The Consultant’s Job...

I keep paying you for consulting, but you never make any recommendations.

I'm what you call a "feel good."

My job is to make you feel secure in the knowledge that someone brilliant is shaping your strategies.

This is weird; I hate you, but at the same time I feel good.

You're welcome.
Cardiac Pre-Operative Evaluation
ACC 2014 Guidelines

David Stultz, MD
September 8, 2017
www.drstultz.com

KPN Heart & Vascular
Objectives of Conference

- Understand “Cardiac Clearance” for noncardiac surgery
- Apply Guidelines for pre-operative evaluation
- Who needs a stress test?
- Who needs a cath?
- Who can go to surgery?
65 year old female for pre-op eval for knee replacement

- HTN, HLP, DM, Obesity
- No known CAD or CHF
- Takes several daily 15 minute walks, although recently more limited due to knee pain
- Normal physical exam otherwise
Pre-Op Cardiac Evaluation
Potentially many facets

- Coronary atherosclerosis
  - Myocardial ischemia
- Heart failure
  - Systolic
  - Diastolic
- Arrhythmia
  - Chronic
  - Pacemaker/ICD
  - Peri-operative
- Valvular disease
- Anticoagulation & Antiplatelet issues
- Congenital heart disease
Why assess patients pre-operatively?

- Identify patients at risk for cardiac complications peri-operatively
  - Myocardial infarction
  - Arrhythmia
  - CHF
- Intervene to reduce the cardiac risk
Why assess patients pre-operatively?

- CAD

- Peri-op MI poses risk for mortality
  - 15,133 patients >50 years old having noncardiac surgery requiring overnight hospital stay
    - 11.6% had an isolated peak troponin T value of ≥0.02ng/mL
    - 1.9% (95% CI 1.9-2.1%) 30-day mortality rate with elevated troponin T values

Why assess patients pre-operatively? CHF

- CHF is worse than CAD
  - Cohort study of 38,047 consecutive patients
  - 30-day postoperative mortality rate for patients with history of cardiac risk factors
    - 9.3% nonischemic HF
    - 9.2% ischemic HF
    - 6.4% atrial fibrillation (AF)
    - 2.9% CAD

The Old Ways of Pre-op Eval

- 1947 – Dripps; assigned physical class to patients prior to anesthesia
  - 1. A healthy patient.
  - 3. A patient with a severe systemic disease that limits activity, but is not incapacitating.
  - 4. A patient with an incapacitating systemic disease that is a constant threat to life.
  - 5. A moribund patient who is not expected to survive 24 hours with or without an operation.

- Note: In the event of an emergency operation, precede the number with an E.
# 1977 Goldman

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>History</strong></td>
<td></td>
</tr>
<tr>
<td>Age &gt; 70</td>
<td>5</td>
</tr>
<tr>
<td>MI in past 6 months</td>
<td>10</td>
</tr>
<tr>
<td><strong>Physical Exam</strong></td>
<td></td>
</tr>
<tr>
<td>3rd Heart sound or JVD</td>
<td>11</td>
</tr>
<tr>
<td>Important Aortic stenosis</td>
<td>3</td>
</tr>
<tr>
<td><strong>EKG</strong></td>
<td></td>
</tr>
<tr>
<td>Rhythm other than sinus or PAC’s</td>
<td>7</td>
</tr>
<tr>
<td>&gt; 5 PVC’s per minute at any time</td>
<td>7</td>
</tr>
<tr>
<td><strong>General status</strong></td>
<td></td>
</tr>
<tr>
<td>Hypoxia, renal failure, LFT abnormality</td>
<td>3</td>
</tr>
<tr>
<td><strong>Operation</strong></td>
<td></td>
</tr>
<tr>
<td>Intraperitoneal, aortic, or intrathoracic</td>
<td>3</td>
</tr>
<tr>
<td>Emergency</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>53</td>
</tr>
</tbody>
</table>
1986 Detsky

- Modified Goldman
- Even more complicated than Goldman
Applying Classification of Recommendations and Levels of Evidence

<table>
<thead>
<tr>
<th>LEVEL A</th>
<th>Multiple populations evaluated*</th>
<th>Data derived from multiple randomized clinical trials or meta-analyses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Recommendation that procedure or treatment is useful/effective</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sufficient evidence from multiple randomized trials or meta-analyses</td>
<td></td>
</tr>
<tr>
<td>LEVEL B</td>
<td>Limited populations evaluated*</td>
<td>Data derived from a single randomized trial or nonrandomized studies</td>
</tr>
<tr>
<td></td>
<td>Recommendation that procedure or treatment is useful/effective</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Evidence from single randomized trial or nonrandomized studies</td>
<td></td>
</tr>
<tr>
<td>LEVEL C</td>
<td>Very limited populations evaluated*</td>
<td>Only consensus opinion of experts, case studies, or standard of care</td>
</tr>
<tr>
<td></td>
<td>Recommendation that procedure or treatment is useful/effective</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Only expert opinion, case studies, or standard of care</td>
<td></td>
</tr>
</tbody>
</table>

