Ischemic Work-up in 2020 vis-à-vis High-Value Care

Who, Why, How, and When?

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Denver Health and Hospital Authority
Disclosures

➢ None
Objectives

➢ High-value care
➢ How to achieve high-value care in clinical practice
➢ Evaluation of patients with suspected angina pectoris
  ▪ Patient selection
➢ Available modalities for ischemic workup
  ▪ Emphasis on stress test modalities
➢ Indications and contraindications
➢ Choosing the right test
➢ Preoperative cardiovascular risk stratification
High-Value Care & Cardiac Imaging

- High-value care = healthcare outcomes per $ spent
- Cardiac imaging has come under intense scrutiny as a contributor to rising (unnecessary) health care costs
- Drivers of increased utilization:
  - Provider-Related & Patient-Related Factors
- Potential ill effects of unwarranted testing
  - Patient anxiety
  - Unwarranted downstream testing
- CMS aimed to “bend the cost curve”
  - Payments cut by 33% between 2006 and 2010
Defining High-Value Care

• Goal:
  – The right test for the right patient at the right time
• So, the critical issue is not how many studies are done, but that they are done if and when the results will enhance patient care
  – Not just lower cost, but higher value
• Transformation of Appropriate Care terminology
  – Appropriate ➞ Appropriate Care
  – Uncertain ➞ May Be Appropriate Care
  – Inappropriate ➞ Rarely Appropriate Care
Bending the Value Curve

• Appropriate Use Criteria
• ABIM’s *Choosing Wisely®* Campaign
• ASNC’s *Refer Wisely™* Campaign
• ACC’s *Imaging in FOCUS*
• Decision Support Tools
  – Smartphone Apps
  – Clinical Care Pathways
  – Programs that link with EMR and provide integrated decision support at the point of order entry
• Or…,
  – *Consult a multimodality cardiac imager, or a cardiologist*
The American Society for Clinical Pathology just released a new list of five tests and procedures related to screenings for stool pathogens, Hepatitis C and adrenal tumors.
FOCUS is a quality initiative to guide and improve appropriate ordering of cardiovascular imaging and tests. Learn more at the links below.

Resources and Related Tools

- Coronary Revascularization AUC Poster | PDF
- Appropriate Use Criteria Brochure | PDF
- ICD Pocket Card | PDF
- Coronary Revascularization in Patients with SIHD Poster | PDF
- Stable Ischemic Heart Disease Pocket Card | PDF
- Peds Echo TTE Pocket Card | PDF
# Management and Testing of Ischemic Heart Disease

## Symptomatic
(Sudden worsening of symptoms could represent ACS and should be referred to the ED)

### Classification of chest pain
- Characteristics
  - Substernal chest pain
  - Brought on by exertion
  - Relieved with rest
- 0 or 1 characteristics = non-cardiac chest pain
- 2 characteristics = atypical chest pain
- 3 characteristics = typical chest pain/angina

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Sex</th>
<th>Typical/Definite Angina Pectoris</th>
<th>Atypical/Probable Angina Pectoris</th>
<th>Nonanginal Chest Pain</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤39</td>
<td>Men</td>
<td>Intermediate</td>
<td>Intermediate</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>Intermediate</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>40-49</td>
<td>Men</td>
<td>High</td>
<td>Intermediate</td>
<td>Intermediate</td>
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<tr>
<td></td>
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<td>Intermediate</td>
<td>Low</td>
<td>Intermediate</td>
</tr>
<tr>
<td>50-59</td>
<td>Men</td>
<td>High</td>
<td>Intermediate</td>
<td>Intermediate</td>
</tr>
<tr>
<td></td>
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<td>Intermediate</td>
<td>Low</td>
<td>Intermediate</td>
</tr>
<tr>
<td>&gt;60</td>
<td>Men</td>
<td>High</td>
<td>Intermediate</td>
<td>Intermediate</td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>Intermediate</td>
<td>Low</td>
<td>Intermediate</td>
</tr>
</tbody>
</table>

