Perioperative Cardiac Risk Assessment

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Surgery or not?

- 87 year old female with known critical AS fall and breaks her hip.
- No CHF, MI, syncope
- Stable and relatively independent before the fall.
- LVEF 65%

- 82 year old male with known CAD. Stable angina pectoris.
- Catheterization shows occluded LAD which was fed by collaterals
- No CHF
- H/O DM and HTN
- Severe worsening spinal stenosis and weakness
- LVEF 50%
Medical Consultation

• The preoperative medical consultation provides an opportunity for the Consultant to contribute to a better surgical outcome for the patient.

• Consultants are often asked to estimate the risk for perioperative cardiac ischemia, infarction, or death in patients undergoing non-cardiac surgery.

• Estimating this risk can be difficult and complex because of heterogeneous studies and recommendations, although there is a growing body of evidence to guide the use of preoperative cardiac revascularization and pharmacologic treatment.
Preoperative cardiac issues

- How healthy is the patient?
- How active is the patient?
- How risky is the planned surgery?
- Is preoperative cardiac testing necessary?
- What preventive measures can be taken to reduce cardiac risk?
Outline I

1. Coronary Risk
   - Clinical Predictors
   - Functional Capacity
   - Surgery-Specific Risk

2. Other Cardiovascular Conditions
   - Hypertension
   - Valvular disease
   - Myocardial disease
   - Arrhythmias
   - ICD’s and pacemakers
3. Supplemental Preoperative Assessment
   - LV function
   - 12-lead ECG
   - Noninvasive Stress Testing
   - Coronary Angiography

4. Perioperative Management
   - Revascularization
   - Medical Therapy
ACC/AHA 2007 Guidelines on Perioperative Cardiovascular Evaluation and Care for Noncardiac Surgery:
Executive Summary


ACC/AHA guideline summary: Stepwise approach to preoperative cardiac assessment-I

**Step 1**
Need for noncardiac surgery
  - Urgent or elective surgery

**Step 2**
Coronary revascularization within 5 yr?
  - Yes
  - Recurrent symptoms or signs?
    - No
    - Operating room
  - No

**Step 3**
Recent coronary evaluation
  - Yes
    - Recent coronary angiogram or stress test?
      - Favorable result and no change in symptoms
        - Operating room
      - Unfavorable result or change in symptoms
        - Clinical predictors
            - Major clinical predictors
              - Consider delay or cancel noncardiac surgery
              - Medical management and risk factor modification
            - Intermediate clinical predictors
              - Consider coronary angiography
              - Subsequent care dictated by findings and treatment results
            - Minor or no clinical predictors
              - Go to step 6
              - Go to step 7
          - Go to step 5

**Step 4**
Clinical predictors
  - Major clinical predictors
  - Intermediate clinical predictors
  - Minor or no clinical predictors
ACC/AHA guideline summary: Stepwise approach to preoperative cardiac assessment-III

Step 7 Clinical predictors

Minor or no clinical predictors

Functional capacity

Poor (<4 METs)

High surgical risk procedure

Intermediate surgical risk procedure

Moderate or excellent (>4 METs)

Step 8 Noninvasive testing

Low risk

Operating room

Noninvasive testing

Postoperative risk stratification and risk factor reduction

Surgical risk

algorithm

Invasive testing

Consider coronary angiography

Subsequent care dictated by findings and treatment results
Calculating the Clinical Risk Index
Risk Indices

Many different risk scores

- Simple models – multivariate analysis
  - Cardiac risk index (i.e. Goldman index)
  - Larsen risk index
  - Revised cardiac risk index (i.e. Lee index)
  - CCS index (i.e. Gilbert index)

- Bayesian models
  - Detsky index
  - Veteran Affairs index

1963 - ASA physical status classification used
1977 - Goldman identified 9 cardiac risk factors
1986 - Detsky added angina class & prior MI
1997 - modified to stratify into 3 risk groups (ACP)
### Detsky Modified Cardiac Risk Index

