Potpourri

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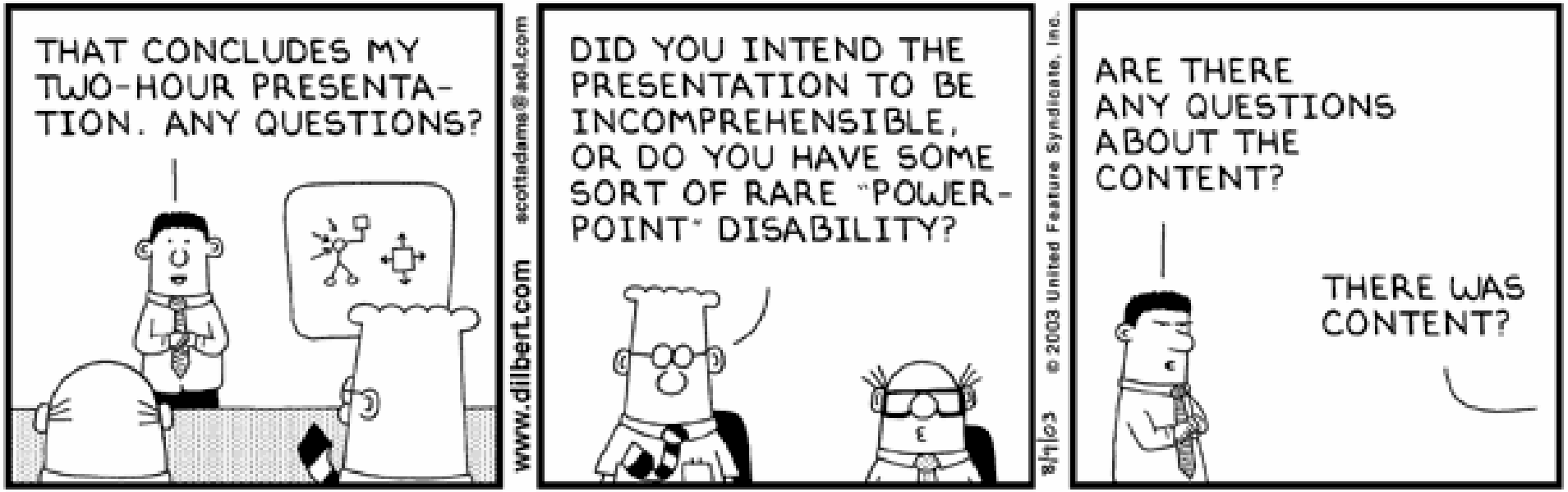


Agenda

- *Isn't this just recycled stuff??*

- An interesting Case/Echo
- A quick review of Stress testing
- Board review questions

Case Presentation

- 88 yo WM
- Hx of Bovine aortic valve prosthesis 1980's
- Hx of unspecified endocarditis
- Admitted with fever, confusion
- Transferred to ICU with respiratory distress, lethargic
- Baseline CRF → worsening
- Blood cultures + Staph Aureus (MRSA)

Vegetation characteristics

- Large vegetation (>10mm) has 3 times risk of embolization compared to small ones[1]
- Prolapsing vegetations or extravalvular involvement carries higher risk of heart failure, brain embolization, need for valve replacement[2]
- However, poor interobserver reproducibility of these characteristics

[1]Tischler M, Vaitkus P. The ability of vegetation size on echocardiography to predict complications: a meta-analysis. J Amer Soc Echo 1997; 10:562-8.
[2]Sanfillipo A, Picard M, Newell J, et al. Echocardiographic assessment of patients with infectious endocarditis: prediction of risk for complication. J Am Coll Cardiol 1991; 18:1191-9.

Valvular location

- Small series show 26% mortality of aortic location vs. 16% with mitral location
- Aortic valve endocarditis more resistant to antibiotic therapy, more likely to need surgery
- Mitral valve endocarditis, especially anterior leaflet, has highest incidence of embolization

Sachdev, 189-190

Anticoagulation and Endocarditis

somewhat controversial

- Anticoagulation not indicated in native valve endocarditis
- In prosthetic valve endocarditis due to *Staph Aureus,* it may be beneficial to stop anticoagulation during the acute phase
- Aspirin therapy does not reduce embolic complications, and may increase bleeding

Chan KL, Dumesnil JG, Cujec B et al. A randomized trial of aspirin on the risk of embolic events in patients with infective endocarditis. J Am Coll Cardiol. 2003 Sep 3;42(5):775-80
Sexton, 280

Indications for Surgery

- Heart failure refractory to medical treatment
  - NYHA class 3-4 due to endocarditis
  - Caused by aortic or mitral regurgitation (acute or subacute)
- Prosthetic valve endocarditis (most cases)
  - Medical management may suffice if
    - Late onset infection (>12 months after prosthesis)
    - Low virulence organism (viridians step, HACEK, enterococci)
    - No evidence of invasive infection
- Local invasive complications
  - Periannular extension, abscess, mycotic aneurysm, pseudoaneurysm, fistula
  - Heart block may herald local extension

Cabell, 151
Olaison 242-247

Indications for Surgery

- 2 or more Major embolic events
  - A recent stroke presents higher operative risk (CVA extension)
  - Prefer to perform surgery at least 10-14 days after CVA
- Major valve dysfunction
  - Valve obstruction
  - Regurgitation
  - Leaflet perforation
- Resistance to antibiotic therapy
  - Persistent bacteremia after 7 days of antibiotics
  - Exclude extracardiac foci of infection
  - Recurrent fever is common, not necessarily an indication of antibiotic failure

