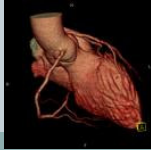


## Pre-Operative Cardiac Evaluation and New Screening Tests



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## Pre-Operative Cardiac Evaluation and New Technologies, An Overview



- Review of ACC algorithm for non-cardiac surgery pre-operative clearance
- Application of the guidelines to specific clinical scenarios
- Evaluating the effectiveness of cardiac testing for specific patients
- Looking at new technology—Cardiac MRI, CTA, Stress MRI and others—what do these tests tell us and will they replace our current testing methods?
- Additional advances in cardiac care in the OR (Beta Blockers, Statins, etc.)

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## Pre-Operative Cardiac Clearance



- What does it mean when we get a note from cardiology saying that patient is “cleared for surgery?”
- How do they (or we) determine who is cleared?
- What does it mean to risk-stratify a patient?
- Are we looking at all of the issues?
  - Coronary Disease: Risk of plaque rupture, MI, CVA
  - Valvular Disease: AS, risk of death on induction from decreased preload
  - Arrhythmia Issues
  - Volume Status: EF adequate?

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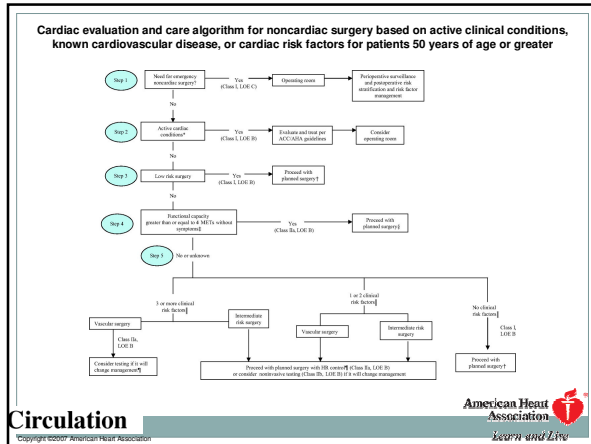
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### Review of Concepts

“Active Cardiac Conditions” (Step 2)	“Low Risk Surgery” (Step 3)
<ul style="list-style-type: none"> <li>• Unstable Coronary Syndromes (severe angina or recent MI)</li> <li>• Decompensated HF</li> <li>• Significant Arrhythmias (High-grade AVB, Mobitz II, CHB, symptomatic vent. Arrhythmias, SVT, A-Fib with uncontrolled HR, Symptomatic Bradycardia)</li> <li>• Significant valvular disease (severe AS or symptomatic MS)</li> </ul>	<ul style="list-style-type: none"> <li>• Low risk = Ophthalmologic Procedures</li> <li>• Moderate Risk</li> <li>• Vascular Surgery = Highest Risk</li> </ul>

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### Surgical Risk Categorization For Periop. MI

- **Low Risk**
  - Ophthalmological
  - Bronchoscopy
  - Colonoscopy
- **Moderate Risk**
  - Orthopedics
  - Urological
  - Gynecological
  - Neurosurgery
  - CEA/Endovascular AAA Repair
- **High Risk**
  - Major Thoracic
  - Major Abdominal
  - Major Vascular

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## What is considered a “Clinical Risk Factor”?

Clinical Risk Factors in Algorithm (Highest Correlation with Periop Events)

- Ischemic Heart Disease
- Compensated or Prior Heart Failure
- Diabetes
- Renal Insufficiency
- Cerebrovascular Disease

Not Listed as Clinical Risk Factors

- Hypertension
- Obesity
- Chest Pain
- History of Smoking
- Family history of CAD

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## What is a Metabolic Equivalent?

- Commonly used concept with varying definition
- ACC Guidelines depend on correct definition
- Mets express energy expenditure in relation to body weight
- Most important is “moderate category”
- Exercise walking is defined as 3.8 mets
- Ask patients whether they can walk up a flight of steps (4 Mets)
- Carry groceries while walking up steps (5 Mets)

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## Commonly Used Table of Mets

Activity	Mets
<b>Light Intensity Activities</b>	
Sleeping	<3
Watching Television	0.9
Desk Work (typing, etc.)	1.0
Walking (less than 2.0 MPH on level ground)	1.8
	2.0
<b>Moderate Intensity Activities</b>	
	3-6
Bicycling, Stationary, Very light effort	3.0
Sexual Activity	3.3
Calisthenics, home exercise, light or mod. effort	3.5
Bicycling, <10 MPH to work or for pleasure	4.0
Bicycling, stationary 100 watts, light effort	5.5
<b>Vigorous Intensity Activities</b>	
	>6
Jogging, general	7.0
Calisthenics (push-ups, sit-ups) heavy, vigorous effort	8.0
Running	8.0

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**Clinical Scenario**

55 year-old male for RALP (Robotic Assisted Laparoscopic Prostatectomy):

Works as a security guard, walks moderately

Obese (6'1", 280lbs.)