### Known IHD (MI, stent, bypass)
1. Aspirin
2. Statins
   - Rosuvastatin - 20-40 mg
   - Atorvastatin - 40-80 mg
3. Beta blockers
   - Not required for all patients
   - Needed if low LVEF (<40% with heart failure) or recent MI
4. Blood pressure control
5. Glucose control
6. Tobacco cessation
7. Regular exercise

### Antianginal drug management
1. Beta blockers
   - Carvedilol - 25 mg bid
   - Metoprolol - 50 mg bid
2. Calcium channel blockers
   - Amlodipine - 10 mg daily
   - Side effects: edema
3. Nitrates
   - Short acting for acute symptoms
   - Long acting, prescribe ONCE daily
     - Goal dose >60 mg
     - Headache common side effect
4. Ranolazine
   - For refractory angina
   - Monitor QT

### Consider antianginals

<table>
<thead>
<tr>
<th>ETT</th>
<th>CTA</th>
<th>MPI</th>
</tr>
</thead>
<tbody>
<tr>
<td>N/A</td>
<td>M</td>
<td>A</td>
</tr>
<tr>
<td>M</td>
<td>M</td>
<td>A</td>
</tr>
<tr>
<td>N/A</td>
<td>M</td>
<td>A</td>
</tr>
</tbody>
</table>

### Known IHD, Symptomatic

### Choosing Wisely
Don't perform cardiac imaging for patients who are at low risk.
Asymptomatic

- **Risk factor modification: recommendations**
  - Physical activity
  - Weight management
  - Tobacco counseling
  - Diet
    - Reduce intake of saturated fat (<7% of total calories)
    - Trans fatty acids (<1% of total calories)
    - Total cholesterol (<200 mg/dL)
    - Limit alcohol consumption
  - Blood pressure control (<140/90 mm Hg)
  - Patients with diabetes: HbA1C <7%

- **IHD medical management**
  - Aspirin
    - 81 mg daily is adequate
  - Statins
    - Rosuvastatin - 20-40 mg daily
    - Atorvastatin - 40-80 mg daily
  - Beta blockers
    - Not required for all patients
    - Needed if low LVEF (<40% with heart failure) or recent MI
  - Blood pressure control
  - Glucose control
  - Tobacco cessation
  - Regular exercise

- **Testing generally not indicated**
- **Assess CV risk**
- **Review medical management**
  - Assess CV risk on the web or your smartphone with the ASCVD Risk Estimator
- **Medications (ASA, statin) if indicated**

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**Choosing Wisely**

- Don't perform stress cardiac imaging or coronary angiography in patients without cardiac symptoms unless high-risk markers are present.
- Don't perform radionuclide imaging as part of routine follow-up in asymptomatic patients.

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Preoperative Assessment

- **Assess exercise capacity**
  - Example METs
    - 3-6 METs
      - Walking >4 mph
      - Bicycling <10 mph
      - Dancing
      - Climbing stairs
      - Yard chores
    - > 6 METs
      - Push mower
      - Running
      - Heavy loads (>20 kg)
      - Aerobics

- **Assess for surgical risk factors**
  - Surgical risk factors
    - Prior MI/CAD
    - Heart failure
    - Diabetes on insulin
    - CKD (Creat >2 mg/dL)
    - Stroke/TIA
  - Medical therapy
    - Control BP
    - Quit smoking
    - Control blood glucose

- **Optimize medical therapy**
  - 4 METs or No risks factors
  - No symptoms <1 year after NL test
  - Unknown METs + RFs
  - Low risk surgery
  - Unknown METs + RFs
  - Intermediate risk surgery
  - Unknown METs + RFs
  - High risk surgery

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Legend: A = appropriate, M = maybe appropriate, R = rarely appropriate, ETT = exercise treadmill test, CTA = computed tomography angiography, MPI = myocardial perfusion imaging

**Suggested Reading:**
Background: Cardiac screening in adults with resting or stress electrocardiography, stress echocardiography, or myocardial perfusion imaging can reveal findings associated with increased risk for coronary heart disease events, but inappropriate cardiac testing of low-risk adults has been identified as an important area of overuse by several professional societies.
What About Symptomatic Patients?

