NONCARDIAC SURGERY IN PATIENTS WITH CORONARY ARTERY DISEASE

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Disclosures: None
PERIOPERATIVE RISK STRATIFICATION FOR NONCARDIAC SURGERY:
SCOPE OF THE PROBLEM

> 30 million noncardiac surgeries/year (including 400,000 vascular procedures)
> 1 million of these patients have CAD
> 2-3 million have multiple risk factors for CAD
> 4 million are over 65 years of age
> 1 million patients develop postop complications/death

Patients with high CAD prevalence but at apparent low risk may have a 5-10% perioperative complication rate
## MAJOR CARDIAC COMPLICATIONS IN PTS UNDERGOING NONCARDIAC SURGERY

- Any major cardiac complication 2.1%*
  - VF/cardiac arrest 0.3%
  - Acute MI 1.1%
  - Pulmonary edema 1.0%
  - Complete AV block 0.1%
- Cardiac death 0.3%
- Total cardiac and noncardiac mortality 1.0%

* ~ 6% in vascular surgical pts.

Lee T 2000
Poldermans 2008
PURPOSE OF PREOPERATIVE EVALUATION

• Evaluate patient’s current medical status
• Provide clinical risk profile
• Provide recommendations for management in the perioperative period
• Not to give “cardiac clearance”
• Alter or cancel the planned procedure
• Recommend revascularization if outcome would be altered
PERIOPERATIVE RISK PREDICTORS

I. Active cardiac conditions (formerly “high risk”)
   - Acute coronary syndromes
   - Decompensated heart failure
   - Significant arrhythmias
   - Severe valvular disease

II. Clinical risk factors (formerly “intermediate risk”)
   - History of ischemic heart disease
   - History of compensated or prior heart failure
   - History of cerebrovascular disease
   - Diabetes mellitus
   - Renal insufficiency (serum creatinine > 2 mg/dL)

III. Minor risk predictors (formerly “low risk”)
   - Age > 70 years
   - Abnormal ECG
   - Rhythm other than sinus
   - Uncontrolled hypertension

ACC/AHA Guidelines 2007
DM AND PERIOPERATIVE EVENTS

Number of segments with transient thallium-201 defects

Probability of Periop CD or NFMI (%)

Brown, Rowen  JACC  2.93  N = 231
RELATIONSHIP OF AGE TO PERIOPERATIVE COMPLICATIONS

## RISK OF COMPLICATIONS BY AORTIC VALVE GRADIENT

<table>
<thead>
<tr>
<th>Aortic Gradient (mmHg)</th>
<th>OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 20</td>
<td>1.0</td>
</tr>
<tr>
<td>20 - 39</td>
<td>2.1 (0.96, 4.5)</td>
</tr>
<tr>
<td>≥ 40</td>
<td>6.3 (1.5, 26)</td>
</tr>
</tbody>
</table>

Rohde et al. Am J Cardiol 2001:87:505
RISK STRATIFICATION FOR NONCARDIAC SURGICAL PROCEDURES

High (Reported risk often > 5%)

• Emergent major operations, particularly in elderly
• Aortic and other major vascular surgery
• Peripheral vascular surgery
• Anticipated prolonged surgical procedures associated with large fluid shifts and/or blood loss

ACC/AHA Guidelines 2007
RISK STRATIFICATION FOR NONCARDIAC SURGICAL PROCEDURES

Intermediate (Reported risk generally < 0-5%)
• Carotid endarterectomy
• Head and neck surgery
• Intraperitoneal and intrathoracic surgery
• Orthopedic surgery
• Prostate surgery

ACC/AHA Guidelines 2007
RISK STRATIFICATION FOR NONCARDIAC SURGICAL PROCEDURES

Low (Reported risk generally < 1%)

- Endoscopic procedures
- Superficial procedure
- Cataract surgery
- Breast surgery
- Ambulatory surgery