Primary Care History Unavailable, Pt. on Lipitor, Metoprolol

Quit smoking 5 years ago, 30 pack-year history

Hypertension x 5 years, controlled in the 140-150/90s range

- Where does this patient fall in the ACC Guidelines?
  - Non-emergency surgery
  - No "Active Cardiac Conditions" as defined by AHA
  - Moderate-Risk Surgery (can lose 1-2 L blood)
  - Functional capacity = 4 Mets
  - Should we evaluate this patient for CAD?
  - Should we delay surgery?
  - What testing is appropriate?

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**Risk Factors**

Patient Has Traditional Risk Factors	But Not "Clinical Risk Factors" as designated by research
<ul style="list-style-type: none"> <li>• Obesity</li> <li>• Smoking</li> <li>• Sedentary Lifestyle</li> </ul>	<ul style="list-style-type: none"> <li>• Renal Insufficiency</li> <li>• Cerebrovascular disease</li> <li>• Ischemic Heart Disease</li> <li>• Diabetes</li> <li>• Compensated or prior Heart Failure</li> </ul>

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**Conclusion for 55 y.o. pt. for RALP**

- Proceed to surgery without further testing

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### What tests are appropriate and what information will they give us?

- ACC/AHA supports testing only when it will change patient management (obvious but frequently not followed)
- Defensive testing? (avoid lawsuits, want “clearance”)
  - No such thing as cardiac “clearance”
  - Risk stratification into low, medium or high risk
  - Final decision is up to anesthesia provider/surgeon/pt.
- What information do tests give us?
  - High Risk for peri-op MI approx. 15-20%
  - Intermediate Risk is 3-7%
  - Low risk is <3%
- Which test(s) should be ordered for these patients?

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### Assessment of LV function

#### What does it predict?

- Number of ways to do
- Correlation between low EF and poor surgical outcome
- But likely because it predicts CAD
- Not found to be consistent predictor of peri-op events
- Does predict CH

#### When to check LV function?

- Dyspnea of unknown etiology
- History of CHF with worsening dyspnea
- Not
  - Reassessment of prior cardiomyopathy when stable
  - Routine assessment of LVF

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### 12 Lead ECG

#### What does it predict?

- Q waves correlate with peri-op events
- ST segment depression, LV hypertrophy with strain, and LBBB associated with decreased life expectancy
- Plain “ECG abnormality” not predictive of peri-op event

#### When to obtain?

- Vascular surgery procedure
- Known atherosclerosis undergoing intermediate risk procedure
- Don't obtain in low risk surgery

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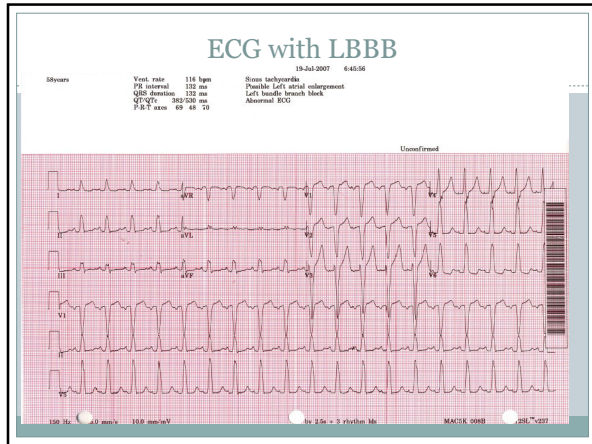
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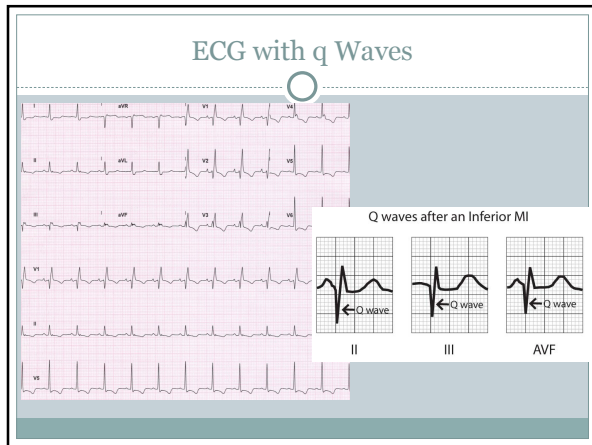
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### Stress Testing

