockers

AHA/ACC Recommendations: 2006 Update

• Beta blockers required in recent past to control symptoms of angina or patients with symptomatic arrhythmias or hypertension

• Patients at high cardiac risk owing to the finding of ischemia on preoperative testing who are undergoing vascular surgery

• Patients undergoing vascular surgery and with identified CAD

• Vascular surgery and multiple cardiac risk factors

• Moderate or high risk surgery and multiple cardiac risk factors

Key Point: if known or suspected CAD and undergoing moderate or high risk surgery, use a beta blocker!
Perioperative Nitrates?

ACC/AHA 2007 Recommendations: Nitrates

Class I: None
Class IIa: None
Class IIb: Can consider in context of anesthetic plan and patient hemodynamics

Perioperative Statins?

• 100 patients pre-op before vascular surgery
• Random assignment:
  – Atorvastatin 20 mg
  – Placebo
• Started 30 days preoperatively
• Follow-up 6 month
• Endpoint:
  – Cardiac death
  – Non-fatal MI
  – USA
  – Stroke

Perioperative Statins

ACC/AHA 2007 Recommendations: Statins

Class I: Patients currently taking statins
Class IIa: Patients undergoing vascular surgery
Class IIb: Patients with at least 1 clinical risk factor undergoing intermediate risk surgery

Treatment of Anemia?

- There is a direct relationship between preoperative anemia and risk of complications (CV complications, infection, mortality), especially if known CAD
- Decline in Hbg associated with increase in mortality, especially in those with CV disease
- Benefits of transfusion have not been proven
Preoperative Hgb and Mortality

Study of Untreated Anemia

**Perioperative Hypothermia**

- 300 pts undergoing general surgery
- Randomized, double-blinded assignment to routine care or supplemental warming

**ACC/AHA 2007 Recommendations:**

**Normothermia**

*Class I: For most procedures except during periods in which mild hypothermia is intended for organ protection*

Frank SM JAMA 1997;227(14)
Key Point:

Avoid Sympathetic Stimulation in those at Risk!

• Beta blocker if able
• Limit hypothermia
• Aggressive post-operative pain control
• Avoid significant anemia
Overview

- Epidemiology
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FAQs

How should I handle the patient with a pacemaker or implantable defibrillator (ICD)?

• ICDs should be turned off immediate preoperative and turned on immediately postoperatively.
• Pacemakers can be left on perioperatively but should be interrogated pre- and post-op.
FAQs

How long should surgery be delayed after a myocardial infarction?

• In general, at least one month.
• In patients treated with PCI, delay based on type of treatment:
  – POBA: 14 days
  – BMS: 30 days
  – DES: 365 days
FAQs

How should I handle the patient with atrial fibrillation?

• If rate controlled, it is not a reason to delay surgery or expect problems.
• If on warfarin, should communicate with PCP or cardiologist about safety of discontinuing.
FAQs

Can anticoagulation be stopped in the patient with a mechanical heart valve?

- **Low risk patients** (bileaflet Aortic valve, no risk factors)
  - Stop warfarin 48-72 pre-op
  - Resume 24 hrs post-op

- **High risk patients** (mitral valve, aortic valve + any risk factor)
  - Bridge with UFH, starting when INR < 2

**Risk factors:** AF, previous thromboembolism, LV dysfunction, hypercoagulable state, older generation valve, mechanical tricuspid valve, more than one mechanical valve
Questions?