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age older than 70 years</td>
<td>5</td>
</tr>
<tr>
<td>Myocardial infarction within six months</td>
<td>10</td>
</tr>
<tr>
<td>Myocardial infarction after six months</td>
<td>5</td>
</tr>
<tr>
<td>Canadian Cardiovascular Society Angina Classification*</td>
<td></td>
</tr>
<tr>
<td>Class III</td>
<td>10</td>
</tr>
<tr>
<td>Class IV</td>
<td>20</td>
</tr>
<tr>
<td>Unstable angina within six months</td>
<td>10</td>
</tr>
<tr>
<td>Alveolar pulmonary edema</td>
<td></td>
</tr>
<tr>
<td>Within one week</td>
<td>10</td>
</tr>
<tr>
<td>Ever</td>
<td>5</td>
</tr>
<tr>
<td>Suspected critical aortic stenosis</td>
<td>20</td>
</tr>
<tr>
<td>Arrhythmia</td>
<td></td>
</tr>
<tr>
<td>Rhythm other than sinus or sinus plus atrial premature beats</td>
<td>5</td>
</tr>
<tr>
<td>More than five premature ventricular beats</td>
<td>5</td>
</tr>
<tr>
<td>Emergency operation</td>
<td>10</td>
</tr>
<tr>
<td>Poor general medical status†</td>
<td>5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Class</th>
<th>Points</th>
<th>Cardiac risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>0 to 15</td>
<td>Low</td>
</tr>
<tr>
<td>II</td>
<td>20 to 30</td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>31+</td>
<td>High</td>
</tr>
</tbody>
</table>
Revised Cardiac Risk Index (LEE)

- High-risk type of surgery
- History of ischemic heart disease
- History of congestive heart failure
- History of cerebrovascular disease
- Preoperative treatment with insulin
- Preoperative serum creatinine >2.0

Lee TH, Marcantonio ER, Mangione CM, et al. Derivation and prospective validation of a simple index for prediction of cardiac risk of major noncardiac surgery. Circulation 1999;100:1043-
**Table 2. Major Cardiac Event Rates by the Revised Cardiac Risk Index***

<table>
<thead>
<tr>
<th>Class</th>
<th>Events/Patients, n/n</th>
<th>Event Rate (95% CI), %</th>
</tr>
</thead>
<tbody>
<tr>
<td>I (0 risk factors)</td>
<td>2/488</td>
<td>0.4 (0.05–1.5)</td>
</tr>
<tr>
<td>II (1 risk factor)</td>
<td>5/567</td>
<td>0.9 (0.3–2.1)</td>
</tr>
<tr>
<td>III (2 risk factors)</td>
<td>17/258</td>
<td>6.6 (3.9–10.3)</td>
</tr>
<tr>
<td>IV (≥3 risk factors)</td>
<td>12/109</td>
<td>11.0 (5.8–18.4)</td>
</tr>
</tbody>
</table>

**ROC curve area** 

0.806†

* Adapted from Lee et al. (21). ROC = receiver-operating characteristic.
† P = 0.034 versus original cardiac risk index (ROC curve area, 0.701), modified cardiac risk index (ROC curve area, 0.582), and American Society of Anesthesia Classification (ROC curve area, 0.697). Major cardiac events include myocardial infarction, cardiac arrest, pulmonary edema, and complete heart block. Risk factors are high-risk surgical procedure (intraperitoneal, intrathoracic, or suprainguinal vascular reconstruction), history of ischemic heart disease (excluding previous revascularization), history of congestive heart failure, history of stroke or transient ischemic attack, preoperative insulin therapy, and preoperative serum creatinine levels > 152.5 μmol/L (>2.0 mg/dL).
Validation of Risk Indices

- Many of the indices validated prospectively individually
  - Mixed and controversial results

- Attempts to compare risk scores
    - n=119 referred for cardiology consultation for noncardiac surgery
    - n=2035 referred for medical consultation for elective/urgent noncardiac surgery
## Comparison of Risk Indices

**Heinisch et al. Arq Bras Cardiol 2002**

<table>
<thead>
<tr>
<th>Index</th>
<th>Class</th>
<th>Number of patients</th>
<th>Cardiac events</th>
<th>P</th>
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</thead>
<tbody>
<tr>
<td>Goldman</td>
<td>1</td>
<td>63</td>
<td>8 (12.7%)</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>47</td>
<td>9 (19.1%)</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>9</td>
<td>2 (22.2%)</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>NS</td>
</tr>
<tr>
<td>ASA¹</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>17</td>
<td>1 (5.9%)</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>90</td>
<td>15 (16.7%)</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>12</td>
<td>3 (25%)</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>NS</td>
</tr>
<tr>
<td>Larsen</td>
<td>1</td>
<td>77</td>
<td>11 (14.3%)</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>10</td>
<td>2 (20%)</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>8</td>
<td>1 (12.5%)</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>24</td>
<td>5 (20.8%)</td>
<td>NS</td>
</tr>
<tr>
<td>Detsky</td>
<td>1</td>
<td>117</td>
<td>19 (16.2%)</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>NS</td>
</tr>
</tbody>
</table>

Source - data on assessment of surgical risk of patients staying at the surgical clinics of the Hospital Universitário of the Universidade Federal de Santa Catarina from 1996 to 2000. † N.S.: nonsignificant. ¹ - American Society of Anesthesiologists.