1. Estimate the pretest probability of CAD
   - Based on age, sex and chest pain characteristics
2. Using the pretest probability
   - PPV and NPV depend on pretest probability
3. Stress testing is most useful in patients with an intermediate pretest probability
   - Variably defined as 25-75% or 10-90%
4. Posttest probability
   - Pretest probability, along with the sensitivity and specificity of the test, can be used to determine the posttest probability of CAD
Estimating the pretest probability of CAD

Pre-test probability of CAD (CAD consortium)
Determine pre-test probability of coronary artery disease in patients with chest pain.

Pretest Probability of CAD

ECG: Corrected QT
Exercise Capacity (METs)
Duke Treadmill Score
HCM Risk-SCD
Geriatric-Sensitive Perioperative Cardiac Risk Index | GS Cli
ACC/AHA CV Risk Calculator (2013)
DAPT Score

Please answer all questions

Results
Estimated Positive Predictive Value of Exercise Stress Test

UpToDate® Stress testing for the diagnosis of obstructive coronary heart disease.
Bayes Theorem in Action

Stress testing for the diagnosis of obstructive coronary heart disease.

*UpToDate*® Stress testing for the diagnosis of obstructive coronary heart disease.
Modalities for Ischemic Work-up

- Exercise: treadmill (usually) or recumbent bike
  - With ECG monitoring (ETT)
  - With Imaging
    - Echocardiography (ESE)
    - Myocardial perfusion imaging (SPECT MPI)
- Pharmacological: always with imaging
  - Dobutamine
    - Echocardiography (DSE), MPI, or cardiac MRI
  - Vasodilator Agents (dipyridamole, adenosine, etc.)
    - SPECT MPI
    - PET ± myocardial blood flow quantification
Modalities for Ischemic Work-up

- Coronary CT angiography (CCTA) ± fractional flow reserve (CT-FFR) *
- Coronary calcium score *
  - Free (qualitative) information available in any patient with a chest CT scan – *Look at the images!*
- Coronary angiography *
- Cardiopulmonary exercise stress test *
- Viability *
  - Cardiac MRI (likely best)
  - SPECT MPI
  - Echo

* Not discussed here
Indications for Stress Testing

• Ischemic Work-up
  – Patients without known CAD: Diagnosis of CAD
  – Patients with known CAD:
    • Diagnosis of new of progressive CAD
    • Risk stratification
    • Guiding revascularization

• Select patients with newly diagnosed severe LV systolic dysfunction or wall motion abnormalities *
  ➢ Most should undergo coronary angiography

• Select post-MI patients who were managed medically *

* Best deferred to cardiologist
Indications for Stress Testing

- Assessment of exercise capacity
- Exercise prescription
- Valvular heart disease: Hemodynamic stress test *
- Select patients with specific arrhythmias *
- Assessment of chronotropic competence
- Prior to prescribing class 1C antiarrhythmic drugs *
- Syncope (rarely indicated)
- Pre-operative risk stratification (occasionally indicated)
- Select professions (pilots, CDL, firefighters, etc.)