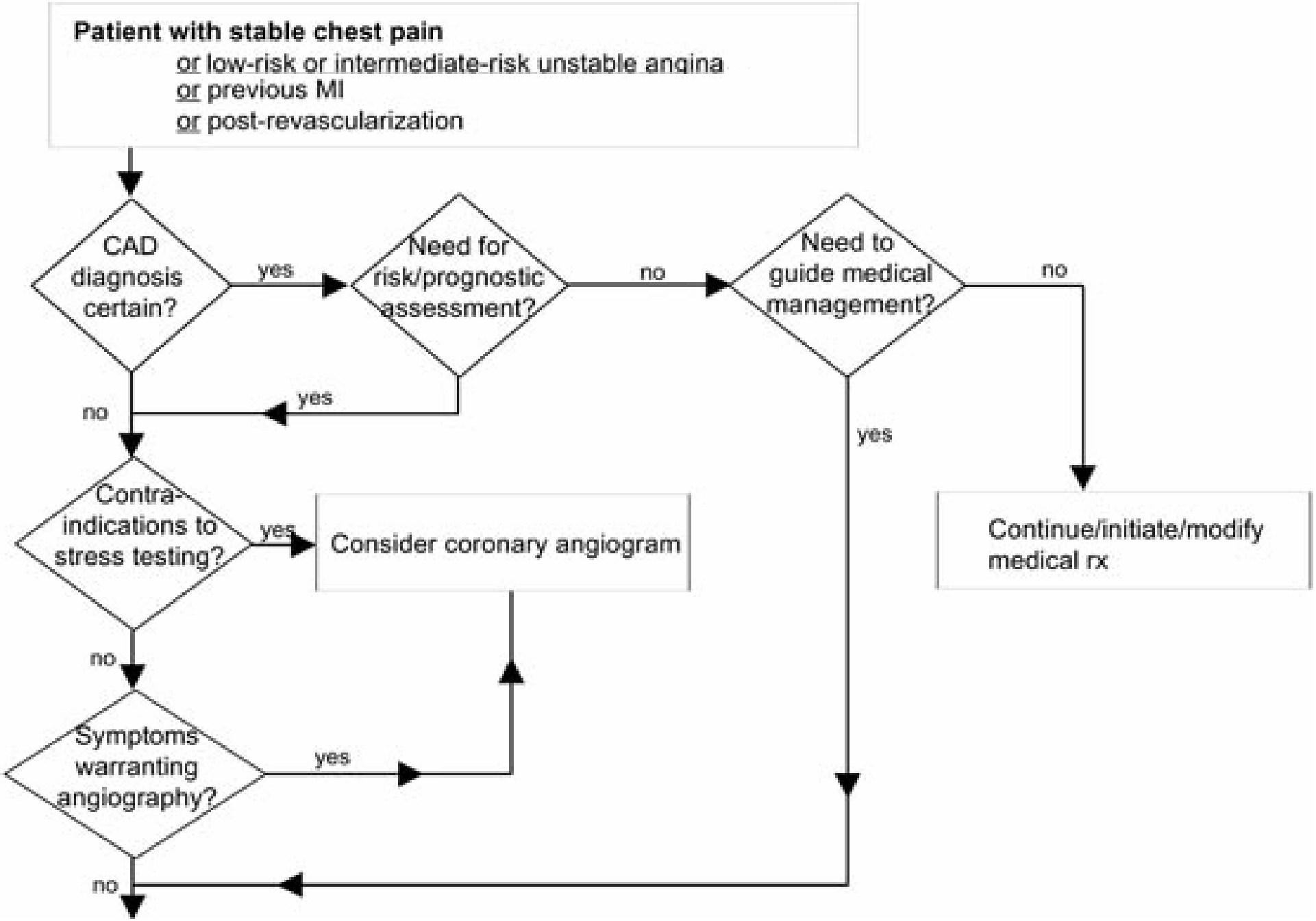
Olaison 242-247
Sexton 276-277

On to Stress testing….

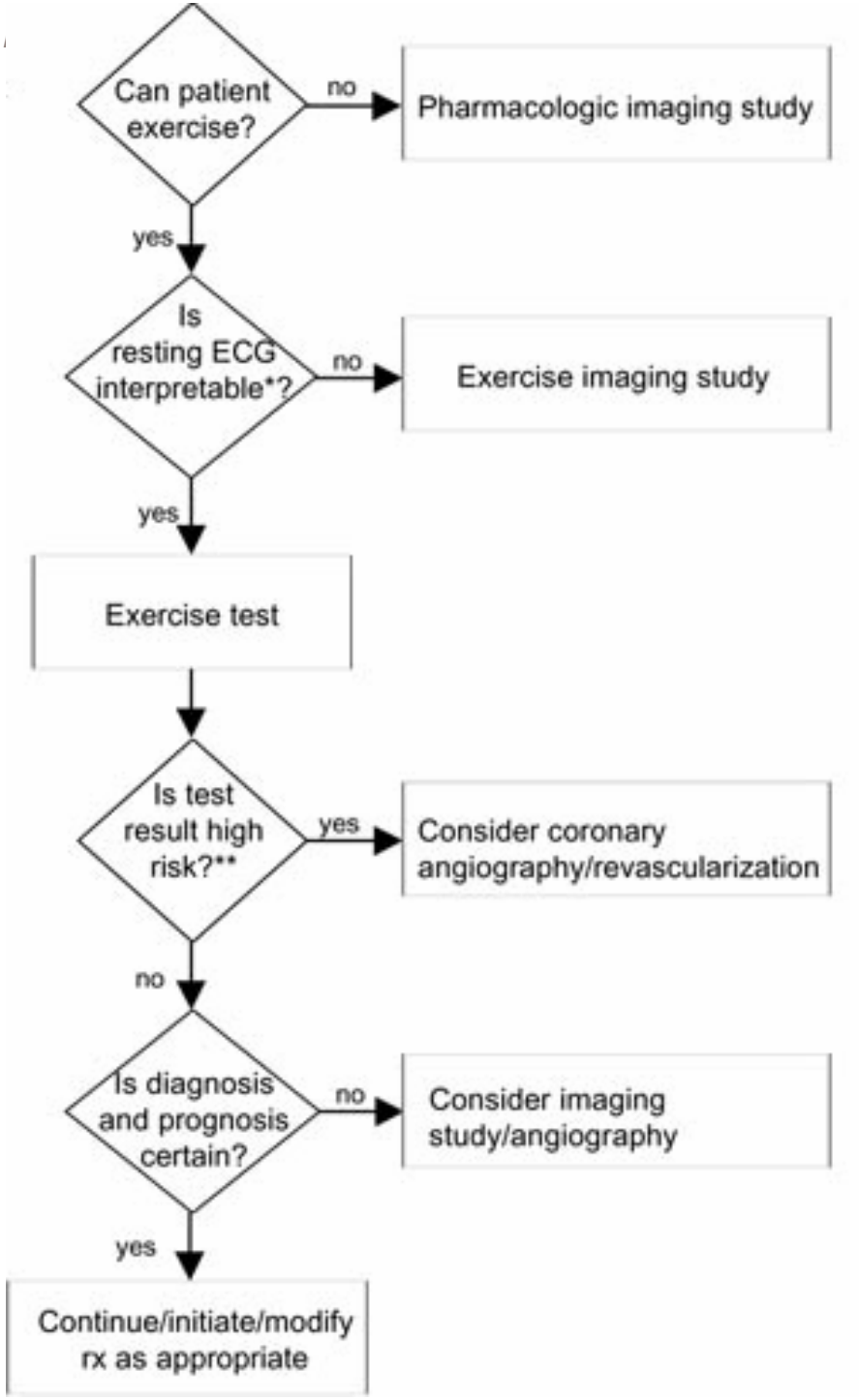
Who Needs a Stress Test?