Stress	Imaging stress changes
<ul style="list-style-type: none"> <li>• Exercise</li> <li>○ Adequate HR 85% MPRH</li> <li>• Pharmacological</li> <li>○ Dobutamine</li> <li>○ Adenosine</li> </ul>	<ul style="list-style-type: none"> <li>• ECG</li> <li>• Echocardiography</li> <li>• Myocardial Perfusion Imaging</li> <li>• MRI</li> </ul>

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### Treadmill ECG Stress-Testing

Aim	What it predicts?
<ul style="list-style-type: none"> <li>• Measure functional capacity</li> <li>• Identify myocardial ischemia</li> <li>• Identify cardiac arrhythmias</li> <li>• These together estimate risk</li> </ul>	<ul style="list-style-type: none"> <li>• Exercise capacity predicts peri-op events (McPhail et al study)</li> <li>• ST depression predicts peri-op events- particularly at lower levels of exercise</li> <li>• 15-20% considered high risk; no ST depression 6% risk</li> </ul>

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### Radionuclide Myocardial Perfusion Imaging

<ul style="list-style-type: none"> <li>• Beneficial if can not exercise</li> <li>○ Increase myocardial demand (dobutamine)</li> <li>○ Induce hyperemic response (adenosine)</li> </ul>	<ul style="list-style-type: none"> <li>• Adenosine MPI well studied form of risk stratification</li> <li>• More sensitive to detect ischemia then ECG</li> <li>• More able to distinguish high from low risk</li> <li>• Detection of ischemia or infarct and extent of these correlates with risk</li> </ul>
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### Radionuclide Myocardial Perfusion Imaging

<ul style="list-style-type: none"> <li>• Ischemia (reversible defect)</li> <li>○ Positive predictive value for peri-op event ~15-20%</li> <li>INFACT (fixed defect)</li> <li>higher risk than normal but not high risk for events (&lt;3%)</li> <li>Negative predictive value:99%</li> </ul>	<ul style="list-style-type: none"> <li>• Ischemia can be continuous risk – smaller area means less risk (&lt;20% of LV mass)</li> <li>• Low positive predictive value therefore use in only those at highest risk</li> </ul>
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### Stress Echocardiography

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<ul style="list-style-type: none"> <li>• If can't exercise dobutamine used</li> <li>• Ischemia again correlates as powerful determinant of events</li> <li>• Degree and extent correlate with increasing risk</li> </ul>	
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### New Cardiac Imaging Technologies

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<p style="text-align: center;">Cardiac CTA</p> <ul style="list-style-type: none"> <li>• Not first line- looks at anatomy not functional capacity or physiology</li> <li>• Used when equivocal stress test or suspected artifact</li> <li>• Used to risk stratify degree of an abnormality</li> </ul>	<p style="text-align: center;">Cardiac Stress MRI</p> <ul style="list-style-type: none"> <li>• Newer way of looking at physiology</li> <li>• Exactly determines degree of ischemia and infarct</li> <li>• Early studies show a good correlation with findings and peri-operative risk</li> </ul>
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### Which test if Test Needed?

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<p style="text-align: center;">Exercise ECG</p> <ul style="list-style-type: none"> <li>• Exercise ECG first choice if ambulatory</li> <li>○ Functional capacity</li> <li>○ Detection of ischemia</li> <li>○ Safe to do even in AAA</li> </ul>	<p style="text-align: center;">Cardiac Imaging</p> <ul style="list-style-type: none"> <li>• If abnormal baseline ECG- LBBB, LVH, digoxin then stress cardiac imaging</li> <li>• If can't exercise               <ul style="list-style-type: none"> <li>○ DSE-avoid HTN, hypotension, arrhythmias; use with concern for valvular dz</li> <li>○ Adenosine MPI-avoid in bronchospasm</li> <li>○ Dobutamine MPI</li> </ul> </li> </ul>
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### If Abnormal Stress: How do we treat?