* Best deferred to cardiologist
### Contraindications to Exercise Stress Test

#### Absolute
- Acute MI (within 3 day)
- Unstable angina
- Unstable arrhythmias
- Unstable hemodynamics
- Acute endocarditis
- Symptomatic severe AS
- Decompensated HF
- Acute pulmonary embolism
- Acute myocarditis / pericarditis
- Acute aortic dissection
- Inability to exercise safely

#### Relative
- Known left main disease
- Moderate-severe AS with uncertain Sx
- Tachyarrhythmias with uncontrolled V-rate
- High-degree AV block
- HOCM with significant resting LVOT obstruction
- Recent stroke / TIA
- Inability to cooperate
- Severe HTN (>200/110 mmHg)
- Uncorrected medical issues
Contraindications to Vasodilators

- Active wheezing / severe bronchospastic disease
- Hypotension (SBP <90 mmHg)
- 2\textsuperscript{nd} or 3\textsuperscript{rd} degree AV block or sinus node dysfunction without a functioning pacemaker
- Unstable or acute coronary syndrome
- Seizures
Contraindications to Dobutamine

- Recent MI (within 3 days)
- Unstable angina
- Sustained or frequent ventricular arrhythmias
- Atrial fibrillation with RVR [or even without…]
- Acute aortic dissection
- Significant LV outflow obstruction
- Severe hypertension (SBP >180 mmHg)
- [Large aortic aneurysm]
Choosing A Stress Test

• Clinical indication / question to be answered
• Can the patient exercise adequately?
  – Walk 5 minutes on flat surface, go up 2 flights of stairs
• Is the resting ECG suitable for ETT?
  – Left bundle branch block
  – Ventricular-paced rhythm
  – LVH with secondary repolarization abnormalities
  – Resting ST-segment depression ≥1 mm
  – Ventricular pre-excitation
  – Digoxin effect on baseline ECG
• Body habitus / lung disease (prior image quality)
Choosing A Stress Test

- Known CAD / prior revascularization
  - In the absence of new symptoms <5 years after CABG or <2 years after PCI, stress testing is rarely appropriate
- Pre-test probability
- Local expertise
- Test performance
  - MPI more sensitive, echocardiography more specific
- Cost
- Potential adverse effects of the test
- Contraindications, including ongoing symptoms
Choosing A Stress Test

• Nearly all patients who are anticipated to exercise to a satisfactory workload should undergo an exercise stress test rather than a pharmacologic stress test.

• Some patients who can exercise may benefit from an imaging modality (MPI or echocardiography)
  – e.g., known CAD / prior revascularization

• Vasodilator MPI tends to be better for patients with:
  – Baseline LBBB or ventricular-paced rhythm
  – Marked LV dyssynchrony
  – Baseline regional wall motion abnormality
  – Atrial fibrillation
Choosing A Stress Test

Can the patient exercise to a satisfactory workload?

Yes

Does the patient have any of the following conditions/requirements?
- LBBB
- V-pacing
- V-pre-excitation
- ≥1 mm resting ST-T abnormalities
- LHV
- On digoxin
- Prior revascularization
- Ischemia localization
- Assessment of viability

Yes

Perform stress imaging
Does the patient have LBBB or V-pacing?

No

Perform the exercise ECG

No

Vasodilator SPECT or PET unless contraindications exist

If so, perform dobutamine SPECT, dobutamine echocardiography, or PET
Use PET if assessment of myocardial viability is needed and PET is available

Yes

Vasodilator stress SPECT or PET unless (+) contraindications to vasodilators or dobutamine echocardiography unless (+) contraindications to dobutamine

No

Does the patient have extensive resting LV wall motion abnormalities?

Yes

Perform vasodilator stress SPECT or PET unless contraindications to vasodilators exist

No

Contraindications

Vasodilators:
- Bronchospastic airway disease, hypotension, sick sinus syndrome, high degree atrioventricular block, and oral dipyridamole therapy (adenosine and A2A receptor agonists contraindicated)
- Theophylline and caffeine should be withheld 48 and 12 hours, respectively

Dobutamines:
- Ventricular arrhythmias, recent myocardial infarction (one to three days), unstable angina, hemodynamically significant left ventricular outflow tract obstruction, aortic dissection, and severe systemic hypertension

UpToDate® Stress testing for the diagnosis of obstructive coronary heart disease.
## Proposed Guidance for Handling Patient with Chest Pain