**S I Z E O F T R E A T M E N T E F F E C T**

<table>
<thead>
<tr>
<th>CLASS I</th>
<th>Benefit &gt;&gt; Risk</th>
<th>Procedure/Treatment SHOULD be performed/administered</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLASS Ia</td>
<td>Benefit &gt;&gt; Risk</td>
<td>Additional studies with focused objectives needed IT IS REASONABLE to perform procedure/administer treatment</td>
</tr>
<tr>
<td>CLASS Iib</td>
<td>Benefit &gt; Risk</td>
<td>Additional studies with broad objectives needed; additional registry data would be helpful Procedure/Treatment MAY BE CONSIDERED</td>
</tr>
<tr>
<td>CLASS III</td>
<td>No Benefit or CLASS III Harm</td>
<td></td>
</tr>
<tr>
<td>Procedure/ Test</td>
<td>Treatment</td>
<td></td>
</tr>
<tr>
<td>COR II:</td>
<td>No benefit</td>
<td>Not Helpful</td>
</tr>
<tr>
<td>COR II:</td>
<td>Harm</td>
<td>Excess Cost with Benefit or Harmful</td>
</tr>
</tbody>
</table>

- Recommendation that procedure or treatment is not useful/effective and may be harmful
- Sufficient evidence from multiple randomized trials or meta-analyses

**Data available from clinical trials or registries about the usefulness/efficacy in different subpopulations, such as sex, age, history of diabetes, history of prior myocardial infarction, history of heart failure, and prior aspirin use.**

- For comparative effectiveness recommendations (Class I and Ila; Level of Evidence A and B only), studies that support the use of comparator verbs should involve direct comparisons of the treatments or strategies being evaluated.

A recommendation with Level of Evidence B or C does not imply that the recommendation is weak. Many important clinical questions addressed in the guidelines do not lend themselves to clinical trials. Although randomized trials are unavailable, there may be a very clear clinical consensus that a particular test or therapy is useful or effective.

---

**Helping Cardiovascular Professionals Learn. Advance. Heal.**
Guideline Recommendations

- **Strength of Recommendations**
  - Class 1 - Should be done
  - Class 2A - Reasonable to be done
  - Class 2B - May be considered
  - Class 3 - No benefit, or Harm

- **Level of Evidence**
  - Level A - multiple RCT's or meta-analysis
  - Level B - Single RCT or nonrandomized trials
  - Level C - Expert consensus, case studies, "Standard of Care"
History & Physical

- History
  - What surgery?
  - Cardiac history and risk factors

- Physical
  - Neck – JVD, carotid bruits
  - Heart - 3\textsuperscript{rd} or 4\textsuperscript{th} heart sound, rhythm
  - Lungs – crackles
  - Extremities – edema, pulses

Clinical Risk Factors:

- High-risk surgery
- Hx ischemic heart dz
- Hx CHF
- Hx CVA/TIA
- Hx Insulin
- Creatinine >2.0 mg/dL
### Conditions requiring further investigation

*Table 2. Active Cardiac Conditions for Which the Patient Should Undergo Evaluation and Treatment Before Noncardiac Surgery (Class I, Level of Evidence: B)*

<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 (NYHA functional class IV; worsening or new-onset HF)</td>
<td>High-grade atrioventricular block</td>
</tr>
<tr>
<td>Significant arrhythmias</td>
<td>Mobitz II atrioventricular block</td>
</tr>
<tr>
<td></td>
<td>Third-degree atrioventricular heart block</td>
</tr>
<tr>
<td></td>
<td>Symptomatic ventricular arrhythmias</td>
</tr>
<tr>
<td></td>
<td>Supraventricular arrhythmias (including atrial fibrillation) with uncontrolled ventricular rate (HR greater than 100 beats per minute at rest)</td>
</tr>
<tr>
<td></td>
<td>Symptomatic bradycardia</td>
</tr>
<tr>
<td></td>
<td>Newly recognized ventricular tachycardia</td>
</tr>
<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 presyncope, or HF)</td>
</tr>
</tbody>
</table>

*According to Campeau (9).
†May include “stable” angina in patients who are unusually sedentary.
‡The American College of Cardiology National Database Library defines recent MI as more than 7 days but less than or equal to 1 month (within 30 days).
CCS indicates Canadian Cardiovascular Society; HF, heart failure; HR, heart rate; MI, myocardial infarction; NYHA, New York Heart Association.
Risk of Surgical Procedure