<table>
<thead>
<tr>
<th>Methods (Reference)</th>
<th>Stratum</th>
<th>Patients</th>
<th>Cardiac Events</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>n (%)</td>
<td></td>
</tr>
<tr>
<td>American Society of Anesthesiologists index (3)</td>
<td>1</td>
<td>179</td>
<td>5 (2.8)</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>1032</td>
<td>47 (4.6)</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>764</td>
<td>65 (8.5)</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>50</td>
<td>12 (24)</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>2</td>
<td>1 (50)</td>
</tr>
<tr>
<td>d = 0.625</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canadian Cardiovascular Society index (11)</td>
<td>0</td>
<td>1418</td>
<td>57 (4.0)</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>215</td>
<td>21 (9.8)</td>
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<tr>
<td></td>
<td>2</td>
<td>293</td>
<td>28 (9.6)</td>
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<tr>
<td></td>
<td>3</td>
<td>75</td>
<td>17 (23)</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>17</td>
<td>6 (35)</td>
</tr>
<tr>
<td>d = 0.654</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Goldman index (5)</td>
<td>1</td>
<td>1433</td>
<td>60 (4.2)</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>478</td>
<td>46 (9.6)</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>113</td>
<td>20 (18)</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>11</td>
<td>4 (36)</td>
</tr>
<tr>
<td>d = 0.642</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Modified Detsky index (1)</td>
<td>1</td>
<td>1875</td>
<td>96 (5.1)</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>125</td>
<td>17 (14)</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>35</td>
<td>17 (49)</td>
</tr>
<tr>
<td>d = 0.601</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Major perioperative events were defined as myocardial infarction, acute pulmonary edema, unstable angina, and death.
Part I: Coronary Risk Stratification

- Clinical Predictors
- Functional Capacity
- Surgery-Specific Risk
ACC/AHA Stepwise Approach

Focuses on following features:

1. Urgency of surgery
2. Prior cardiac tests / treatment
3. Clinical markers
4. Functional capacity
5. Surgery-specific risk
Preop Assessment

Need for noncardiac surgery

- Urgent or Elective
  - Coronary revasc within 5 yrs?
    - Yes
      - Recent coronary angiogram or XST
        - Favourable
          - Operating room
        - Unfavourable or change in Sx’s
          - Operating room
    - No
      - Recent coronary evaluation?
        - Yes
          - Clinical predictors
            - Major clinical predictors
            - Intermediate clinical predictors
            - Minor or No clinical predictors
        - No
          - Operating room

- Emergency
  - Operating room
  - Postop risk stratification and management
Major Clinical Predictors

Major clinical predictors

1. Unstable coronary syndrome
2. Decompensated CHF
3. Significant arrhythmia
4. Severe valvular disease

Consider delay or cancel surgery
Medical management and RF modification

Consider coronary angiography
Care dictated by findings & Rx results
Intermediate Clinical Predictors

1. Mild angina or prior MI
2. Compensated or prior CHF
3. Diabetes mellitus
4. Renal insufficiency

Poor functional capacity (<4 METs)

High surgical risk
Low risk
Consider coronary angiography

Mod or Excellent (>4 METs)

Intermediate risk
Operating room
Care dictated by findings & Rx results

Low risk
Postop risk stratification & RF modification

1. Functional Capacity
2. Surgical Risk
3. Noninvasive Testing
4. Invasive Testing
Minor or No Clinical Predictors

1. Advanced age
2. Abnormal ECG
3. Non-sinus rhythm
4. Low functional capacity
5. Prior CVA
6. Uncontrolled HTN

- Poor functional capacity (<4 METs)
  - High surgical risk
    - Noninvasive testing
      - High risk
      - Consider coronary angiography
      - Low risk
  - Intermediate or low risk
    - Operating room
- Mod or Excellent (>4 METs)
  - Operating room
  - Postop risk stratification & RF modification