- What can cardiac catheterization and revascularization achieve?
  - Main benefit is symptomatic relief*
- USPSTF recommends AGAINST routine screening in asymptomatic, low risk patients
- Stress testing should be employed in symptomatic patients
  - May be used for patients in certain occupations such as pilots, heavy equipment operators, etc. based on clinical risk factors

*ACS, 3VD, Left Main disease derive mortality benefit


Patient with stable chest pain
or low-risk or intermediate-risk unstable angina
or previous MI
or post-revascularization
CAD diagnosis certain?
yes
Need for risk/prognostic assessment?
no
Need to guide medical management?
no
yes
no
yes
Contra-indications to stress testing?
yes
Consider coronary angiogram
Continue/initiate/modify medical rx
no
Symptoms warranting angiography?
yes
no

ACC 2002



ACC 2002

ACC Indication Classification

- **Class I:** Conditions for which there is evidence and/or general agreement that a given procedure or treatment is useful and effective.
- **Class II:** Conditions for which there is conflicting evidence and/or a divergence of opinion about the usefulness/efficacy of a procedure or treatment.
  - **Class IIa:** Weight of evidence/opinion is in favor of usefulness/efficacy.
  - **Class IIb:** Usefulness/efficacy is less well established by evidence/opinion.
- **Class III:** Conditions for which there is evidence and/or general agreement that the procedure/treatment is not useful/effective and in some cases may be harmful.

Indications for Exercise Stress Testing (Diagnosis of CAD)

- **Class I**
  - Adult patients (including those with complete right bundle-branch block or less than 1 mm of resting ST depression) with an intermediate pretest probability of CAD on the basis of gender, age, and symptoms (specific exceptions are noted under Classes II and III below).
- **Class IIa**
  - Patients with vasospastic angina.
- **Class IIb**
  - High pretest probability of CAD by age, symptoms, and gender.
  - Low pretest probability of CAD by age, symptoms, and gender.
  - Patients with less than 1 mm of baseline ST depression and taking digoxin.
  - Patients with electrocardiographic criteria for left ventricular hypertrophy (LVH) and less than 1 mm of baseline ST depression.

Risk Assessment and Prognosis in Patients with history or symptoms of CAD

Class I

1. Patients undergoing initial evaluation with suspected or known CAD, including those with complete right bundle-branch block or less than 1 mm of resting ST depression.
2. Patients with suspected or known CAD presenting with significant change in clinical status.
3. Low-risk unstable angina patients 8 to 12 hours after presentation without active ischemic or heart failure symptoms.
4. Intermediate-risk unstable angina patients 2 to 3 days after presentation without active ischemic or heart failure symptoms.

Class IIa

Intermediate-risk unstable angina patients with normal cardiac markers at 6-12 hours and repeat ECG without significant changes.

Class IIb

1. Patients with the following resting ECG abnormalities:
- Pre-excitation (Wolff-Parkinson-White) syndrome
- Electronically paced ventricular rhythm
- 1 mm or more of resting ST depression
- Complete left bundle-branch block or QRS duration greater than 120 ms.

2. Patients with a stable clinical course who undergo periodic monitoring to guide treatment.

Adapted from ACC 2002

Indications for Asymptomatic Patients

Class I - None

Class IIa

1. **Evaluation of asymptomatic persons with diabetes mellitus who plan to start vigorous exercise.**

Class IIb

1. **Evaluation of pt with multiple risk factors as a guide to risk-reduction therapy.**
2. **Evaluation of asymptomatic men older than 45 and women older than 55:**
   - **Who plan to start vigorous exercise (especially if sedentary) or**
   - **Who are involved in occupations in which impairment might impact public safety or**
   - **Who are at high risk for CAD due to other diseases (e.g., peripheral vascular disease and chronic renal failure)**

Adapted from ACC 2002

Non-indications for Exercise Stress Testing (Class III)

- Patients with the following baseline ECG abnormalities:
  - Pre-excitation (Wolff-Parkinson-White) syndrome
  - Electronically paced ventricular rhythm
  - Greater than 1 mm of resting ST depression
  - Complete left bundle-branch block
- Patients with known CAD or prior MI; however, ischemia and risk can be determined by testing
- Patients with severe comorbidity likely to limit life expectancy and/or candidacy for revascularization.
- High-risk unstable angina patients
- Routine screening of asymptomatic men or women.

TABLE 10G–4 ACC/AHA Guidelines for Exercise Testing to Diagnose Obstructive Coronary Artery Disease

	Indication
Class I (indicated)	Adult patients (including those with complete right bundle branch block or less than 1 mm of resting ST depression) with an intermediate pretest probability of CAD on the basis of gender, age, and symptoms (specific exceptions are noted under Classes II and III below).
Class IIa (good supportive evidence)	Patients with vasospastic angina.
Class IIb (weak supportive evidence)	1. Patients with a high pretest probability of CAD by age, symptoms, and gender. 2. Patients with a low pretest probability of CAD by age, symptoms, and gender. 3. Patients with less than 1 mm of baseline ST depression and taking digoxin. 4. Patients with electrocardiographic criteria for left ventricular hypertrophy and less than 1 mm of baseline ST depression.
Class III (not indicated)	1. Patients with the following baseline ECG abnormalities: • Preexcitation (Wolff-Parkinson-White) syndrome • Electronically paced ventricular rhythm • Greater than 1 mm of resting ST depression • Complete left bundle branch block 2. Patients with a documented myocardial infarction or prior coronary angiography demonstrating significant disease who have an established diagnosis of CAD; however, ischemia and risk can be determined by testing.

CAD = coronary artery disease.