**Table 4. 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 often more than 5%)</td>
<td>Aortic and other major vascular surgery</td>
</tr>
<tr>
<td></td>
<td>Peripheral vascular surgery</td>
</tr>
<tr>
<td>Intermediate (reported cardiac risk generally 1% to 5%)</td>
<td>Intraperitoneal and intrathoracic surgery</td>
</tr>
<tr>
<td></td>
<td>Carotid endarterectomy</td>
</tr>
<tr>
<td></td>
<td>Head and neck surgery</td>
</tr>
<tr>
<td></td>
<td>Orthopedic surgery</td>
</tr>
<tr>
<td></td>
<td>Prostate surgery</td>
</tr>
<tr>
<td>Low† (reported cardiac risk generally less than 1%)</td>
<td>Endoscopic procedures</td>
</tr>
<tr>
<td></td>
<td>Superficial procedure</td>
</tr>
<tr>
<td></td>
<td>Cataract surgery</td>
</tr>
<tr>
<td></td>
<td>Breast surgery</td>
</tr>
<tr>
<td></td>
<td>Ambulatory surgery</td>
</tr>
</tbody>
</table>

*Combined incidence of cardiac death and nonfatal myocardial infarction.
†These procedures do not generally require further preoperative cardiac testing.
Routine Pre-op EKG?

- A routine pre-operative EKG is generally recommended (Class 1 or 2a) in pt with
  - No clinical risk factors for cholecystectomy
  - 1 clinical risk factor for breast biopsy
  - Known CAD for thoracic surgery
  - History of Stroke for cataract surgery
Routine Pre-op EKG?

- A routine pre-operative EKG is generally recommended (Class 1 or 2a) in pt with
  - No clinical risk factors for cholecystectomy
  - 1 clinical risk factor for breast biopsy
  - Known CAD for thoracic surgery
  - History of Stroke for cataract surgery
# The 12-Lead ECG

## Supplemental Preoperative Evaluation

### Recommendations

<table>
<thead>
<tr>
<th>Recommendations</th>
<th>COR</th>
<th>LOE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preoperative resting 12-lead ECG is reasonable for patients with known coronary heart disease, significant arrhythmia, peripheral arterial disease, cerebrovascular disease, or other significant structural heart disease, except for those undergoing low-risk.</td>
<td>IIa</td>
<td>B</td>
</tr>
<tr>
<td>Preoperative resting 12-lead ECG may be considered for asymptomatic patients without known coronary heart disease, except for those undergoing low-risk surgery.</td>
<td>IIb</td>
<td>B</td>
</tr>
<tr>
<td>Routine preoperative resting 12-lead ECG is not useful for asymptomatic patients undergoing low-risk surgical procedures.</td>
<td>III: No Benefit</td>
<td>B</td>
</tr>
</tbody>
</table>
Routine Pre-op EKG

- **Class 2A**
  - EKG reasonable for intermediate or high risk surgeries with
    - Known CAD
    - Significant arrhythmia
    - Cerebrovascular disease
  - Other significant structural heart disease

- **Class 2B**
  - Consider EKG except for low risk surgery

- **Class 3**
  - Routine EKG not recommended for low risk surgery
Case #1

65 year old female for pre-op eval for knee replacement

- HTN, HLP, DM, Obesity
- No known CAD or CHF
- Takes several daily 15 minute walks, although recently more limited due to knee pain
- Normal physical exam otherwise
- EKG - Class 2B recommendation
Case #2

85 year old female for pre-op eval for hip fracture after mechanical fall

- Heart murmur; echo shows severe Aortic Stenosis
- HTN
- No known CAD or CHF
- Low physical function level, but no chest pain, unusual shortness of breath, syncope
  - Was able to walk with walker down the hall at ECF
- Physical Exam otherwise unremarkable
Step 1

- Identify patients with symptomatic
  - Congestive Heart Failure
  - Valvular Heart Disease
  - Arrhythmia
- Is this emergency surgery?
  - If yes, go to the OR

*Patient scheduled for surgery with known or risk factors for CAD* (Step 1)

- Emergency: Yes → Clinical risk stratification and proceed to surgery
- No →
It is recommended that patients with clinically suspected moderate or greater degrees of valvular stenosis or regurgitation undergo preoperative echocardiography if there has been either 1) no prior echocardiography within 1 year or 2) a significant change in clinical status or physical examination since last evaluation.

<table>
<thead>
<tr>
<th>Recommendations</th>
<th>COR</th>
<th>LOE</th>
</tr>
</thead>
<tbody>
<tr>
<td>For adults who meet standard indications for valvular intervention (replacement and repair) on the basis of symptoms and severity of stenosis or regurgitation, valvular intervention before elective noncardiac surgery is effective in reducing perioperative risk.</td>
<td>I</td>
<td>C</td>
</tr>
</tbody>
</table>
### Clinical Risk Factors

#### Aortic Stenosis

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>COR</th>
<th>LOE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elevated-risk elective noncardiac surgery with appropriate intraoperative and postoperative hemodynamic monitoring is reasonable to perform in patients with asymptomatic severe AS.</td>
<td>IIa</td>
<td>B</td>
</tr>
</tbody>
</table>

#### Mitral Stenosis

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>COR</th>
<th>LOE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elevated-risk elective noncardiac surgery using appropriate intraoperative and postoperative hemodynamic monitoring may be reasonable in asymptomatic patients with severe mitral stenosis if valve morphology is not favorable for percutaneous mitral balloon commissurotomy.</td>
<td>IIb</td>
<td>C</td>
</tr>
</tbody>
</table>
### Recommendations