ACC/AHA Guidelines 200y
PERTINENT PHYSICAL FINDINGS IN CARDIAC PTS BEING EVALUATED FOR NONCARDIAC SURGERY

**Signs of LV dysfunction** (post MI, ischemic cardiomyopathy)
- PMI displacement, abnormalities
- LV lift
- ↓ S₁
- MR
- Pulse volume alterations

**Signs of pulmonary hypertension**
- Parasternal lift
- ↑ P₂
- RVS₃, RVS₄
- TR
- Prominent ‘a’ wave in neck
- ↑ CVP

**Signs of significant valve disease** (esp. AS and etiology)
PERTINENT ECG FINDINGS IN CARDIAC PTS BEING EVALUATED FOR NONCARDIAC SURGERY

- MI and location
  - Known acute, known old, indeterminate age
- LBBB
- AV block (type and degree)
- QT interval
- Unexpected signs of RVH
- Newly diagnosed VT
RECOMMENDATIONS FOR PREOPERATIVE 12-LEAD ECG

Class I

- At least 1 clinical risk factor in patients undergoing vascular surgical procedures
- Known coronary heart disease, peripheral arterial disease, or cerebrovascular disease in patients undergoing intermediate-risk surgical procedures

ACC/AHA Guidelines 2007
RECOMMENDATIONS FOR PREOPERATIVE 12-LEAD ECG

Class IIa

• No clinical risk factors in patients undergoing vascular surgical procedures

Class IIb

• Patients undergoing intermediate-risk operative procedures

Class III

• Asymptomatic patients undergoing low-risk surgical procedures

ACC/AHA Guidelines 2007
## ROLE OF ECHOCARDIOGRAPHY IN PREOPERATIVE ASSESSMENT OF THE CARDIAC PATIENT

<table>
<thead>
<tr>
<th>Category</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coronary artery disease</td>
<td>- Ejection fraction</td>
</tr>
<tr>
<td></td>
<td>- Wall motion abnormalities</td>
</tr>
<tr>
<td></td>
<td>- Ischemic valvular regurgitation</td>
</tr>
<tr>
<td></td>
<td>- Pulmonary artery pressure</td>
</tr>
<tr>
<td>Valvular disease</td>
<td>- Quantification of gradients</td>
</tr>
<tr>
<td></td>
<td>- Severity of regurgitation</td>
</tr>
<tr>
<td></td>
<td>- Prosthetic valve function</td>
</tr>
<tr>
<td>Primary myocardial disease</td>
<td>- HCM</td>
</tr>
<tr>
<td></td>
<td>- HOCM</td>
</tr>
<tr>
<td></td>
<td>- DCM</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>- Tumor</td>
</tr>
<tr>
<td></td>
<td>- Right ventricular dysplasia</td>
</tr>
<tr>
<td></td>
<td>- Thrombus</td>
</tr>
</tbody>
</table>
Class IIa

- Dyspnea of unknown origin
- Current or prior heart failure with worsening dyspnea or other change in clinical status if LV function not evaluated within prior 12 months
RECOMMENDATIONS FOR PREOPERATIVE NONINVASIVE EVALUATION OF LEFT VENTRICULAR FUNCTION

Class IIb

• Reassessment in clinically stable patients with previously documented cardiomyopathy is not well established

Class III

• Routine perioperative evaluation

ACC/AHA Guidelines 2007
EXERCISE STRESS TESTING

• Mean sensitivity for Dx of CAD 68%
• Mean specificity 77%
• Sensitivity for 3-vessel dis. 86%
• Negative predictive value 93%
# PREOPERATIVE NONINVASIVE EVALUATION OF THE CARDIAC PT FOR NONCARDIAC SURGERY