Care dictated by findings & Rx results
Functional Capacity

1 MET
- Self-care
- Eat, dress, toilet
- Walk indoors
- Walk 1 block slowly
- Light housework

4 METs
- 1 flight of stairs
- Brisk walk
- Short run
- Heavy housework
- Moderate recreation
- Strenuous sport

10 METs
# Surgery-Specific Risk

## Cardiac Event Risk* Stratification for Noncardiac Surgical Procedures

<table>
<thead>
<tr>
<th>High</th>
<th>Intermediate</th>
<th>Low†</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Reported cardiac risk often &gt;5%)</td>
<td>(Reported cardiac risk generally &lt;5%)</td>
<td>(Reported cardiac risk generally &lt;1%)</td>
</tr>
<tr>
<td>■ Emergent major operations, particularly in the elderly</td>
<td>■ Intraperitoneal and intrathoracic surgery</td>
<td>■ Endoscopic procedures</td>
</tr>
<tr>
<td>■ Aortic and other major vascular surgery</td>
<td>■ Carotid endarterectomy surgery</td>
<td>■ Superficial procedures</td>
</tr>
<tr>
<td>■ Peripheral vascular surgery</td>
<td>■ Head and neck surgery</td>
<td>■ Cataract surgery</td>
</tr>
<tr>
<td>■ Anticipated prolonged surgical procedures associated with large fluid shifts and/or blood loss</td>
<td>■ Orthopedic surgery</td>
<td>■ Breast surgery</td>
</tr>
</tbody>
</table>

* Cardiac event risk may vary depending on individual patient factors.
† Low risk does not guarantee no cardiac events.
Stepwise Approach Summary

No further testing if:

- Emergency surgery precludes testing
- Revascularization <5 yrs & no new Sx
- Favourable cardiac test <2 yrs & no new Sx
- No major clinical predictors
- Does not have 2 or more of:
  1. Intermediate clinical predictors
  2. Poor functional capacity
  3. High risk surgery
Short-Cut Tool

- Majority of patients have intermediate or minor clinical predictors

Non-invasive testing required if ≥ 2 of:

1. Intermediate clinical predictor
   - CCS I/II, stable CHF, DM, renal insufficiency

2. Poor functional capacity (<4 METs)

3. High risk surgical procedure
   - Emergency, aortic/periph vascular, prolonged
After estimating a patient’s risk of adverse perioperative cardiac events from the Revised LEE Cardiac Risk Index or another index, then the physician must decide to proceed with further cardiac testing, pharmacologic management, both, or neither.

The most difficult to manage group is the intermediate risk patient…and a lot of our patients end up in this category.
Defining the role of non-invasive testing
Strengths and Weaknesses of Preoperative Noninvasive Cardiac Testing

- Although the negative predictive value of dobutamine echocardiography and nuclear perfusion tests for perioperative MI and death is close to 100%, the positive predictive value is quite low ~20%

Does perioperative administration of beta-blockers reduce or eliminate the need for noninvasive preoperative cardiac testing in Intermediate risk patients?
Predicators of Cardiac Events After Major Vascular Surgery

Role of Clinical Characteristics, Dobutamine Echocardiography, and Betablocker Therapy

Estimate of the Perioperative Risk of Cardiac Death or Myocardial Infarction
## Results

<table>
<thead>
<tr>
<th>Clinical risk score</th>
<th>B-Blockers</th>
<th>Cardiac complications</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-2 and DES result not considered</td>
<td>+</td>
<td>&lt;2%</td>
</tr>
<tr>
<td>3 or more</td>
<td>+</td>
<td>still low</td>
</tr>
<tr>
<td>But no WMA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 or more, with WMA</td>
<td>+</td>
<td>&gt;6%</td>
</tr>
</tbody>
</table>
Conclusions

• Perioperative cardiac event rate was low (<1%) in patients with a clinical risk score of < 3 and who were receiving beta-blockers

• Therefore, non-invasive cardiac testing could be appropriately omitted in this group
Conclusions

Dobutamine stress echo is useful to further risk stratify patients with a clinical risk score of 3 or more.

- Patients with a risk factor of 3 but without stress induced ischemia had a low perioperative risk of cardiac events in the setting of beta-blocker therapy.

- Patients with a risk factor of 3 or more and new wall motion abnormalities (NWMA’s), specifically patients with >4 segments involved were not adequately protected with betablockers, Cardiac catheterization and revascularization should be considered in these
Should major vascular surgery be delayed because of preoperative cardiac testing in intermediate-risk patients receiving betablocker therapy with tight heart rate control?