<table>
<thead>
<tr>
<th>Recommendations</th>
<th>COR</th>
<th>LOE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elevated-risk elective noncardiac surgery with appropriate intraoperative and postoperative hemodynamic monitoring is reasonable in adults with asymptomatic severe MR.</td>
<td>IIA</td>
<td>C</td>
</tr>
<tr>
<td>Elevated-risk elective noncardiac surgery with appropriate intraoperative and postoperative hemodynamic monitoring is reasonable in adults with asymptomatic severe AR and a normal LVEF.</td>
<td>IIA</td>
<td>C</td>
</tr>
</tbody>
</table>
Significant Valvular Disease
Aortic/Mitral Stenosis/Regurgitation

- **Class 1 Recommendations**
  - For moderate or worse stenosis/regurgitation
  - Echocardiogram if no echo in 1 year or there has been a change in clinical status in past year
  - If patient meets usual indications for valve intervention, do it prior to surgery
Severe Valve Stenosis

- **Aortic Stenosis**
  - Class 2A - ok to proceed with surgery (with appropriate monitoring) for asymptomatic severe AS

- **Mitral Stenosis**
  - Class 2B - If not amenable to balloon valvuloplasty, ok to proceed with surgery

- These are increased risk procedures!

ACC 2014
Severe Aortic and Mitral Regurgitation

- Class 2A - ok to proceed to surgery if asymptomatic (and normal EF for AR)
Step 1

- Identify patients with symptomatic
  - Congestive Heart Failure
  - Valvular Heart Disease
  - Arrhythmia
- Is this emergency surgery?
  - If yes, go to the OR

ACC 2014
Case #2

85 year old female for pre-op eval for hip fracture after mechanical fall

- Heart murmur; echo shows severe Aortic Stenosis
- HTN
- No known CAD or CHF
- Low physical function level, but no chest pain, unusual shortness of breath, syncope
  - Was able to walk with walker down the hall at ECF
- Physical Exam otherwise unremarkable
- Class 2A - Reasonable to proceed to surgery at increased cardiac risk
Case #3

55 year old male pre-op for routine endoscopy

- HTN, HLP
- Family history of CAD
- Physical exam unremarkable
Step 2

- Is there an acute coronary syndrome?
  - Unstable Angina
  - STEMI
  - Non-STEMI
Step 3/4

- Is this low risk?
  - RCRI 0 or 1
    - Proceed to Surgery

- Alternative risk calculators
- American College of Surgeons NSQIP MICA
- American College of Surgeons NSQIP Surgical Risk Calculator
Revised Cardiac Risk Index

RCRI

- 4315 Patients >50 years old undergoing elective non-cardiac surgery
  - 2893 assigned to derivation cohort
    - 56 (2%) had major cardiac complication
  - 6 risk factors identified
    - 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 mg/dL

Revised Cardiac Risk Index (RCRI)

- Risk of Major cardiac complications based on RCRI Score
  - Myocardial infarction
  - Pulmonary edema
  - Ventricular fibrillation or primary cardiac arrest
  - Complete heart block

<table>
<thead>
<tr>
<th>RCRI Score</th>
<th>Derivation Cohort (2893)</th>
<th>Validation Cohort (1422)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.5%</td>
<td>0.4%</td>
</tr>
<tr>
<td>1</td>
<td>1.3%</td>
<td>0.9%</td>
</tr>
<tr>
<td>2</td>
<td>4%</td>
<td>7%</td>
</tr>
<tr>
<td>3 or more</td>
<td>9%</td>
<td>9%</td>
</tr>
</tbody>
</table>

High-risk surgery
- Hx ischemic heart dz
- Hx CHF
- Hx CVA/TIA
- Hx Insulin
- Creatinine >2.0 mg/dL

Case #3

55 year old male pre-op for routine endoscopy

- HTN, HLP
- Family history of CAD
- Physical exam unremarkable
- Low risk procedure without active cardiac condition (RCRI = 0) - proceed to surgery

Clinical Risk Factors:
- High-risk surgery
- Hx ischemic heart dz
- Hx CHF
- Hx CVA/TIA
- Hx Insulin
- Creatinine >2.0 mg/dL
Case #4

60 year old male pre-op for cholecystectomy

- Coronary stent 2 years ago for unstable angina
- Class 1 compensated diastolic CHF
- HTN, HLP
- Physical exam unremarkable
- Exercises on treadmill 4 times a week, 20 minutes at a time (3.5mpH) without Chest pain or shortness of breath

Clinical Risk Factors:
- High-risk surgery
- Hx ischemic heart dz
- Hx CHF
- Hx CVA/TIA
- Hx Insulin
- Creatinine >2.0 mg/dL
Step 5

If Functional Status is good (\(\geq 4\) METS), go to OR
Assessing Activity Level
Duke Activity Score Index (DASI)