TABLE 10G–11 ACC/AHA Guidelines for Exercise Testing Before and After Revascularization

	Indication
Class I (indicated)	1. Demonstration of ischemia before revascularization. 2. Evaluation of patients with recurrent symptoms that suggest ischemia after revascularization.
Class IIa (good supportive evidence)	After discharge for activity counseling and/or exercise training as part of cardiac rehabilitation in patients who have undergone coronary revascularization.
Class IIb (weak supportive evidence)	1. Detection of restenosis in selected, high-risk asymptomatic patients within the first 12 months after percutaneous coronary intervention. 2. Periodic monitoring of selected, high-risk asymptomatic patients for restenosis, graft occlusion, incomplete coronary revascularization, or disease progression.
Class III (not indicated)	1. Localization of ischemia for determining the site of intervention. 2. Routine, periodic monitoring of asymptomatic patients after percutaneous coronary intervention or coronary artery bypass grafting without specific indications.

Summary of Indications

- Initial evaluation of suspected or known CAD
- Symptomatic patients with Intermediate likelihood of CAD
- Low-Medium risk Unstable Angina with negative EKG and cardiac enzymes
- Asymptomatic Diabetics starting vigorous exercise (2A)
- Asymptomatic Men >45, Women >55 in high risk occupation or starting vigorous exercise (2B)

TABLE 13G–1 American College of Cardiology/American Heart Association/American Society of Nuclear Cardiology Guidelines for the Clinical Use of Cardiac Radionuclide Imaging*

Indication	Class I (Indicated)	Class IIa (Good Supportive Evidence)	Class IIb (Weak Supportive Evidence)	Class III (Not Indicated)
Diagnosis of STE acute myocardial infarction		Right ventricular infarction Infarction not diagnosed by standard means–late presentation		Routine diagnosis with ischemia/necrosis already documented clinically
Risk assessment, prognosis, and assessment of therapy after STE acute myocardial infarction	Rest RV/LV function Presence/extent of stress-induced ischemia Detection of infarct size and residual viable myocardium			
Diagnosis, prognosis, and assessment of therapy in patients with unstable angina/NSTEMI	Identification of ischemia in the distribution of the culprit lesion or in remote areas Measurement of baseline LV function Identification of the severity/extent of disease in patients whose angina is satisfactorily stabilized with medical therapy	Identification of the severity/extent of disease in patients with ongoing ischemia but nondiagnostic ECG	Diagnosis of myocardial ischemia in patients when the combination of history and ECG changes is unreliable	
Suspected ACS in the emergency department with nondiagnostic ECG and initial biomarkers	Assessment of risk with rest MPI Stress MPI for diagnosis of CAD after negative biomarkers or normal rest MPI			
Diagnosis of chronic ischemic heart disease	Diagnosis of symptomatic and selected patients with asymptomatic myocardial ischemia Assessment of ventricular performance (rest or exercise) Planning PTCA–identifying lesions causing myocardial ischemia, if not otherwise known Risk stratification before noncardiac surgery in select patients			Screening of asymptomatic patients with low likelihood of disease

	1	2A	2B	3
Assessment of severity/prognosis/ risk stratification of chronic ischemic heart disease	Assessment of LV performance Identification of extent and severity of ischemia and localization of ischemia† Risk stratification in patients with an intermediate risk Duke Treadmill Score Assessment of functional significance of intermediate coronary stenosis	MPI as the initial test in patients with diabetes or with >20% 10-yr CHD risk	Redefining risk 1–3 yr after initial MPI in patients with stable symptoms	
Assessment of interventions in chronic ischemic heart disease	Assessment for restenosis after PCI (symptomatic) Assessment of ischemia in symptomatic patients after CABG	Assessment 3–5 yr after CABG or PCI in select, high-risk asymptomatic patients	Assessment of drug therapy for myocardial perfusion	Routine assessment of asymptomatic patients after PTCA or CABG
Heart failure	Determination of initial LV and RV performance in heart failure Initial evaluation of LV function in patients receiving chemotherapy with doxorubicin Assessment of myocardial viability in patients with CAD and LV dysfunction without angina	Assessment of the co-presence of CAD in patients without angina	Routine serial assessment of LV and RV function Detection of myocarditis Diagnosis of CAD in hypertrophic cardiomyopathy	
After cardiac transplantation	Assessment of ventricular performance		Detection and assessment of coronary angiopathy	
Valvular heart disease	Initial and serial assessment of LV and RV function		Detection and assessment of function significance of concomitant coronary artery disease	

*Table represents a compilation of recommendations from the 1995 and 2003 guidelines.

†Exercise MPI in patients with baseline ECG abnormalities, vasodilator pharmacologic stress MPI in patients who cannot exercise adequately or who have LBBB or paced rhythm.

ACS = acute coronary syndrome; CABG = coronary artery bypass graft; CAD = coronary artery disease; CHD = coronary heart disease; ECG = electrocardiographic; LBBB = left bundle branch block; LV = left ventricular; MPI = myocardial perfusion imaging; NSTEMI = non-ST segment elevation myocardial infarction; PCI = percutaneous coronary intervention; PTCA = percutaneous transluminal coronary angioplasty; RV = right ventricular; STE = ST segment elevation.

Exercise EKG

The basic “stress test”