Poldermans D, Bax J-J, Schouten O, et al; Dutch Echocardiographic Cardiac Risk Evaluation Applying Stress Echo Study Group
Intervention

- Preoperative cardiac stress testing with dobutamine stress echo or perfusion scintigraphy (n=386) or no testing (n=384)

- All patients received perioperative beta-blockers titrated to a target resting HR of 60-65 beats/min.
Results

- At 30 days, the frequency of cardiac death and non-fatal MI was similar in the testing and no testing groups.

- No difference in 2-year outcome was observed between the groups.

- Testing delayed surgery an average of 3 weeks.

- In both testing and no testing groups, patients with a heart rate less than 65 had a significant decrease in the number of cardiac deaths and non-fatal MI’s.
Regardless of testing or no testing, patients with beta-blockers titrated to tight HR control (HR<65 bpm) had lower risk.

It appears that cardiac testing may be safely omitted in intermediate-risk patients, when betablockers are used for tight HR control.
Part III: Supplemental Preoperative Testing

- 12-lead ECG
- LV function
- Noninvasive Stress Testing
- Coronary Angiography
Resting LV Function

- In general, not a consistent predictor of perioperative ischemic events
  - LVEF<35% predicts postop HF

<table>
<thead>
<tr>
<th>Class</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class I</td>
<td>Poorly controlled CHF</td>
</tr>
<tr>
<td>Class IIa</td>
<td>Prior CHF</td>
</tr>
<tr>
<td></td>
<td>Dyspnea of unknown etiology</td>
</tr>
<tr>
<td>Class III</td>
<td>Routine with no prior CHF</td>
</tr>
</tbody>
</table>
Who to do stress test on?
### Stress Testing

| Class I     | 1. Dx of CAD with intermediate pretest probability |
|            | 2. Prognostication in initial evaluation of CAD or in those with change in clinical status |
|            | 3. Evaluation of ischemia prior to PCI |
|            | 4. Evaluation of adequacy of medical Rx |
| Class IIa   | 1. Exercise capacity when history unreliable |
| Class IIb   | 1. Dx of CAD with high/low pretest probability |
|            | 2. Detection of restenosis in high risk asymptomatic patients following PCI |
| Class III   | 1. Routine screening if asymptomatic |
|            | 2. Severe comorbidity precluding revascularization |
|            | 3. For isolated ectopic beats in young patients |

Part IV: Perioperative Management

- Revascularization
- Medical Therapy
Still a paucity of strong evidence for perioperative management
Preoperative CABG

- Evidence:
  - Retrospective cohorts show prior CABG reduces periop events
  - However, no randomized controlled trials

- Rarely indicated for noncardiac surgery
- Only indicated for high risk coronary anatomy scheduled for interim-high risk elective noncardiac surgery
Coronary-Artery Revascularization Before Elective Major Vascular Surgery (CARP)

Study design

- Prospective randomized study

- 510 patients randomized to either coronary-artery revascularization or No revascularization before surgery

- Within the Revascularization group
  - 59% PCI
  - 41% CABG
Conclusions

• Coronary artery revascularization before elective surgery does not alter long-term survival.

• There was also no reduction in early postoperative deaths, myocardial infarctions, or length of stay.

• Coronary artery revascularization before elective vascular surgery among patients with stable cardiac symptoms cannot be recommended.
With the exclusion of very high risk patients and the optimization of medical management in both groups, coronary revascularization did not provide an additional benefit.
Coronary artery stenting and noncardiac surgery – a prospective outcomes study

VICENZE MN, MEISLITZER T, HEITZINGER B, ET AL. BR J ANAESTH. 2006; 96:686-693
Results and Conclusion

- 45% of all patients had cardiovascular complications
  - 9% death
  - 21% redo PCI
  - 9% unstable angina

7% of patients had significant bleeding

Adverse cardiovascular event rates are high among patients who receive a coronary stent within one year before noncardiac surgery.
Conclusion

- Adverse cardiovascular event rates are high among patients who receive a coronary stent within one year before noncardiac surgery.