Table 4. Duke Activity Status Index

<table>
<thead>
<tr>
<th>Activity</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Can you…</td>
<td></td>
</tr>
<tr>
<td>1. take care of yourself, that is, eating, dressing, bathing, or using</td>
<td>2.75</td>
</tr>
<tr>
<td>the toilet?</td>
<td></td>
</tr>
<tr>
<td>2. walk indoors, such as around your house?</td>
<td>1.75</td>
</tr>
<tr>
<td>3. walk a block or 2 on level ground?</td>
<td>2.75</td>
</tr>
<tr>
<td>4. climb a flight of stairs or walk up a hill?</td>
<td>5.50</td>
</tr>
<tr>
<td>5. run a short distance?</td>
<td>8.00</td>
</tr>
<tr>
<td>6. do light work around the house like dusting or washing dishes?</td>
<td>2.70</td>
</tr>
<tr>
<td>7. do moderate work around the house like vacuuming, sweeping floors,</td>
<td>3.50</td>
</tr>
<tr>
<td>or carrying in groceries?</td>
<td></td>
</tr>
<tr>
<td>8. do heavy work around the house like scrubbing floors or lifting or</td>
<td>8.00</td>
</tr>
<tr>
<td>moving heavy furniture?</td>
<td></td>
</tr>
<tr>
<td>9. do yardwork like raking leaves, weeding, or pushing a power mower?</td>
<td>4.50</td>
</tr>
<tr>
<td>10. have sexual relations?</td>
<td>5.25</td>
</tr>
<tr>
<td>11. participate in moderate recreational activities like golf, bowling,</td>
<td>6.00</td>
</tr>
<tr>
<td>dancing, doubles tennis, or throwing a baseball or football?</td>
<td></td>
</tr>
<tr>
<td>12. participate in strenuous sports like swimming, singles tennis,</td>
<td>7.50</td>
</tr>
<tr>
<td>football, basketball, or skiing?</td>
<td></td>
</tr>
</tbody>
</table>

Duke Activity Status Index

\[
(DASI) = \text{sum of “Yes” replies}
\]

\[
VO2\text{peak} = (0.43 \times DASI) + 9.6
\]

\[
VO2\text{peak} \div 3.5 \text{ ml/kg/min} = \text{METs}
\]
## Assessing Activity Level

<table>
<thead>
<tr>
<th>METs</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 MET</td>
<td>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 (3.2-4.8 kph)?</td>
</tr>
<tr>
<td>4 METs</td>
<td>Do light work around the house such as dusting or washing dishes? Climb a flight of stairs or walk up a hill? Walk on level ground at 4 mph (6.4 kph)? Run a short distance? Do heavy work around the house such as scrubbing floors or lifting or moving heavy furniture? Participate in moderate recreational activities such as golf, bowling, dancing, doubles tennis, or throwing a baseball or football?</td>
</tr>
<tr>
<td>&gt;10 METs</td>
<td>Participate in strenuous sports such as swimming, singles tennis, football, basketball, or skiing?</td>
</tr>
</tbody>
</table>
Case #5

60 year old male pre-op for cholecystectomy

- Coronary stent 2 years ago for unstable angina
- Class 1 compensated diastolic CHF
- HTN, HLP
- Physical exam unremarkable
- Exercises on treadmill 4 times a week, 20 minutes at a time (3.5mph) without Chest pain or shortness of breath
- RCRI = 2, but moderate/good functional status.
  Proceed to surgery

Clinical Risk Factors:
- High-risk surgery
- Hx ischemic heart dz
- Hx CHF
- Hx CVA/TIA
- Hx Insulin
- Creatinine >2.0 mg/dL
Case #6

80 year old female pre-op for lower extremity bypass

- Severe peripheral vascular disease
- Active smoking
- Coronary stent 2 years ago for NSTEMI
- Diabetes on Insulin
- History of TIA 5 years ago
- Low level of function
- No active chest pain
- Chronic Shortness of breath (COPD)

Clinical Risk Factors:

- High-risk surgery
- Hx ischemic heart dz
- Hx CHF
- Hx CVA/TIA
- Hx Insulin
- Creatinine >2.0 mg/dL
Step 6/7

- Poor or Unknown METS with risk >1%

- Will Stress testing change your management?

Diagram:

- Poor OR unknown functional capacity (<4 METs): Will further testing impact decision making OR perioperative care? (Step 6)
  - Yes: Pharmacologic stress testing (Class IIa)
  - No: Proceed to surgery according to GDMT OR alternate strategies (noninvasive treatment, palliation) (Step 7)
  - If normal: Coronary revascularization according to existing CPGs (Class I)
  - If abnormal: Proceed to surgery according to GDMT OR alternate strategies (noninvasive treatment, palliation) (Step 7)
## Coronary Revascularization Prior to Noncardiac Surgery

<table>
<thead>
<tr>
<th>Recommendations</th>
<th>COR</th>
<th>LOE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revascularization before noncardiac surgery is recommended in circumstances in which revascularization is indicated according to existing CPGs.</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>It is not recommended that routine coronary revascularization be performed before noncardiac surgery exclusively to reduce perioperative cardiac events.</td>
<td>III: No Benefit</td>
<td>B</td>
</tr>
</tbody>
</table>
Revascularization Prior to Elective Non-Cardiac Surgery