- Understand degree of abnormality and true positive predictive value of peri-operative event...
- PCI only indicated in patients who would require revascularization irrespective of non-cardiac surgery..i.e unstable angina, MI, or possibly high risk stress test
- Studies have demonstrated limited benefit in taking patients to revascularization abnormal stress unless very high risk stress test.

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### Revascularization prior to Non-Cardiac Surgery

- CARP trial
- 500 patient
- Randomized to revascularization (PCI/CABG) prior to non-cardiac surgery vs medical therapy
- No significant difference in peri-op events with either strategy
- Longer delays with revascularization secondary to antiplatelet drugs and recovery from CABG
- Only difference in subgroup analysis was very high risk stress test with large ischemia and dilatation of cavity with stress

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### Revascularization prior to Non-Cardiac Surgery

- Remember antiplatelets have to be continued for period of time or risk of stent thrombosis..especially with drug eluting stents (plavix/asa one year)
- Why is revascularization of critical lesions not the solution?

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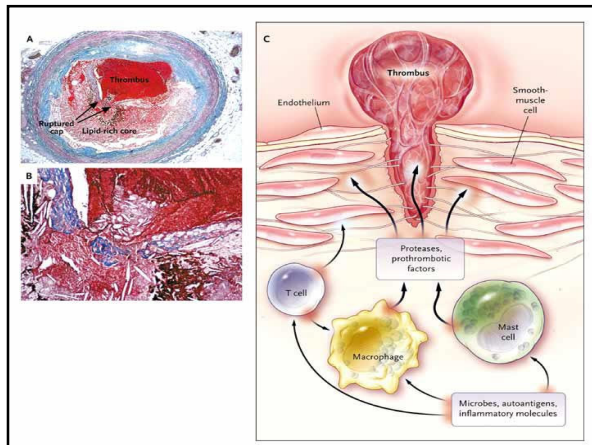
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### Revascularization

- So even though revascularize critical lesions; subcritical lesion can have plaque rupture
- This is why stents have not been shown to decrease MI or death except in setting of MI. Does not treat entire coronary tree to protect against plaque rupture
- Medical therapy is key for this

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### Why are Statins important in the perioperative period?

- In addition to their lipid-lowering properties, there is evidence that statins:
  - Improve endothelial function
  - Reduce vascular inflammation
  - Stabilize atherosclerotic plaque (prevent plaque rupture and MI)

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### Statin Data: NEJM2009;361:980-9

- 500 pt randomized going for vascular surgery
- 250 received fluvastatin, 247 received placebo
- Peri-operative ischemia 10.8% in fluvastatin vs 19.0% in placebo group
- Death from cardiac causes 4.8% in statin group vs 10.1 % in placebo group
- Statins not stents prevent not only MIs but also death peri-operatively in high risk surgery

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### Recommendations For Perioperative Statin Therapy

- Class 1: For patients currently taking statins and scheduled for non-cardiac surgery, statins should be continued.
- Class IIa: For patients undergoing vascular surgery with or without clinical risk factors, statin use is reasonable.
- Class IIb: For patients with at least one clinical risk factor who are undergoing intermediate-risk procedures, statins may be considered.

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## Strategies to Decrease Peri-Op Morbidity

### • Beta-Blocker Therapy

- Inadequate evidence for which drug should be used, when it should be given, etc.
- Current recommendations are on hand-out.
- Though there are only a few randomized trials, evidence suggests beta blockers can reduce perioperative ischemia, risk of MI and death in high-risk patients.
- See article from Chopra, V. and Eagle, K. *Perioperative Beta-Blockers for Cardiac Risk Reduction*, JAMA, 303 (6), Feb. 10, 2010.

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## Beta Blocker Therapy

- Should be started days to weeks before elective surgery.
- Dose should be titrated to achieve a resting HR of 60 BPM.
- Rate control should continue during intra-op and post-op period to maintain a HR of 60.