<table>
<thead>
<tr>
<th>Chest Pain</th>
<th>Troponin</th>
<th>ECG</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Normal</td>
<td>Normal</td>
<td>Stress Test</td>
</tr>
<tr>
<td>+/-</td>
<td>Normal</td>
<td>Abnormal, stable</td>
<td>Stress Test</td>
</tr>
<tr>
<td>+/-</td>
<td>Normal</td>
<td>Abnormal, dynamic</td>
<td>Consult Cardiology</td>
</tr>
<tr>
<td>+/-</td>
<td>Abnormal</td>
<td>+/-</td>
<td>Consult Cardiology</td>
</tr>
</tbody>
</table>
Medications & Stress Test

• ß-Blockers / Calcium-channel blockers

• Methylxanthines
  – Theophylline
  – Caffeine

• Diabetes management
  – A 2-4 hour fast is required
Opportunities for Improving Value

• Stress test referral with no ECG performed
• Stress test referral with uncontrolled HTN
  – For exertional dyspnea!
• Pre-operative risk stratification before low-risk surgery
• Stress test referral when the results do not change management
• Low-risk patients or those with normal ECG referred for nuclear stress test
• Not consulting patient’s cardiologist before ordering stress test
Pre-operative Cardiovascular Risk Stratification
CLINICAL PRACTICE GUIDELINE

2014 ACC/AHA Guideline on Perioperative Cardiovascular Evaluation and Management of Patients Undergoing Noncardiac Surgery

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

Developed in Collaboration With the American College of Surgeons, American Society of Anesthesiologists, American Society of Echocardiography, American Society of Nuclear Cardiology, Heart Rhythm Society, Society for Cardiovascular Angiography and Interventions, Society of Cardiovascular Anesthesiologists, and Society of Vascular Medicine

Endorsed by the Society of Hospital Medicine

Lee A. Fleisher, MD, FACC, FAHA, Chair†
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Barry F. Uretsky, MD, FACC, FAHA, FSCAI
Duminda N. Wijeysundera, MD, PhD,
Evidence Review Committee Chair
"Always make things as simple as possible,… but never more so."

- Albert Einstein
Does this patient need a stress test?

- DS, a 74 y/o M due for revision of R-THA due to prosthesis recall
- PMH
  - CAD w/ h/o acute anterior STEMI in 2002
    - LHC 03/2002
      - LAD occluded proximally, s/p BMS x 2 to proximal & distal LAD
      - LCx: anomalous origin from RCA, patent
      - RCA: 40-50% lesion in mid-vessel
    - ICM w/ LVEF = 15-20%
    - Chronic, stable systolic heart failure, stage C, NYHA class I
    - s/p single chamber ICD in 2010; no shocks ever
    - HTN, Hyperlipidemia, Hypothyroidism – all under excellent control
- He works on his farm and is able to move 50-60 lbs bales of hay for a couple of hours without symptoms:
  "I just can’t do it as fast as I used to."
The Purposes of Pre-Op Evaluation

1) NOT to “get medical clearance”

2) To assess perioperative risk to inform
   a) the decision to proceed
   b) the choice of surgery (or alternative therapies)

3) To determine the need for changes in management
   a) Changes in medical therapy
   b) Need for further cardiovascular tests / interventions
   c) Recommendations for postoperative monitoring

4) To identify cardiovascular conditions or risk factors that require longer-term management
Individualizing Care

• Complexity of managing patients with multiple comorbid conditions

• Guidelines define practices that meet the needs of most, but not all, patients
  
  – Guidelines do not replace clinical judgment

• Clinicians should engage the patient to participate in selecting interventions on the basis of the their values and preferences
  
  – There are circumstances in which deviations from these CPGs are appropriate
The Overarching Theme

• Communication among all parties is key
  – i.e., surgeon, anesthesiologist, consultants, the patient, and the primary caregiver

• To promote patient engagement and facilitate shared decision making
  – Must provide clear, understandable information about perioperative cardiovascular risk in the context of the overall risk of surgery

• Preoperative revascularization (PCI or CABG) is rarely necessary just to get a patient through surgery
  – Only if indicated independent of the need for surgery
Out With the Old…

- **Risk Categories**
  - Low Risk: risk of MACE <1%
  - Elevated Risk: risk of MACE ≥1%
  - “Intermediate Risk” Is No More!