<table>
<thead>
<tr>
<th># Studies</th>
<th>% Abnormal</th>
<th>% Events</th>
<th>PV(%) +</th>
<th>PV(%) –</th>
</tr>
</thead>
<tbody>
<tr>
<td>ETT</td>
<td>11</td>
<td>16-57</td>
<td>3-38</td>
<td>0-81</td>
</tr>
<tr>
<td>Vascular Surgery</td>
<td>17</td>
<td>31-69</td>
<td>3-12</td>
<td>4-20</td>
</tr>
<tr>
<td>Nonvascular</td>
<td>6</td>
<td>23-47</td>
<td>4-15</td>
<td>8-67</td>
</tr>
<tr>
<td>Dobutamine echo</td>
<td>6</td>
<td>23-50</td>
<td>2-15</td>
<td>7-23</td>
</tr>
<tr>
<td>AECG</td>
<td>7</td>
<td>9-39</td>
<td>------</td>
<td>4-15</td>
</tr>
</tbody>
</table>

P-Thal\textsuperscript{201}
RECOMMENDATIONS FOR NONINVASIVE STRESS TESTING BEFORE NONCARDIAC SURGERY

Class I

- Active cardiac conditions per ACC/AHA guidelines

Class IIa

- 3 or more clinical risk factors and poor functional capacity (< 4 METs) who require vascular surgery, if it will change management

ACC/AHA Guidelines 2007
RECOMMENDATIONS FOR NONINVASIVE STRESS TESTING BEFORE NONCARDIAC SURGERY

Class IIb

- At least 1 to 2 clinical risk factors and poor functional capacity (< 4 METs) who require intermediate-risk noncardiac surgery, if it will change management
- At least 1 to 2 clinical risk factors and good functional capacity (≥ 4 METs) who are undergoing vascular surgery

ACC/AHA Guidelines 2007
RECOMMENDATIONS FOR NONINVASIVE STRESS TESTING BEFORE NONCARDIAC SURGERY

Class III

- No clinical risk factors, intermediate-risk noncardiac surgery
- Low-risk noncardiac surgery

ACC/AHA Guidelines 2007
LANDMARK RANDOMIZED TRIALS

CARP (2004)
- Revasc vs No Revasc in high-risk pts with severe CAD prior to major vascular surgery

DECREASE II (2006)
- Screening stress test vs no test in intermediate risk patients prior to major vascular surgery

DECREASE V (2007)
- Revasc vs No Revasc in high-risk pts (with extensive ischemia on stress testing) prior to major vascular surgery
CORONARY ARTERY REVASCULARIZATION PROPHYLAXIS (CARP) TRIAL

• High-risk stable patients undergoing elective vascular surgery (ischemia, IDDM, CRI, CVA) randomized to revascularization (PCI 59%) or no revascularization (LM CAD, AS excluded) (< 20% excluded)

• 510 VA patients, average EF ~ 55%

• Endpoint, long-term mortality, FU ~ 2.5 yr

• 30 day outcomes (death, MI, CVA): P= NS

• 2.7 yr mortality: P= NS (22%, 23%)

McFalls et al, NEJM 2004;351:2795
DECREASE II TRIAL

• 1^{st} large RCT of stress test before major vascular surgery
• Intermediate risk pts randomized to stress test vs no testing
• All received aggressive beta blockade
• Outcome = cardiac death or nonfatal MI

JACC 2006; 48:964
DECREASE II: RESULTS

• Stress testing is unhelpful in majority of vascular surgery pts (low + intermediate = 75%)

• Testing in intermediate risk pts led to revascularization only 3% of the time

• Testing delayed surgery by about 3 wks

• Tight HR control with β-blocker assoc with lower risk

• Value of stress testing & revascularization for “high risk” pts (≥ 3 RF’s not tested in this study, but tested in later study (DECREASE V))
DECREASE-V STUDY

- N = 430; 101 (23%) with high risk (extensive) ischemia on dobutamine echo or stress nuclear imaging
- Prophylactic revascularization in 49/101
- Endpoints: death or MI at 30 d and 1 year
- No difference in outcome in revascularized vs nonrevascularized groups