- A standardized heparin and antiplatelet protocol does not decrease risk.
<table>
<thead>
<tr>
<th>Study Author</th>
<th>Year Published</th>
<th>No. of Patients who Underwent PCI</th>
<th>Time From PCI to Surgery</th>
<th>Perioperative Mortality, %</th>
<th>Perioperative Infarction Rate, %</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Huber et al (179)</td>
<td>1992</td>
<td>50</td>
<td>9 days (mean)</td>
<td>1.9</td>
<td>5.6</td>
<td>CABG needed after balloon angioplasty in 10% of pts. No control group for comparison.</td>
</tr>
<tr>
<td>Elmore et al (180)</td>
<td>1993</td>
<td>14</td>
<td>10 days (mean)</td>
<td>0</td>
<td>0</td>
<td>Very small study. Event rate in pts. treated with CABG or balloon angioplasty less than in control group. Angioplasty pts. had fewer risk factors than pts. undergoing CABG.</td>
</tr>
<tr>
<td>Allen et al (181)</td>
<td>1991</td>
<td>148</td>
<td>338 days (mean)</td>
<td>2.7</td>
<td>0.7</td>
<td>No increase in events if surgery performed within 90 days of PTCA. Only vascular surgeries included.</td>
</tr>
<tr>
<td>Gottleib et al (296)</td>
<td>1998</td>
<td>194</td>
<td>11 days (median)</td>
<td>0.5</td>
<td>0.5</td>
<td>Only vascular surgeries included. Pts. who had undergone PCI had a similar frequency of death and MI but half the angina and HF of matched pts. with CAD who had not undergone PCI. Event rates were much higher if PCI had been performed within 90 days.</td>
</tr>
<tr>
<td>Possner et al (298)</td>
<td>1999</td>
<td>686</td>
<td>1 year (median)</td>
<td>2.6</td>
<td>2.2</td>
<td></td>
</tr>
<tr>
<td>Kaluza et al (301)</td>
<td>2000</td>
<td>40</td>
<td>13 days (mean)</td>
<td>20</td>
<td>16.8</td>
<td>The only study in which stents were used. Mortality was 32% among pts. operated on less than 12 days after stent placement vs. 0 in pts. operated on 12 to 30 days after PCI. Among pts. who received PCI in BARI, outcome after noncardiac surgery was equivalent to that of BARI pts. who had received CABG.</td>
</tr>
<tr>
<td>Hassan et al (303)</td>
<td>2001</td>
<td>251</td>
<td>29 months (median)</td>
<td>0.8</td>
<td>0.8</td>
<td></td>
</tr>
</tbody>
</table>
Preoperative PCI

- No randomized trials

- Observational studies:
  - Periop cardiac death infrequent with PCI prior to noncardiac surgery
  - May lead to emergency CABG

- Timing
  - Uncertainty of time b/w PCI and surgery
  - > 1 week for PTCA
  - > 2 weeks (ideally 4-6 weeks) for stent
Coronary artery bypass grafting is superior to percutaneous coronary intervention in prevention of perioperative myocardial infarctions during subsequent vascular surgery.

Significantly more non-fatal MI’s in the PCI treated patients:

- PCI 16.8%
- CABG 6.6%

No significant difference in mortality rates between the two groups:

- PCI 3.8%
- CABG 2.2 %

No significant difference:

- length of stay
- left ventricular ejection fraction at 3 months
- Mortality at 2.7 years
- Need for additional coronary revascularization
Where does this leave us regarding recommendations for perioperative revascularization?
Conclusion

- For patients with stable coronary artery disease and no independent need for revascularization, medical therapy is preferred.

- In patients who have independent indications for coronary revascularization (Unstable angina, Left main disease, or 3-vessel coronary disease with impaired LV function), both strategies have disadvantages:

  - CABG carries its own higher procedural mortality
  - PCI carries a higher perioperative event risk, and use of PTCA alone does not decrease this risk.
Pharmacologic Myocardial Protection in Patients Undergoing Noncardiac Surgery: A Quantitative Systematic Review