- Order a test only if the result may change patient care
  - *Easier said than done!*

- Guideline-Directed Medical Therapy (GDMT)
  - Consult other Clinical Practice Guidelines (CPG’s)
Urgency of the Procedure
Urgency of the Procedure

- **Emergent**: Life or limb threatened if not in OR in < 6 hr
- **Urgent**: Life or limb threatened if not in OR in 6-24 hr
- **Time-Sensitive**: Delay of >1-6 weeks will negatively affect outcome (Most oncologic procedures)
- **Elective**: Can be delayed for up to 1 year
A validated risk-prediction tool can be useful in predicting the risk of perioperative MACE in patients undergoing noncardiac surgery.

For patients with a low risk of perioperative MACE, further testing is not recommended before the planned operation.
Revised Cardiac Risk Index (RCRI)

• aka. “Lee Criteria”

• Based on 6 risk factors; each worth 1 point:
  – High-risk Surgery
  – Ischemic Heart Disease
  – Heart Failure
  – Stroke or TIA
  – Diabetes (insulin-requiring)
  – Renal insufficiency (serum creatinine >2.0 mg/dL)

• **RCRI < 2 = Low-risk**

• May underestimate risk in major vascular surgery

• *There is an App for that! Calculate by Qx*
RCRI: Procedure-Specific CV Risk

- **Low-risk**
  - Endoscopic Procedures
  - Superficial Procedures
    - Cataract Surgery
    - Breast Surgery
    - Skin Surgery
  - Ambulatory Surgery

- **High-risk**
  - Supra-inguinal Vascular Surgery
  - Intraperitoneal Surgery
  - Intrathoracic Surgery
Other Calculators

- American College of Surgeons’ National Surgical Quality Improvement Program Myocardial Infarction and Cardiac Arrest (MICA)
  - aka. “Gupta Cardiac Risk”
  - Validated in only one center
  - Also available on Qx Calculate

- American College of Surgeons’ National Surgical Quality Improvement Project (ACS NSQIP)
  - Based on CPT codes
  - Cumbersome: 21 patient-specific variables
  - Yet to be validated outside ACS NSQIP database
The 2014 ACC-AHA Guidelines for Perioperative Assessment of CAD

Step 1. Patient scheduled for surgery who is known to have coronary artery disease or risk factors for it:

Emergency surgery?

Yes

Perform clinical risk stratification and proceed to surgery

No

Step 2. Is the patient experiencing acute coronary syndrome?

Yes

Evaluate and treat according to guidelines

No

Step 3. Estimate perioperative risk of major adverse cardiac events based on clinical and surgical factors

Low (< 1%)

Step 4. No further testing (class IIIb recommendation); proceed with surgery

Elevated (≥ 1%)

Step 5. Assess functional capacity

Continued on the next slide...
The 2014 ACC-AHA Guidelines for Perioperative Assessment of CAD, Cont’d

Step 5. Assess functional capacity

Excellent (> 10 METs) or moderate/good (4–10 METs)
No further testing (class IIa recommendation if excellent, class IIb if moderate/good); proceed to surgery

Poor (< 4 METs) or unknown
Step 6. Will further testing affect decision-making or perioperative care?

No
Normal
Step 7. Proceed to surgery according to guidelines or pursue noninvasive treatment or palliation

Yes
Pharmacologic stress testing (class IIa recommendation)
Abnormal
Coronary revascularization according to guidelines (class I recommendation)
What’s New in the Algorithm?