Poldermans et al
JACC 2007;49:1763
DECREASE-V STUDY
Incidence of all-cause death or MI during 1-yr FU per allocated strategy in pts with 3+ cardiac risk factors and extensive stress-induced ischemia

Poldermans et al    JACC 2007; 49:1763    N = 1888
RECOMMENDATIONS FOR CORONARY ANGIOGRAPHY BEFORE (OR AFTER) NONCARDIAC SURGERY

Class I: Patients with suspected or known CAD

- Evidence for high risk of adverse outcome based on noninvasive test results.
- Angina unresponsive to adequate medical Rx.
- Unstable angina, particularly if intermediate- or high-risk noncardiac surgery.
- Equivocal noninvasive test results in patients at high clinical risk undergoing high-risk surgery

ACC/AHA Guidelines 2002
Class III

• Low risk surgery, known CAD, no high-risk results on noninvasive testing.

• Asymptomatic after coronary revascularization, exercise capacity greater than or equal to 7 METs

• Mild stable angina with good LV function and no high-risk noninvasive test results

• Noncandidate for coronary revascularization owing to concomitant medical illness, severe LV dysfunction or refusal

ACC/AHA Guidelines 2002
RECOMMENDATIONS FOR PREOPERATIVE CORONARY REVASCULARIZATION (CABG OR PCI)

Class I

- Stable angina, significant left main CAD
- Stable angina, 3-vessel disease. (Survival benefit greater when LVEF is less than 0.50)

ACC/AHA Guidelines 2007
RECOMMENDATIONS FOR PREOPERATIVE REVASCULARIZATION

Class I

- Stable angina, 2-vessel disease with significant proximal LAD stenosis and either EF < 0.50 or demonstrable ischemia on noninvasive testing
- High-risk unstable angina or non-ST segment elevation MI
- Acute ST-elevation MI

ACC/AHA Guidelines 2007
RECOMMENDATIONS FOR PREOPERATIVE REVASCULARIZATION

Class III

• Routine prophylactic revascularization in patients with stable CAD

• Elective noncardiac surgery is not recommended within 4 to 6 weeks of bare-metal stent implant or within 12 months of drug-eluting stent in patients in whom ASA and thienopyridine therapy will need to be D/c’d perioperatively

• Elective noncardiac surgery is not recommended within 4 weeks of balloon angioplasty

ACC/AHA Guidelines 2007
Acute MI, high-risk ACS, or high-risk cardiac anatomy

Bleeding risk of surgery

Low

Stent and continued dual-antiplatelet therapy

Not low

Timing of surgery

14 to 29 days
Balloon angioplasty

30 to 365 days
Bare-metal stent

> 365 days
Drug-eluting stent
Previous PCI

Balloon angioplasty

Time since PCI < 14 days > 14 days > 30-45 days < 30-45 days > 14 days < 30-45 days

Delay for elective or nonurgent surgery Proceed to operation room with ASA Delay for elective or nonurgent surgery Proceed to operating room with ASA

Bare-Metal Stent

Drug-Eluting Stent

< 365 days > 365 days
PERIOPERATIVE β-BLOCKERS: DECREASE I

- 112 high-risk (+ stress echo) vascular pts
- Bisoprolol started mean 37 days preop
- Preop dose increased if HR > 60 bpm
- Postop “Hold if HR < 50 or SBP < 100”

Poldermans et al NEJM 1999;341
DECREASE I: BISOPROLOL IN HIGH RISK PTS (+ DOBUTAMINE ECHO) UNDERGOING VASCULAR SURGERY

Poldermans et al    NEJM  341:1999    N = 173
RECOMMENDATIONS FOR BETA-BLOCKER THERAPY

Class I

• Continue in patients receiving them to treat angina, symptomatic arrhythmias, hypertension, or other Class I indications