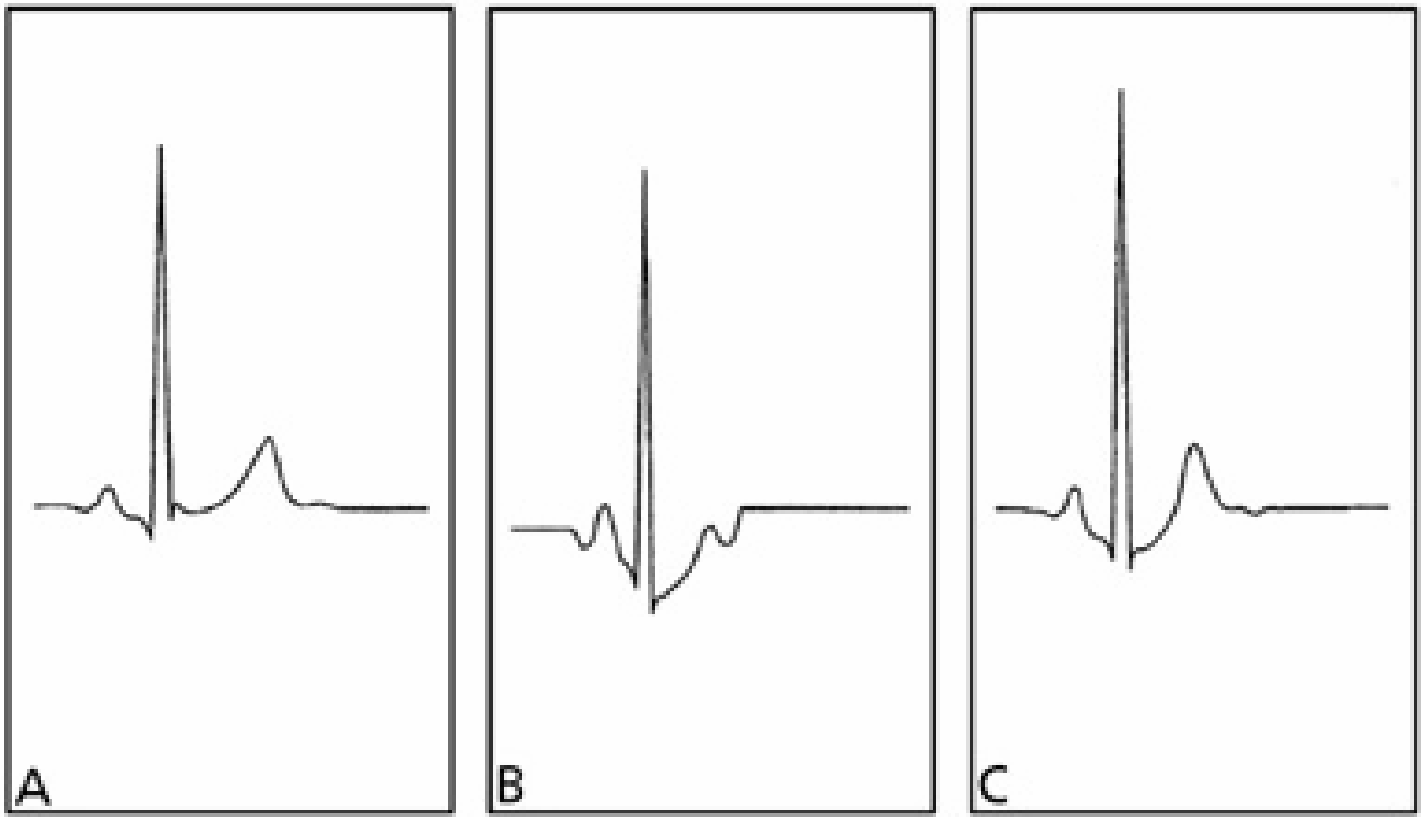
- Patient exercises on treadmill or bicycle
  - Bruce protocol common for treadmill
    - Start at 1.7 mph at 10% grade
    - Increase about 0.8 mph and 2% every 3 minutes
- EKG monitoring performed throughout
- Patient must achieve 85% of maximum predicted HR for valid results
  - Max HR = 220 - Age

Positive EKG Stress

- PQ segment used as reference baseline
- Identify J point as junction of QRS complex and ST segment
- Measure ST changes 60-80 ms after J point
- ≥0.1mm of ST depression that is horizontal or downsloping
- 0.1mm ST depression with upsloping may be equivocal