- If indicated, CABG should be done prior to elective non-cardiac surgery
- PCI before noncardiac surgery
  - Patients with left main disease whose comorbidities preclude bypass surgery without undue risk
  - Patients with unstable CAD who would be appropriate candidates for emergency or urgent revascularization
    - Consider Balloon Angioplasty or Bare-Metal Stent
## Timing of Elective Noncardiac Surgery in Patients With Previous PCI

<table>
<thead>
<tr>
<th>Recommendations</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Elective noncardiac surgery should be delayed 14 days after balloon angioplasty…</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>…and 30 days after BMS implantation</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>Elective noncardiac surgery should optimally be delayed 365 days after DES implantation.</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>In patients in whom noncardiac surgery is required, a consensus decision among treating clinicians as to the relative risks of surgery and discontinuation or continuation of antiplatelet therapy can be useful.</td>
<td>IIa</td>
<td>C</td>
</tr>
</tbody>
</table>
Elective noncardiac surgery after DES implantation may be considered after 180 days if the risk of further delay is greater than the expected risks of ischemia and stent thrombosis.

**Elective noncardiac surgery should not be performed within 30 days after BMS implantation or within 12 months after DES implantation in patients in whom DAPT will need to be discontinued perioperatively.**

**Elective noncardiac surgery should not be performed within 14 days of balloon angioplasty in patients in whom aspirin will need to be discontinued perioperatively.**

*Because of new evidence, this is a new recommendation since the publication of the 2011 PCI CPG.*
Timing of Surgery After Revascularization

- **Class 1**
  - 14 Days after Balloon Angioplasty
  - 30 Days after Bare Metal Stent
  - 365 Days (Optimally) after Drug Eluting Stent

- **Class 2b**
  - 180 days after DES if waiting would increase risk
Case #6

80 year old female pre-op for lower extremity bypass

- Severe peripheral vascular disease
- Active smoking
- Coronary stent 2 years ago for NSTEMI
- Diabetes on Insulin
- History of TIA 5 years ago
- Low level of function
- No active chest pain
- Chronic Shortness of breath (COPD)
- **Would stress testing change your management??***

Clinical Risk Factors:

- High-risk surgery
- Hx ischemic heart dz
- Hx CHF
- Hx CVA/TIA
- Hx Insulin
- Creatinine >2.0 mg/dL
Case #7

60 year old male pre-op cholecystectomy

- Drug eluting stent 6 months ago for NSTEMI
- Smoker, quit 6 months ago
- HTN, HLP
- Has been on Aspirin & Clopidogrel since stent
- Good functional capacity, no angina

Clinical Risk Factors:
- High-risk surgery
- Hx ischemic heart dz
- Hx CHF
- Hx CVA/TIA
- Hx Insulin
- Creatinine >2.0 mg/dL
How do I manage a patient who just had a stent?
Stent less than 4-6 weeks ago?

- Prefer to delay surgery
- If unable to delay, then prefer to continue DAPT
### Perioperative Therapy

#### Antiplatelet Agents

<table>
<thead>
<tr>
<th>Recommendations</th>
<th>COR</th>
<th>LOE</th>
</tr>
</thead>
<tbody>
<tr>
<td>In patients undergoing urgent noncardiac surgery during the first 4 to 6 weeks after BMS or DES implantation, DAPT should be continued unless the relative risk of bleeding outweighs the benefit of the prevention of stent thrombosis.</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>In patients who have received coronary stents and must undergo surgical procedures that mandate the discontinuation of P2Y$<em>{12}$ platelet receptor–inhibitor therapy, it is recommended that aspirin be continued if possible and the P2Y$</em>{12}$ platelet receptor–inhibitor be restarted as soon as possible after surgery.</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>Management of the perioperative antiplatelet therapy should be determined by a consensus of the surgeon, anesthesiologist, cardiologist, and patient, who should weigh the relative risk of bleeding versus prevention of stent thrombosis.</td>
<td>I</td>
<td>C</td>
</tr>
</tbody>
</table>
### Antiplatelet Agents (cont’d)

<table>
<thead>
<tr>
<th>Recommendations</th>
<th>COR</th>
<th>LOE</th>
</tr>
</thead>
<tbody>
<tr>
<td>In patients undergoing nonemergency/nonurgent noncardiac surgery who have not had previous coronary stenting, it may be reasonable to continue aspirin when the risk of potential increased cardiac events outweighs the risk of increased bleeding.</td>
<td>IIb</td>
<td>B</td>
</tr>
<tr>
<td>Initiation or continuation of aspirin is not beneficial in patients undergoing elective noncardiac noncarotid surgery who have not had previous coronary coronary stenting,…</td>
<td>III: No Benefit</td>
<td>B</td>
</tr>
<tr>
<td>…unless the risk of ischemic events outweighs the risk of surgical bleeding.</td>
<td></td>
<td>C</td>
</tr>
</tbody>
</table>
How do I manage antiplatelets?