# Preoperative Medical Rx

<table>
<thead>
<tr>
<th>Author</th>
<th>Procedure</th>
<th>n</th>
<th>Control</th>
<th>Drug</th>
<th>Ischemia*</th>
<th>MI</th>
<th>Death</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitroglycerin</td>
<td>Carotid endarterectomy</td>
<td>45</td>
<td>0.5 mcg per kg per min nitroglycerin</td>
<td>1 mcg per kg per min nitroglycerin intraoperatively</td>
<td>14/22 (64%)</td>
<td>4/23* (17%)</td>
<td>0/22 (0)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Placebo</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nitroglycerin</td>
<td>Noncardiac</td>
<td>45</td>
<td>Placebo</td>
<td>0.9 mcg per kg per min nitroglycerin intraoperatively</td>
<td>7/22 (32%)</td>
<td>7/23 (30%)</td>
<td>1/22 (5%)</td>
</tr>
<tr>
<td>Calcium channel blockers</td>
<td>Vascular</td>
<td>30</td>
<td>Placebo</td>
<td>3 mcg per kg per min diltiazem intraoperatively</td>
<td>11/15 (73%)</td>
<td>6/15 (40%)</td>
<td>0/15 (0)</td>
</tr>
<tr>
<td>Beta-adrenergic blockers</td>
<td>Abdominal aortic aneurysmorrhaphy</td>
<td>83</td>
<td>Case-control</td>
<td>50 mg PO metoprolol preoperatively</td>
<td>1.8+3.2* (17%*</td>
<td>0.8+1.6 (3.1%*</td>
<td>9/51 (17%)</td>
</tr>
<tr>
<td></td>
<td>Vascular</td>
<td>200</td>
<td>Unblinded</td>
<td>50 mg PO metoprolol preoperatively</td>
<td>1.8+3.2* (17%*</td>
<td>0.8+1.6 (3.1%*</td>
<td>9/51 (17%)</td>
</tr>
<tr>
<td></td>
<td>Noncardiac</td>
<td>128</td>
<td>Placebo</td>
<td>labetalol preoperatively</td>
<td>11/30 (28%)</td>
<td>2/89* (2%)</td>
<td>0/39 (0)</td>
</tr>
<tr>
<td></td>
<td>Mild hypertension</td>
<td></td>
<td>Placebo</td>
<td>olprrenolol preoperatively</td>
<td>11/30 (28%)</td>
<td>2/89* (2%)</td>
<td>0/39 (0)</td>
</tr>
<tr>
<td></td>
<td>Placebo</td>
<td>112</td>
<td>Unblinded</td>
<td>5 to 10 mg PO bisoprolol preoperatively</td>
<td>5/15 (13%)</td>
<td>5/15 (33%)</td>
<td>9/53 (17%)</td>
</tr>
<tr>
<td></td>
<td>Vascular</td>
<td>26</td>
<td>Placebo</td>
<td>8/11 (17%)</td>
<td>5/15 (33%)</td>
<td>5/15 (17%)</td>
<td>2/50 (3%)</td>
</tr>
<tr>
<td></td>
<td>Noncardiac</td>
<td>200</td>
<td>Placebo</td>
<td>30 to 100 mg PO atenolol preoperatively</td>
<td>39/101 (39%)</td>
<td>24/99 (24%)</td>
<td>(at 6 months)</td>
</tr>
<tr>
<td>Alpha agonists</td>
<td>Noncardiac</td>
<td>300</td>
<td>Placebo</td>
<td>0.75 mcg per kg per h nitroglycerol</td>
<td>35/103 (34%)</td>
<td>20/98 (20%)</td>
<td>6/103 (6%)</td>
</tr>
<tr>
<td></td>
<td>Noncardiac</td>
<td>61</td>
<td>Placebo</td>
<td>1.5 mcg per kg per h nitroglycerol</td>
<td>6/103 (6%)</td>
<td>2/98 (2%)</td>
<td>2/98 (2%)</td>
</tr>
<tr>
<td></td>
<td>Placebo</td>
<td>1897</td>
<td>Placebo</td>
<td>0.2 to 0.3 mcg clomidine preoperatively</td>
<td>5/24 (21%)</td>
<td>1/28 (4%)</td>
<td>25/940 (8%)</td>
</tr>
<tr>
<td></td>
<td>Placebo</td>
<td>904</td>
<td>Placebo</td>
<td>1.5 mcg per kg per h nitroglycerol</td>
<td>78/946 (8%)</td>
<td>78/946 (8%)</td>
<td>78/946 (8%)</td>
</tr>
<tr>
<td></td>
<td>Placebo</td>
<td>297</td>
<td>Placebo</td>
<td>1.5 mcg per kg per h nitroglycerol</td>
<td>10/101 (10%)</td>
<td>6/454 (4%)</td>
<td>10/101 (10%)</td>
</tr>
<tr>
<td></td>
<td>Placebo</td>
<td>297</td>
<td>Placebo</td>
<td>2 mcg per kg PO clomidine preoperatively</td>
<td>59/152 (39%)</td>
<td>35/145 (24%)</td>
<td>1/152 (1%)</td>
</tr>
<tr>
<td></td>
<td>Vascular</td>
<td></td>
<td>Placebo</td>
<td>2 mcg per kg PO clomidine preoperatively</td>
<td>1/152 (1%)</td>
<td>2/145 (1%)</td>
<td>1/152 (1%)</td>
</tr>
</tbody>
</table>
Conclusion

- B-blockers and alpha2-agonists offer significant protection against cardiac morbidity in patients undergoing major noncardiac surgery

- For every 100 patients receiving a B-blocker:
  - 13 (NNT 8) will be prevented from having intra- or postoperative ischemia.
  - 4 (NNT 23) will not have an MI.
  - 3 (NNT 32) deaths will be prevented.