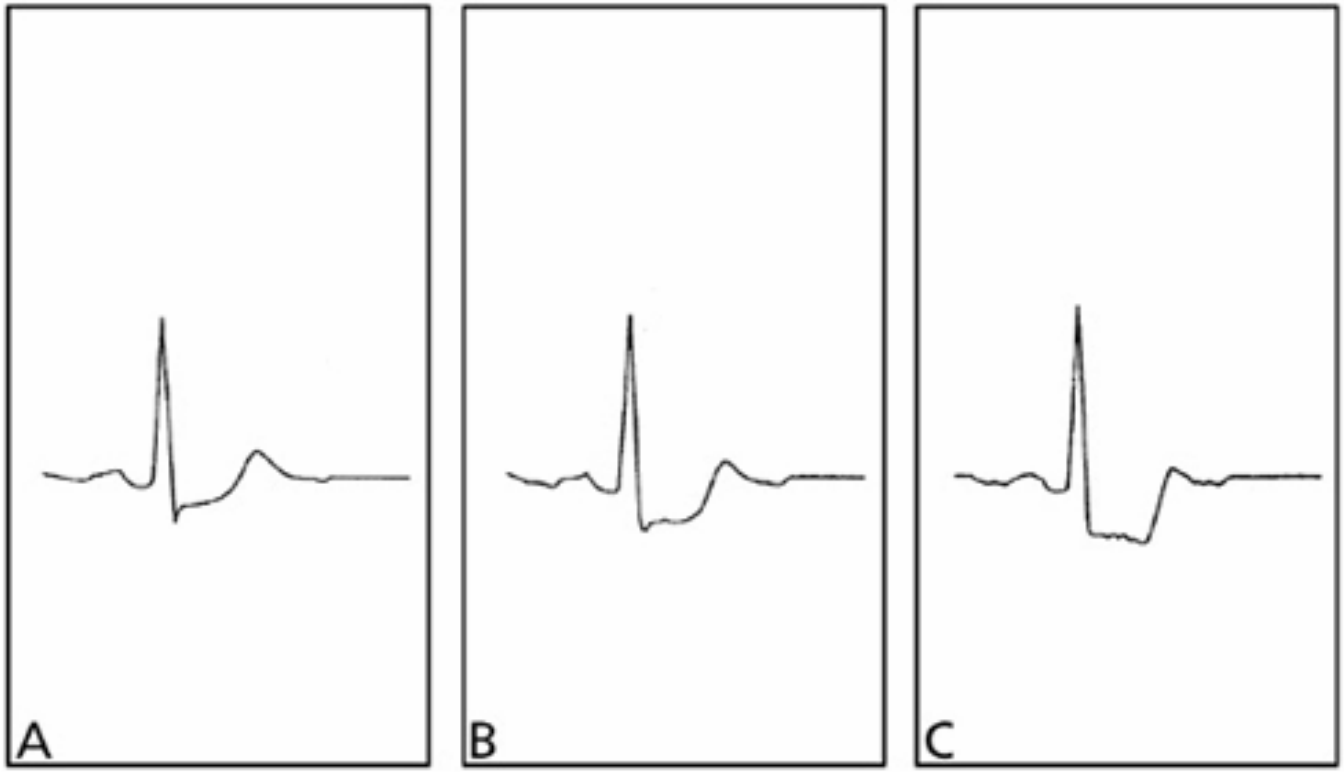
Topol
ACC 2002

Healthy Subject EKG Progression



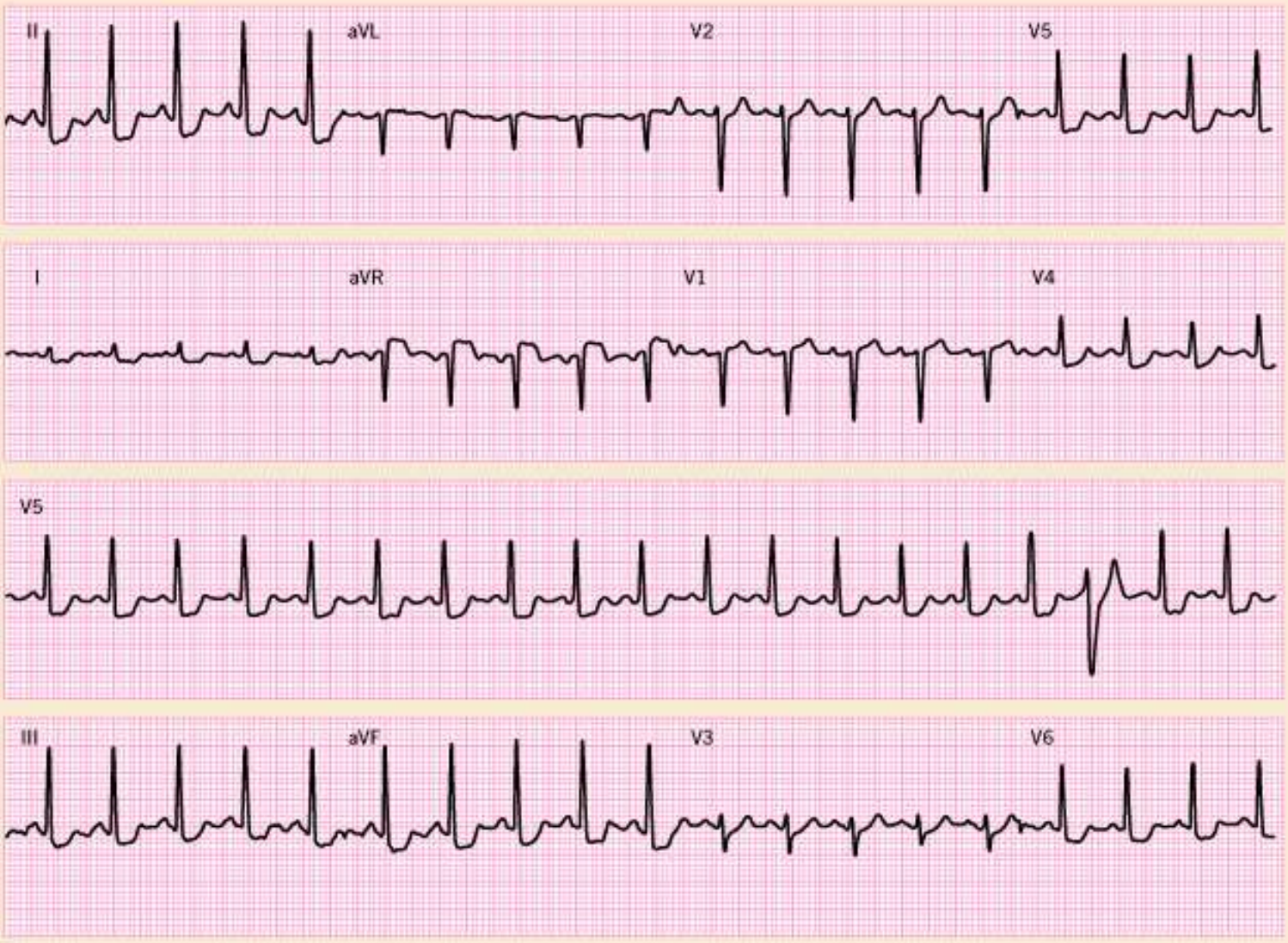
- A = Pre-test
- B = Maximal Stress with J point depression and ST upsloping
- C = Recovery

Comparison of ST segment response



- A = Slowly Upsloping ST segment depression
- B = Horizontal ST segment depression
- C = ST depression with downsloping

ABNORMAL EXERCISE ECG WITH MARKED HORIZONTAL ST-SEGMENT DEPRESSION



DiMarco

Duke Treadmill Score for Prognosis

- Exercise time (minutes) – 5 x (ST change in mm) – 4 x (angina index) [0=no angina, 1=nonlimiting angina, 2=angina stops test]
- <= -11 = high risk, >5% annual CV mortality
- >=5 = low risk, <0.5% annual CV mortality

Absolute Contraindications for Exercise

- Acute myocardial infarction in past 2 days
- Unstable angina not addressed by medical therapy
- Uncontrolled, significant arrythmia
- Symptomatic severe aortic stenosis
- Uncontrolled CHF
- Acute PE
- Acute myocarditis or pericarditis
- Acute aortic dissection

Relative Contraindications for Exercise

- Significant left main coronary disease
- Moderate valvular stenosis
- Electrolyte abnormalities
- Severe hypertension (SBP >200 or DBP >110)
- HOCM
- High degree AV block
- Pt inability or refusal to exercise

Patients who should not have EKG only

- These lead to uninterpretable EKG or have high rate of false positives
  - Left Bundle Branch Block
  - Wolf-Parkinson-White (Ventricular pre-excitation)
  - Left Ventricular hypertrophy with strain
  - Ventricular pacing
  - Digoxin use

Exercise EKG

- 1 in 2500 risk of death or MI[1]
- Sensitivity about 68%, Specificity about 77%[2] (using 50% stenosis by cath as gold standard)
- Functional capacity assessed by METS
- BP expected to rise with exercise
- Poor heart rate recovery (HR decrease <12bpm 2 minutes after peak exercise) has negative prognosis
- Location of ST depressions does not anatomically localize coronary lesions

1 DiMarco
2 Gianrossi

Exercise testing in Females

- Increased incidence of false positives compared to males[1]
  - CASS data shows sensitivity similar for women (76%) and men (78%)
  - However, specificity for women (64%) lower than for men (73%)
- Functional information is important
  - Females achieving 7.5 METS have same 20 year mortality prognosis with or without ST depression[2]

1 Wiener
2 Mora

Costs of Testing

	2000 Medicare Total Relative Value Units	1998 Medicare # performed
Treadmill Exercise Test	3.12	533,000
Stress Echocardiography	6.16 (+ doppler charge)	353,942
Stress SPECT myocardial perfusion imaging	17.79 (+ isotope charge)	1,362,210
LHC with left Ventriculography and coronary angiography	65.58	901,625