- **Class 1**
  - Continue Dual Antiplatelet Therapy (DAPT) for 4-6 weeks after stent (unless bleeding risk outweighs benefits)
  - If P2Y\textsubscript{12} inhibitor is stopped prior to surgery, restart it ASAP after surgery

- **Class 2b**
  - In patient without prior stent, continue aspirin peri-operatively if benefit exceeds bleeding risk
Stent 1 month - 1 year ago?

- Prefer to wait
  - 30 days for BMS
  - 365 days for DES

- OK to proceed after 180 days
Stent over 1 year old?

- If you have to stop P2Y$_{12}$ inhibitor, then continue aspirin and restart it after surgery.
Case #7

60 year old male pre-op cholecystectomy
- Drug eluting stent 6 months ago for NSTEMI
- Smoker, quit 6 months ago
- HTN, HLP
- Has been on Aspirin & Clopidogrel since stent
- Good functional capacity, no angina
- **Class 2B - OK to proceed with surgery at 180 days**
  - Prefer to continue clopidogrel, but reasonable to hold if bleeding risk is high
  - Continue aspirin peri-operatively

Clinical Risk Factors:
- High-risk surgery
- Hx ischemic heart dz
- Hx CHF
- Hx CVA/TIA
- Hx Insulin
- Creatinine >2.0 mg/dL
Who gets pre-operative Beta Blocker?

- Which is a Class 1 or 2A situation for pre-operative Beta Blocker?
  - On Beta-Blocker 2 clinical risk factors, for cataract
  - Beta-blocker naïve
    - No known CAD
      - B-blocker naïve, 1 clinical risk factor, for AAA
      - B-blocker naïve, 0 clinical risk factors, for AAA
      - B-blocker naïve, 2 clinical risk factors, for carotid endarterectomy
    - Known CAD (either ischemic or stable) for AAA
    - Known CAD (either ischemic or stable) for gallbladder
Who gets pre-operative Beta Blocker?

- Which is a Class 1 or 2A situation for pre-operative Beta Blocker?
  - On Beta-Blocker 2 clinical risk factors, for cataract (1)
  - Beta-blocker naïve (2B at best)
    - No known CAD
      - B-blocker naïve, 1 clinical risk factor, for AAA
      - B-blocker naïve, 0 clinical risk factors, for AAA
      - B-blocker naïve, 2 clinical risk factors, for carotid endarterectomy
    - Known CAD (either ischemic or stable) for AAA
    - Known CAD (either ischemic or stable) for gallbladder

ACC 2014
Peri-operative Beta Blockers Still an Enigma

- Small initial trials (mid 1990’s to early 2000’s) showed benefit of peri-operative beta blockers
  - Reduced post-op cardiac complications
- Subsequent trials (early/mid 2000’s) showed no benefit
- Meta-analysis (2005) suggested harm
- POISE (2008)
  - Beta Blockers reduced cardiac risks
  - But increased other risks
    - Stroke
    - Death from non-cardiac complications

ACC 2014
Beta blockers should be continued in patients undergoing surgery who have been on beta blockers chronically.

It is reasonable for the management of beta blockers after surgery to be guided by clinical circumstances, independent of when the agent was started.

In patients with intermediate- or high-risk myocardial ischemia noted in preoperative risk stratification tests, it may be reasonable to begin perioperative beta blockers.

In patients with 3 or more RCRI risk factors (e.g., diabetes mellitus, HF, CAD, renal insufficiency, cerebrovascular accident), it may be reasonable to begin beta blockers before surgery.

These recommendations have been designated with a SR to emphasize the rigor of support from the ERC’s systematic review. See the ERC systematic review report, “Perioperative beta blockade in noncardiac surgery: a systematic review for the 2014 ACC/AHA guideline on perioperative cardiovascular evaluation and management of patients undergoing noncardiac surgery” for the complete evidence review on perioperative beta-blocker therapy.
### Perioperative Beta-Blocker Therapy (cont’d)

<table>
<thead>
<tr>
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</tr>
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<tbody>
<tr>
<td>In patients with a compelling long-term indication for beta-blocker therapy but no other RCRI risk factors, initiating beta blockers in the perioperative setting as an approach to reduce perioperative risk is of uncertain benefit.</td>
<td>IIb</td>
<td>B&lt;sup&gt;SR&lt;/sup&gt;</td>
</tr>
<tr>
<td>In patients in whom beta-blocker therapy is initiated, it may be reasonable to begin perioperative beta blockers long enough in advance to assess safety and tolerability, preferably more than 1 day before surgery.</td>
<td>IIb</td>
<td>B&lt;sup&gt;SR&lt;/sup&gt;</td>
</tr>
<tr>
<td>Beta-blocker therapy should not be started on the day of surgery.</td>
<td>III: Harm</td>
<td>B&lt;sup&gt;SR&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