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## Suggested Protocol for Peri-Op Beta Blockade

Patient Status	Recommendations
Pre-Hospitalization or on admission	<b>Patients not receiving chronic beta-blocker therapy</b> <ul style="list-style-type: none"> <li>• Give metoprolol (Toprol-XL®, AstraZeneca) 25–100 mg PO b.i.d.</li> <li>• Begin as outpatient, up to 30 days prior to surgery</li> <li>• Titrate new or pre-existing beta blocker to heart</li> </ul>
Pre-Op Holding Area (Immediate Pre-Op Period)	<b>All patients: Give metoprolol 5 mg IV every 10 minutes to reach target heart rate</b> before induction of anesthesia, if needed
In Hospital Period and Transition to Oral Medications	<b>Patients not taking oral medications who are hemodynamically stable</b> <ul style="list-style-type: none"> <li>• Give metoprolol 5 mg IV every 15 minutes up to 15 mg, titrate to heart rate of 65 bpm, repeat every six hours.</li> <li>• Consider clonidine patch if unable to administer IV metoprolol.</li> </ul>

*ICU patients with potential hemodynamic*

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## Peri-Op Beta Blockade Recommendations (Cont)

Patient Status	Recommendations
In Hospital Period and Transition to Oral Medications (Cont..)	<p><b>Patients switching from IV medications</b></p> <ul style="list-style-type: none"> <li>• Overlap first PO dose of metoprolol or chronic agent with IV metoprolol to maintain target heart rate.</li> </ul> <p><b>Patients taking oral medications</b></p>
Post-Hospitalization	<p>Continue preoperative beta blocker to 30 days postoperatively,* and taper.</p> <ul style="list-style-type: none"> <li>• Continue beta-blocker lifelong therapy in patients with a history of myocardial</li> </ul>
<small>From: Auerbauch, A.D. <a href="http://www.pharmscope.com/ptjournal/fulltext/29/6/PTJ2906380.pdf">http://www.pharmscope.com/ptjournal/fulltext/29/6/PTJ2906380.pdf</a></small>	
<small>Practical, Effective Use of Beta Blockers to Improve Perioperative Patient Outcome.</small>	

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## Health Care Reform

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- Identify practices associated with high cost and limited benefit
  - Perioperative coronary revascularization does not improve outcomes in patients with stable coronary disease
  - Perioperative stress testing benefits fewer patients than current implementation rates justify
  - Perioperative beta-blocker therapy should be directed to clearly defined, at-risk patient populations
- Review of Clinical Trials:
  - CASS, COURAGE and BARI 2D: coronary revascularization beyond excellent medical therapy may offer no substantial benefit in stable patients, regardless of operative status

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## Health Care Reform Article

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- Autopsy studies of patients with perioperative MI found fatal event often originated from non-stenotic coronary arteries.
- Many are a result of the rupture of vulnerable plaque which pre-operative testing does not identify.
- “Coronary disease is far more complex than the number of diseased vessels, plaque burden, or morphologic characteristics: It is the biology rather than the anatomy of coronary arteries that matters most.”

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## Health Care Reform Article

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- University of Michigan Pre-Operative Clinic: through an educational program emphasizing the ACC/AHA guidelines their pre-operative clinic improved test appropriateness and clinical outcomes while reducing cost by 50 to 75%.
- Health care reforms should incentivize evidence-based care to payment.
- This will be the future of peri-operative medicine and health care.

• Chopra, V., Flanders, S., Froelich, J., Lau, W., Eagle, K. *Ann Intern Med.* 2010; 152, 47-51.

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### Clinical Scenario

81 y.o. patient presents with SBO (vomiting, abdominal distention & pain)

Troponin 2.1

CT Scan demonstrates complete SBO

HR is 110

BP 140/80

On no previous medications

- Patient falls into category 1 of algorithm—need for emergency surgery
- But what about recent/evolving MI?
- How do we minimize risk for the patient?
  - Should we get an ECG? Yes (high risk, but we are looking for dynamic ECG changes after surgery)
  - Should we get an ECHO? Yes (will help with fluid management and EF)
  - Would you get a stress test?

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## Clinical Scenario Continued

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- How do we reduce patient's risk?
  - Fluid load (depending on Echo results)
  - Beta Blockade

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### Clinical Scenario

35 year-old male with Crohn's Disease for bowel resection

"Heart problems as a child" but no prior records

Sternotomy scar

5'8", 135 lbs., recently inactive, complains of syncope, unable to walk up stairs, has been hospitalized sporadically

Does not have a cardiologist, can't remember having a cardiac evaluation as an adult

- Non-emergent, moderate-risk surgery
- Unknown underlying condition
- Poor functional capacity, decompensated physical condition

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### Questions

- Thank You!
- Comments to [anesthesia.anne@yahoo.com](mailto:anesthesia.anne@yahoo.com)



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