• “Active cardiac conditions” are no more!
  – Unstable coronary syndrome, decompensated heart failure, significant arrhythmias, severe valvular disease
  – Instead, the new version specifically asks about acute coronary syndrome (and recommends GDMT for it)
  – A footnote directs readers to other CPG’s

• Exercise Capacity
  – Moderate to Good (4 -10 METs)
  – Excellent (>10 METs)
  – Both categories proceed to surgery
    • “Excellent” gets a stronger recommendation to proceed
## 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 the toilet?</td>
<td>2.75</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><strong>4. climb a flight of stairs or walk up a hill?</strong></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, or carrying in groceries?</td>
<td>3.50</td>
</tr>
<tr>
<td><strong>8. do heavy work around the house like scrubbing floors or lifting or moving heavy furniture?</strong></td>
<td>8.00</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><strong>11. participate in moderate recreational activities like golf, bowling, dancing, doubles tennis, or throwing a baseball or football?</strong></td>
<td>6.00</td>
</tr>
<tr>
<td>12. participate in strenuous sports like swimming, singles tennis, football, basketball, or skiing?</td>
<td>7.50</td>
</tr>
</tbody>
</table>

Reproduced with permission from Hlatky et al.
What Else Is New?

• What if the patient cannot exercise to at least 4 METs?
  – Would further testing affect care? *(A new consideration!)*
    • If yes, discuss with patient and perioperative team
      – Alternatives to the original planned surgery?
      – Is the patient willing to undergo revascularization?
      – If so, pharmacologic stress testing is recommended
  – Previously, only the RCRI score and the type of surgery (vascular vs. non-vascular) were taken into account
  – The new algorithm also suggests considering alternative strategies, including palliation
Preoperative Cardiac Tests
Before Non-Cardiac Surgery
Class of Recommendations and Levels of Evidence

CLASS I
Benefit >>> Risk
Should Do It

CLASS IIa
Benefit >> Risk
Could Do It

CLASS IIb
Benefit ≥ Risk
May Consider

CLASS III No Benefit or CLASS III Harm
Don’t Do It!

LEVEL A
Multiple populations evaluated*
Data derived from multiple randomized clinical trials or meta-analyses

LEVEL B
Limited populations evaluated*
Data derived from a single randomized trial or nonrandomized studies

LEVEL C
Very limited populations evaluated*
Only consensus opinion of experts, case studies, or standard of care
### The 12-Lead ECG

<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 surgery.</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><strong>Routine</strong> 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>
## Assessment of LV Function

### Recommendations

<table>
<thead>
<tr>
<th>Recommendations</th>
<th>COR</th>
<th>LOE</th>
</tr>
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<tbody>
<tr>
<td>It is reasonable for patients with <strong>dyspnea of unknown origin</strong> to undergo preoperative evaluation of LV function.</td>
<td>IIa</td>
<td>C</td>
</tr>
<tr>
<td>It is reasonable for patients with <strong>HF with worsening dyspnea or other change in clinical status</strong> to undergo preoperative evaluation of LV function.</td>
<td>IIa</td>
<td>C</td>
</tr>
<tr>
<td>Reassessment of LV function in clinically <strong>stable patients</strong> with <strong>previously documented LV dysfunction</strong> may be considered if there has been <strong>no assessment within 1 yr</strong>.</td>
<td>IIb</td>
<td>C</td>
</tr>
<tr>
<td><strong>Routine</strong> preoperative evaluation of LV function is not recommended.</td>
<td>III: No Benefit</td>
<td>B</td>
</tr>
</tbody>
</table>
### Exercise Stress Testing for Myocardial Ischemia and Functional Capacity