• Vascular surgery patients at high risk (ischemia on preoperative testing)
• β-blockers should be started ≥ 30 days prior to surgery; if hours to few days preop, no outcome benefit and may be harmful

POISE (Periop Ischemic Evaluation)
MAVS (Metoprolol after Vascular surgery)
POBBLE (Periop Beta Blockade)
DIPOM (Diabetic Postop mortality and morbidity)

• Later effects of beta blockade include antiinflammatory effects and (?) ↓ ASVD progression (↓ atheroma volume by IVUS)

• Greatest benefits in high-risk pts

• Avoid hypotension and bradycardia (POISE trial)
POISE TRIAL

- Long acting metoprolol vs placebo, begun 2-4 h preop; 400 mg in 1st 24 h
- CV death, MI, cardiac arrest reduced in beta blocker group
- Total mortality and stroke increased in beta blocker group (HR 1.33)
- Hypotension and bradycardia more in metoprolol group

Lancet 2008; 371:1839
N-4174 metoprolol, 4177 placebo
43% CHD, 41% PAD; Vascular surgery in 42%
STARRS STUDY: STATINS FOR RISK REDUCTION IN SURGERY*

- Retrospective review
- Complications
  - Statins 9.9%
  - No statins 16.5%
- Adjusted OR statin 0.52, P = 0.001
- Effect seen predominantly in postop ischemia and HF

O’Neil-Callahan et al  JACC 2005;45:336
N=1163; 157 death, MI, CHF, VEA, ischemia
* AO, carotid, periph vascular
STATINS REDUCE CARDIAC EVENTS IN VASCULAR SURGERY

AGE
>70
<70

GENDER
Male
Female

BMI
<25.8
>25.8

TYPE OF SURGERY
Carotid
Lower extremity
Aortic

O’Neil-Callahan et al JACC 2005; 45:336
DECREASE* RISK SCORE

• 1 point for each of the following
  Hx MI
  Hx angina
  Hx HF
  Hx CVA
  DM
  CRI
  Age > 70 years
• Low risk – no risk factors
• Intermediate risk – 1-2 risk factors
• High risk – > 3 risk factors

*Dutch Echocardiographic Cardiac Risk Evaluation Applying Stress Echo
Schouten et al AJC 2007;100:316 N=298
EFFECT OF STATIN WITHDRAWAL ON CARDIAC PATIENTS UNDERGOING VASCULAR SURGERY

• Endpoints
  - Postop troponin increase: 27%
  - Nonfatal MI: 11.4%
  - CV death: 3%
  - Nonfatal MI + cardiac death: 31.4%

• Odds ratio for endpoints
  - Low risk: 1.0
  - Intermediate risk: 8-9
  - High risk: 8-17

Schouten et al (Poldermans)
AJC 2007;100:316 N =298, 69 d/c'd statins
RECOMMENDATIONS FOR STATIN THERAPY

Class I
- For patients currently taking statins and scheduled for noncardiac surgery, statins should be discontinued

Class IIa
- Patients undergoing vascular surgery with or without clinical risk factors

Class IIb
- Patients with at least 1 clinical risk factor undergoing intermediate-risk procedures

ACC/AHA Guidelines 2007
TROTONIN I AS EVENT PREDICTOR IN VASCULAR SURGERY PTS

6-mo mortality (%)

Peak serum cTnl (ng/mL)

≤ 0.35
0.4 – 1.5
1.6 – 3.0
> 3.0

Kim et al  Circulation 2002;106:2366  N = 229
Tnl postop and AM days 1-3
RECOMMENDATIONS FOR SURVEILLANCE FOR PERIOPERATIVE MI

Class I
• Postoperative troponin measurement recommended in patients with ECG changes or chest pain typical of acute coronary syndrome

Class IIb
• Postoperative troponin measurement is not well established in patients who are clinically stable and have undergone vascular and intermediate risk surgery

Class III
• Asymptomatic stable patients who have undergone low-risk surgery

ACC/AHA Guidelines 2007