Sensitivity of Noninvasive testing

	Sensitivity	Specificity
Stress EKG	68%	77%
Stress Echo	81%	92%
Nuclear	88%	90%

Pre Test Probability

Table 4. Pretest Probability of Coronary Artery Disease by Age, Gender, and Symptoms*

Age (y)	Gender	Typical/Definite Angina Pectoris	Atypical/Probable Angina Pectoris	Nonanginal Chest Pain	Asymptomatic
30–39	Men	Intermediate	Intermediate	Low	Very low
	Women	Intermediate	Very low	Very low	Very low
40–49	Men	High	Intermediate	Intermediate	Low
	Women	Intermediate	Low	Very low	Very low
50–59	Men	High	Intermediate	Intermediate	Low
	Women	Intermediate	Intermediate	Low	Very low
60–69	Men	High	Intermediate	Intermediate	Low
	Women	High	Intermediate	Intermediate	Low

*No data exist for patients <30 or >69 years, but it can be assumed that prevalence of CAD increases with age. In a few cases, patients with ages at the extremes of the decades listed may have probabilities slightly outside the high or low range. High indicates >90%; intermediate, 10%–90%; low, <10%; and very low, <5%.

ACC 2002

Electron Beam CT

- Not a stress test
- Noninvasive evaluation of coronary calcification
- ACC 2000 guidelines essentially do not recommend use of EBCT
- USPSTF recommends against using EBCT to screen asymptomatic patients
- Probably best employed in asymptomatic patients – but studies not conclusive on indications or long term prognosis

J Am Coll Cardiol 2000;36:326-40

On to Board Review….

An 82-year-old man with sinus node dysfunction and a transvenous pacemaker was admitted with anorexia, fever, and weakness. He was admitted 3 months earlier with the same complaints and multiple blood cultures were positive for enterococcus faecalis. The blood was sterilized with a 6-week course of intravenous antibiotics.

On examination, he is frail with poor muscle mass, pleasant and cooperative, but clearly mildly demented. The neck veins are mildly dilated and JVP estimated at 7-8cm. There is no cardiomegaly to palpation, with normal heart sounds. There is a Grade 2 ejection murmur at the apex, left sternal border, and base without respiratory variation. There are no abnormalities on pulmonary examination. There is no hepatomegaly. Hematocrit, 31; WBC, 12,500; Albumin, 2.8. ECG: NSR with NSST changes; voltage for LVH.

Echocardiogram (including TEE): Chamber size normal as is ejection fraction, with mild MR. Right ventricle was minimally dilated with moderately severe TR with probable torn chords of the septal leaflet. The pacemaker wire seems "attached" to the tricuspid valve with possible vegetations. Pulmonary systolic pressure was estimated at 30-35ml.

Which management strategy is preferred?

A. Reinstitute intravenous antibiotics for another 6-week course.

B. Reinstitute intravenous antibiotics and switch to oral antibiotics (on the basis of sensitivities) and treat indefinitely.

C. Reinstitute intravenous antibiotics and proceed to open heart surgery to extract the pacemaker lead and correct tricuspid regurgitation.

D. Reinstitute intravenous antibiotic therapy and use a laser extraction technique.

E. Reinstitute intravenous antibiotics and extract lead using conventional mechanical techniques.

The correct answer is D.

The preferred management strategy is option D, a laser extraction technique after the infection is controlled with antibiotics. Although a very large observational experience with other extraction techniques (extraction of 3,540 leads in 2,338 patients) demonstrated a very high success rate (complete removal in 93% of leads) and a low complication rate (1.4% of major complication, and 1.7% minor), a randomized trial in 301 patients with 465 chronically implanted leads comparing 12-F Excimer Laser sheaths demonstrated a strikingly better lead removal rate (94% in the laser group compared with the nonlaser group (64%). Potential life-threatening complications occurred in none of the nonlaser-treated patients but in three of the laser-treated patients, including one death. A variety of factors have been related to successful lead removal including physician experience and duration of the implant (increasing success with duration the lead has been in place and possibly less success with endocarditis). Endocarditis is an indication for lead removal in less than 5% of explanted leads.

It is very unlikely another course of antibiotics would cure this patient's endocarditis and, although chronic indefinite use of oral antibiotics may be effective in this elderly man, such a course would provide its own set of complications and problems. To submit this elderly, frail, somewhat demented patient to open heart surgery would provide substantial risk including mortality and should be avoided if at all possible. Although substantial tricuspid regurgitation is present, it can be assumed that such will be well tolerated chronically since pulmonary hypertension is not present and this patient has limited life expectancy. The risks of open-heart surgery for worsening the patient's dementia are quite substantial and constitute a relatively strong contraindication for that approach. As noted, surgical treatment of the TR should not be necessary.

A patient with staphylococcal septicemia develops acute aortic regurgitation with severe heart failure. What is the best choice of treatment?

A. Antibiotics for 6 weeks and medical treatment of shock and heart failure.

B. Three weeks of antibiotics plus medical treatment of shock and heart failure with aortic valve replacement in 3 weeks.

C. Antibiotics for 1 week plus medical treatment of heart failure, followed by aortic valve replacement in 1 week.

D. Antibiotics immediately and emergency aortic valve replacement that day.

E. Intravenous nitroprusside plus antibiotics with the surgical decision to be made once the patient is stable.

The correct answer is D.

The timing of aortic valve replacement in aortic regurgitation is determined by the patient's symptoms or clinical state and left ventricular function. In this patient with severe congestive heart failure, it is imperative to stop the aortic regurgitation immediately because the regurgitant volume is too excessive to permit survival. Intravenous vasodilator therapy may be helpful in temporarily reducing afterload and the regurgitation, but it will not unload the major part of the regurgitant volume.

Staphylococcal endocarditis causes severe destruction to the valve and frequently leads to abscess formation around the valve. Ideally, an infection should be controlled before surgery, but in staphylococcal endocarditis, the destruction of valve tissue usually progresses at such a rapid rate that antibiotic treatment cannot prevent worsening of the regurgitation or abscess formation. Antibiotics should be started immediately and continued after surgery, but in the presence of congestive heart failure and shock due to acute severe aortic regurgitation, the valve must be replaced immediately.