#### Recommendations

<table>
<thead>
<tr>
<th>Recommendations</th>
<th>COR</th>
<th>LOE</th>
</tr>
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<tbody>
<tr>
<td>For patients with elevated risk and excellent (&gt;10 METs) functional capacity, it is reasonable to forgo further exercise testing with cardiac imaging and <strong>proceed to surgery</strong>.</td>
<td>Ila</td>
<td>B</td>
</tr>
<tr>
<td>For patients with elevated risk and unknown functional capacity, it may be reasonable to perform exercise testing to assess for functional capacity if it will change management.</td>
<td>IIb</td>
<td>B</td>
</tr>
<tr>
<td>For patients with elevated risk and moderate to good (≥4 METs to 10 METs) functional capacity, it may be reasonable to forgo further exercise testing with cardiac imaging and <strong>proceed to surgery</strong>.</td>
<td>IIb</td>
<td>B</td>
</tr>
</tbody>
</table>

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**Helping Cardiovascular Professionals**

**Learn. Advance. Heal.**
Exercise Stress Testing for Myocardial Ischemia and Functional Capacity

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<tr>
<td>For patients with <strong>elevated risk</strong> and poor (&lt;4 METs) or unknown functional capacity, it may be reasonable to perform exercise testing with cardiac imaging to assess for myocardial ischemia <strong>if it will change management</strong>.</td>
<td>IIb</td>
<td>C</td>
</tr>
<tr>
<td><strong>Routine</strong> screening with noninvasive stress testing is not useful for patients at <strong>low risk</strong> for noncardiac surgery.</td>
<td>III: No Benefit</td>
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Noninvasive Pharmacological Stress Testing Before Noncardiac Surgery

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<tbody>
<tr>
<td>It is reasonable for patients who are at an <strong>elevated risk</strong> for noncardiac surgery and have poor functional capacity (&lt;4 METs) to undergo <strong>noninvasive pharmacological stress testing</strong> (either DSE or pharmacological stress MPI) <strong>if it will change management</strong>.</td>
<td>Ila</td>
<td>B</td>
</tr>
<tr>
<td><strong>Routine</strong> screening with noninvasive stress testing is not useful for patients undergoing <strong>low-risk</strong> noncardiac surgery.</td>
<td>III: No Benefit</td>
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The only two RCTs (CARP and DECREASE V) evaluating prophylactic coronary revascularization before non-cardiac surgery found no difference in either short-term or long-term outcomes.
Back to Our Case
How it was handled… (10/14/2013)

- “Patient is at higher than average risk for the proposed surgery due to medical problems.”
- “Patient accepts the risks of procedure and wishes to proceed with procedure as scheduled.”
- “Pt may proceed with surgery pending completion and review of the following tests and cardiology consultation:”
  - ECG (last ECG on 11/12/2010)
  - CBC with diff, BMP, TSH, U/A
  - Echocardiogram (last study on 05/27/2010)
  - LexiScan SPECT MPI (last study on 07/28/2010)
  - Cardiology consultation
What happened next...

- **SPECT MPI:**
  - Enlarged left ventricle with marked global hypokinesis
  - Large, fixed left ventricular perfusion defects
  - Ischemia in LCx territory

- **LHC:**
  - LM: 20-30%
  - LAD: 40-50% proximal ISR, 50% mid lesion
  - LCx: 90% ostial OM1 lesion
  - RCA: 80% lesion at the crux

- **CABG x 3:** LIMA>>LAD, SVG>>OM, SVG>>R-PDA + LV lead

- Post-Op A. Fib, s/p TEE-guided DCCV, started on warfarin
- Cardiogenic shock, refractory to vasopressors
- Transferred to OSF for LVAD on 11/08/2013
What happened next...

- CentriMag extracorporeal VAD
  - Post-Op CVA
  - VAD thrombosis
  - VAD was removed, drive lines clamped & left in pace

- Returned to Carle on 11/19/2013, moribund
  - DC’d to SNF on BB & ACE-I in stable condition 01/09/2014
  - Made remarkable recovery in rehab

- Drive lines removed at BJH in April 2014

- Re-hospitalized on 05/19/2014 with weakness and INR = 5.8
  - AMS after admission; subdural hematoma on head CT
  - Passed away on 05/22/2014
“Medicine is an art of uncertainty and a science of probability.”

- Sir William Osler