- For every 100 patients receiving an Alpha2-agonist:
  - 1.5 (NNT 73) deaths will be prevented.
Use of perioperative B-blockade?!!!
2009 ACCF/AHA Focused Update on Perioperative Beta Blockade
Incorporated Into the ACC/AHA 2007 Guidelines on Perioperative Cardiovascular Evaluation and Care for Noncardiac Surgery

*J. Am. Coll. Cardiol.* published online Nov 2, 2009;
doi:10.1016/j.jacc.2009.07.010

This information is current as of November 6, 2009

### 2009 ACCF/AHA Focused Update on Perioperative Beta Blockade

A Report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines

*Developed in Collaboration With the American Society of Echocardiography, American Society of Nuclear Cardiology, Heart Rhythm Society, Society of Cardiovascular Anesthesiologists, Society for Cardiovascular Angiography and Interventions, Society for Vascular Medicine, and Society for Vascular Surgery*
Perioperative Beta-Blockers

- 10 small published noncardiac surgery RCTs
- 855 patients randomized
  - 467 treatment
  - 388 control
- Very few events
  - 20 deaths (15 were cardiac)
  - 18 non-fatal MIs
- Results dominantly from one study
  Poldermans
### Perioperative Beta-Blockers

**Meta-Analysis: All-cause Mortality**

<table>
<thead>
<tr>
<th>Study</th>
<th>Year</th>
<th>#Pts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cucchiara</td>
<td>1986</td>
<td>62</td>
</tr>
<tr>
<td>Magnusson</td>
<td>1986</td>
<td>27</td>
</tr>
<tr>
<td>Stone</td>
<td>1988</td>
<td>128</td>
</tr>
<tr>
<td>Mangano</td>
<td>1996</td>
<td>200</td>
</tr>
<tr>
<td>Jakobsen</td>
<td>1997</td>
<td>31</td>
</tr>
<tr>
<td>Bayliff</td>
<td>1999</td>
<td>99</td>
</tr>
<tr>
<td>Poldermans</td>
<td>1999</td>
<td>112</td>
</tr>
<tr>
<td>Raby</td>
<td>1999</td>
<td>26</td>
</tr>
<tr>
<td>Zaugg</td>
<td>1999</td>
<td>63</td>
</tr>
<tr>
<td>Urban</td>
<td>2000</td>
<td>107</td>
</tr>
<tr>
<td><strong>Overall</strong></td>
<td></td>
<td><strong>855</strong></td>
</tr>
</tbody>
</table>

Odds Ratio 95% CI

\[ z = -0.76 \quad 2P = 0.45 \]
Perioperative Beta-Blockers

Meta-Analysis: Non-Fatal MI

[Graph showing odd ratios and confidence intervals for studies.]
Perioperative Medical Rx

Recommendations:

- **Beta-Blockers**
  - I: If required in past to control angina, symptomatic arrhythmia, or hypertension
  - IIa: Untreated HTN, known CAD, major risk factors for CAD

- **Alpha-Blockers**
  - IIb: Periop control of HTN, known CAD, major risk factors for CAD

- Still very few well-designed trials
  - POISE currently enrolling (goal of n=10 000)
SUMMARY

- **Risk Stratification:**
  1. Urgency of surgery
  2. Prior cardiac tests / treatment
  3. Clinical markers (Major, Intermediate, and Minor)
  4. Functional capacity (<4 METs)
  5. Surgery-specific risk

- **Preoperative Cardiac Testing:**
  - Indications same as in nonoperative setting

- **Perioperative Management:**
  - No evidence for revascularization
  - Moderate evidence for beta-blockade
What Does the Future Hold?

- **POISE**
  - International study, funded by the Canadian Institutes of Health Research.
  - 10,000 patients/75 centers/9 countries.
  - Evaluate the efficacy of 30 days of controlled release metoprolol to prevent cardiovascular death, nonfatal MI, nonfatal cardiac arrest in patients undergoing all types of noncardiac surgery.

- **DECREASE IV**
  - Currently ongoing.
  - Looks at fluvastatin and bisoprolol for the reduction of perioperative cardiac mortality and morbidity in high-risk patients undergoing noncardiac surgery.
Thanks