These recommendations have been designated with a SR to emphasize the rigor of support from the ERC’s systematic review. See the ERC systematic review report, “Perioperative beta blockade in noncardiac surgery: a systematic review for the 2014 ACC/AHA guideline on perioperative cardiovascular evaluation and management of patients undergoing noncardiac surgery” for the complete evidence review on perioperative beta-blocker therapy.
Beta Blockers peri-operatively: Still an Enigma

- **Class 1**
  - Continue Beta Blockers in patients already on Beta Blockers

- **Class 2A**
  - Use beta blockers peri-operatively guided by clinical circumstances

- **Class 2B**
  - Start Beta Blockers on patients with intermediate or high risk ischemia on pre-operative testing
  - Start Beta Blockers in patients with 3 or more risk factors
  - Start Beta Blockers if there is a compelling long term indication
  - Start Beta Blockers more than 1 day before surgery

- **Class 3**
  - Don’t start Beta Blockers on the day of surgery
Pre-operative Statin?

- In which patients is a statin recommended (Class 1 or 2A) pre-operatively
  - Already taking a statin, for basal cell removal
  - Statin naïve, 1 clinical risk factor, for gallbladder
  - Statin naïve, for carotid endarterectomy
  - Statin naïve, no clinical risk factors, for colon resection
Pre-operative Statin?

- In which patients is a statin recommended (Class 1 or 2A) pre-operatively
  - Already taking a statin, for basal cell removal
  - Statin naïve, 1 clinical risk factor, for gallbladder (2B recommendation)
  - Statin naïve, for carotid endarterectomy
  - Statin naïve, no clinical risk factors, for colon resection
Perioperative Statin Therapy

**Recommendations**

<table>
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<tr>
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<th>LOE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Statins should be continued in patients currently taking statins and scheduled for noncardiac surgery.</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>Perioperative initiation of statin use is reasonable in patients undergoing vascular surgery.</td>
<td>IIa</td>
<td>B</td>
</tr>
<tr>
<td>Perioperative initiation of statins may be considered in patients with clinical indications according to GDMT who are undergoing elevated-risk procedures.</td>
<td>IIb</td>
<td>C</td>
</tr>
</tbody>
</table>

**Alpha-2 Agonists**

**Recommendation**

<table>
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</tr>
</thead>
<tbody>
<tr>
<td>Alpha-2 agonists for prevention of cardiac events are not recommended in patients who are undergoing noncardiac surgery.</td>
<td>III: No Benefit</td>
<td>B</td>
</tr>
</tbody>
</table>
Who gets a Statin?

- **Class 1**
  - If already on a statin, continue taking it

- **Class 2A**
  - Initiate statin for patients undergoing vascular surgery

- **Class 2B**
  - Consider statin if otherwise indicated by guidelines for elevated risk procedure
Why stress and cath so few patients?

- CARP
CARP
Coronary Artery Revascularization Prophylaxis

- VA study of 510 patients undergoing vascular surgery
  - 33% Abdominal aortic aneurysm
  - 67% Lower extremity arterial occlusive disease
- Avg age 66 years, significant but stable CAD
  - Randomized to revascularization vs. med management
    - 59% PCI; 41% CABG
- Surgery delayed 54 days (vs 18 days) for revascularization

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Revascularization</th>
<th>Medical Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Postop MI</td>
<td>11.6%</td>
<td>14.3%</td>
</tr>
<tr>
<td>30-day mortality</td>
<td>3.1%</td>
<td>3.4%</td>
</tr>
<tr>
<td>2.7-year mortality</td>
<td>22%</td>
<td>23%</td>
</tr>
</tbody>
</table>
Other Peri-operative measures

- ACE Inhibitors
  - Class 2A - Either continue them peri-operatively or restart them ASAP after surgery
- Prophylactic Nitroglycerin – Class 3 (No Benefit)
- Swan-Ganz - Probably not
  - Class 2b - Consider when significant hemodynamics cannot be corrected prior to surgery (Shock, heart failure, severe valvular disease)
- Class 3 - Routine use not recommended
- Clonidine (alpha 2 agonist) - Class 3 (No Benefit)
Intraoperative and Postoperative Monitoring

- **Class 2A**
  - 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. (*Level of Evidence: B*)

- **Class 2B**
  - Intraoperative and postoperative ST-segment monitoring may be considered in patients with single or multiple risk factors for CAD who are undergoing noncardiac surgery. (*Level of Evidence: B*)
Surveillance of post-op MI

- **Class 1**
  - Postoperative troponin measurement is recommended in patients with ECG changes or chest pain typical of acute coronary syndrome. *(Level of Evidence: C)*

- **Class 2B**
  - The use of postoperative troponin measurement is not well established in patients who are clinically stable and have undergone vascular and intermediate-risk surgery. *(Level of Evidence: C)*

- **Class 3**
  - Postoperative troponin measurement is not recommended in asymptomatic stable patients who have undergone low-risk surgery. *(Level of Evidence: C)*
Conclusion

- Risk stratification important
- Address risk factors as possible
- Coronary revascularization is not generally the optimal way to reduce operative risk
References