A 45-year-old male with a history of diabetes mellitus comes to the emergency department with a 2-day history of intermittent chest pain at rest that became worse 1 hour before arrival. His initial ECG was normal, and his initial CK, CK-MB, and troponin T values were all normal.

Which of the following is the appropriate assessment and next step?

A. He is low risk, and may be sent home with appropriate follow-up.

B. He is at high risk based on duration of his symptoms, and he should be admitted.

C. His diabetes places him at high risk, and he should be admitted and have early angiography.

D. His risk is uncertain, and he should have repeat ECG and cardiac biomarker determination in 4-8 hours.

E. His risk is uncertain, and he should have an echocardiogram or resting Sestimibi study in the emergency department to help decide whether to send him home.

The correct answer is D.

Because it may take 4-6 hours for CK-MB and troponin levels to become elevated following an ischemic episode, a patient may be at high risk even if the initial values are normal. Therefore, biomarkers should be re-evaluated 6-12 hours after symptoms, or 4-8 hours after presentation, to assure that an elevation is not missed. Patients with elevated troponin, even with T-wave inversion only or a normal ECG, are at high risk, with a 4% risk of 30-day death. Longer duration of episodes of pain is more likely to represent myocardial infarction, although anginal symptoms prior to the episode leading to presentation have had an inconsistent relationship with outcome. Studies have shown that very early use of echocardiography or radionuclide perfusion imaging in the emergency department has been promising for differentiating acute ischemia. However, there is insufficient information to recommend their use in routine practice. Stress testing generally should not be performed until cardiac markers are negative after 6-8 hours of observation.

Which of the following statements about early risk stratification is **not** true?

A. Appropriate care cannot be delivered without risk stratification.

B. Age is the most important demographic factor in predicting risk of death.

C. ST-segment shift and positive cardiac biochemical markers have been consistently found to predict risk in large acute coronary syndrome populations.

D. stress testing should be performed in most patients with acute coronary syndromes to help in risk stratification.

E. Low ejection fraction is an important determinant of risk and should generally prompt cardiac catheterization.

The correct answer is D.

Stress testing is recommended for patients at low risk, and it is one of two acceptable approaches to risk stratification for patients at intermediate risk, who may be managed with an early invasive or early conservative strategy. The other statements are all true. Early risk stratification is essential for decisions about level of care and treatments. Age is the most important single factor in determining risk. ST-segment shift and positive markers are consistent and important factors. Low ejection fraction is likewise a consistent and important risk factor and is one of the criteria that should generally prompt cardiac catheterization.

A 39-year-old woman with a family history of CAD (father had MI at age 61) presents complaining of palpitations and shortness of breath with intermittent chest tightness. She notes this when emotionally stressed but with no particular association to exertional activity. Her primary care physician performed a standard ETT. She went 11 minutes (12 METS) and complained of sharp left-sided chest pain during peak exercise. There were no ECG changes. She thought that her chest pain was similar but not exactly the same as that which prompted her to seek medical attention. Her primary care physician feels she should have further evaluation. She is thus referred to you. You find no abnormalities on physical exam.

Which of the following should be performed?

A. No further workup is needed.

B. Proceed with ETT-Thallium.

C. Proceed with coronary angiography.

D. Proceed with stress echo.

E. Recommend Ultrafast CT

The correct answer is A.

The pretest probability of coronary artery disease is very low in this patient, in that her symptoms are atypical, she is premenopausal, and has no risk factors other than a family history of coronary artery disease. Although the sensitivity of exercise testing may be compromised by a number of factors in women, including lower exercise capacity and the low-pretest probability of coronary artery disease in premenopausal women, the negative predictive value of a normal exercise electrocardiogram for excluding the diagnosis of coronary heart disease is comparable in women and men. In this patient, the negative stress test and excellent workload is very reassuring.

Which of the following is the best indicator of a poor prognosis in a patient with stable coronary artery disease from a thallium-201 stress test?

A. Ischemia in the distribution of two coronary vessels.

B. Increased lung uptake of thallium.

C. A fixed defect in the distribution of two coronary vessels.

D. 1-1.5mm of ST depression late in exercise.

E. An exercise duration of 6 minutes.

The correct answer is B.

The options concerning two coronary vessels indicate mild to moderate ischemia or prior infarction. The 2-vessel fixed defect and 6-minute exercise duration are less predictive than any of the nuclear variables.

A 61-year-old overweight woman with a family history of coronary artery disease, but no other cardiac risk factors or cardiac symptoms, requested a routine stress test before starting an exercise program. On ECG, she had slight nonspecific ST-T wave abnormalities and, therefore, an exercise thallium was performed. She exercised 8 minutes (9 METS) on a standard Bruce protocol. She achieved 90% of her maximum predicted heart rate. She had no chest pain and no ECG changes. The nuclear images showed a moderate-sized irreversible defect in the anterior wall. Gated SPECT analysis showed normal LV function. Her physician refers her to you for further evaluation.

Which one of the following would be the most appropriate next step?

A. Perform coronary angiography.

B. Repeat stress thallium as this may represent a false positive.

C. Perform dobutamine echo.

D. Perform resting echocardiogram to assess anterior regional wall motion.

E. No further work-up indicated. Patient should be allowed to proceed with exercise program.

The Correct Answer is E

Anterior wall-image artifacts due to breast attenuation are well documented and may reduce the specificity of thallium stress testing. This may be minimized by judicious interpretation of transaxial images and by newer technologies, such as attenuation correction. The use of technetium isotopes, such as sestamibi, may reduce the number of false-positive results.

Other factors which may influence the sensitivity of myocardial perfusion imaging in women include the smaller size of the female heart, the greater prevalence of mild coronary artery disease and the performance of submaximal exercise. In this particular patient, several factors suggest that the cause of the defect may be artifactual. The fact that she is overweight increases the likelihood of a false positive, in addition to the fact that she achieved an adequate workload on the Bruce protocol without chest pain or ECG changes. Despite the presence of a fixed perfusion defect in the anterior wall, the gated SPECT analysis demonstrated normal left ventricular function without regional wall motion abnormalities. To perform an echocardiogram to assess anterior wall motion would be redundant, and there is no reason to repeat the stress thallium as the likelihood of a repeat false positive is high. Dobutamine echocardiography would not provide additional information since the stress component of the thallium study was normal. Coronary angiography would not be justified in this patient based on the basis of the lack of any demonstrable ischemia.

ACC 2002 Guideline for Exercise Testing

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