FEDERAL BUREAU OF PRISONS
CLINICAL PRACTICE GUIDELINES FOR
THE MANAGEMENT OF CORONARY ARTERY DISEASE
SEPTEMBER, 2001

PURPOSE

The Federal Bureau of Prisons Clinical Practice Guidelines for the Management of Coronary Artery Disease provide recommendations for the outpatient management of federal inmates with coronary artery disease.

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DEFINITIONS

Acute myocardial infarction is severe cardiac ischemia that lasts more than 5 to 20 minutes and results in myocardial cell death and the release of detectable amounts of myocardial markers into the blood. Myocardial infarctions are termed transmural or Q-wave MIs if a Q wave develops on the patient's ECG; or nontransmural or non-Q-wave MIs if no Q wave develops on the patient's ECG.

Atypical angina is a clinical syndrome that is probably cardiac in origin but meets only two of the three criteria for typical angina.

Canadian Cardiovascular Society (CCS) Classification System is a commonly used method of grading the severity of angina as follows:

- **Class I:** Angina occurs only with strenuous, rapid, or prolonged exertion. Ordinary physical activity does not cause angina, such as walking or climbing stairs.

- **Class II:** Angina occurs on walking or climbing stairs rapidly, walking uphill, walking or climbing stairs under stressful situations (cold, emotional stress, after meals), or walking more than 2 blocks on level ground or climbing more than one flight of stairs at a normal pace and in normal conditions. Activities of daily living are only slightly limited.

- **Class III:** Angina occurs on walking 1 to 2 blocks on level ground or climbing one flight of stairs in normal conditions and at a normal pace. Activities of daily living are markedly limited.

- **Class IV:** Angina may occur at rest. Activities of daily living are limited to the degree that any physical activity produces discomfort.

Clinician is a physician or midlevel practitioner.

Coronary artery bypass grafting (CABG) is a surgical procedure that uses the patient's own arteries or veins to reroute blood around blocked sections of the patient's coronary arteries.

Non-ST-segment elevation myocardial infarction (NSTEMI) is a myocardial infarction that presents clinically in patients as unstable angina without ST segment electrocardiographic elevations, but with severe enough ischemia to cause myocardial damage and the release of detectable myocardial markers of infarction into the blood. Most patients with NSTEMI have nontransmural myocardial infarctions.

Noncardiac chest pain is chest pain that is characterized by one or none of the characteristics of typical angina.

Percutaneous transluminal coronary angioplasty (PTCA) is a technique in which an intravascular catheter device is introduced through the skin and threaded to the heart to open a closed coronary artery.

Typical angina is (1) substernal chest discomfort of cardiac origin with a characteristic quality and duration that (2) is provoked by exertion or emotional stress and is (3) relieved by rest or sublingual nitroglycerin.

Unstable angina is acute myocardial ischemia that is not of

sufficient severity and duration to result in myocardial necrosis. It is defined as angina of recent onset (within 2 months) or that has begun to intensify or occur at rest, or with a lower level of exertion within the previous 2 months. Up to 20% of individuals with unstable angina may progress to acute myocardial infarction or sudden cardiac death within 3 months. Patients with unstable angina typically do not present with ST-segment ECG changes and do not release biochemical markers indicative of myocardial damage into the blood.

Variant or Prinzmetal's angina is an uncommon clinical syndrome of rest angina associated with reversible ST-segment ECG elevations without evidence of myocardial injury. The cause of this syndrome may be coronary artery vasospasm alone or underlying atherosclerotic coronary artery disease.

PROCEDURES

Clinical areas covered under "PROCEDURES" are outlined as follows:

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1. INTRODUCTION

Despite a 30 year decline in age-adjusted death rates from cardiovascular disease, heart disease remains the leading cause of mortality for men and women in the United States. At age 40 the cumulative lifetime risk for either myocardial infarction (MI) or coronary artery disease (CAD)-induced death is 1 in 2 for men and 1 in 3 for women. Established risk factors for CAD include habitual tobacco usage, hypercholesterolemia, hypertension, diabetes mellitus, and a family history of premature CAD. The prevention and amelioration of cardiac risk factors for all patients should be a priority for primary health care providers, since 20% to 25% of patients with CAD die suddenly without previous manifestations of CAD. These Clinical Practice Guidelines for the Management of Inmates with Coronary Artery Disease, however, do not detail prevention strategies for asymptomatic inmates, but rather address the medical management of inmates with clinical evidence of CAD.

2. ACUTE CHEST PAIN: ASSESSMENT AND DIAGNOSIS

Inmates complaining of chest pain or discomfort should receive a timely evaluation by a health care provider that includes the following components:

Medical history: The medical history should be targeted to identify risk factors for CAD and diagnostic clues for the etiology of chest pain.

- Identify risk factors for CAD, including smoking, hypercholesterolemia, hypertension, diabetes mellitus, family history of CAD, and cocaine use

- Inquire about the inmate's personal medical history of cardiac disease such as previous stable or unstable angina, MI, cardiac arrhythmia, angioplasty, or coronary artery bypass graft(CABG) surgery

- Determine if nitroglycerin (NTG) has been used successfully in the past to treat chest pain

- Establish a description of the chest discomfort including its location, quality, frequency, duration, radiation, and its relationship to exertion, stress, positioning, respirations, and eating

- Determine the presence of associated cardiac symptoms such as shortness of breath, palpitations, dizziness, or weakness

The evaluating health care provider should determine that the inmate's symptoms by patient history are most consistent with one of the following three basic types of chest pain:

- **Typical angina** defined as (1) substernal chest discomfort with a characteristic quality and duration that is (2) provoked by exertion or emotional stress and is (3) relieved by rest or sublingual nitroglycerin. Typical angina has the following characteristics:

    - Presents with poorly localized pain or discomfort that is most often substernal, but radiation to the neck, jaw, epigastrum, left shoulder, or inner arms occurs frequently

    - Described by the patient as "squeezing," "pressurelike," "suffocating," "heavy," or "someone sitting or standing on my chest"

    - Has a duration of pain or discomfort that last minutes, not seconds, hours, or days

    - Is usually NOT sharp or stabbing

    - Does NOT usually change with respiration or position

- **Atypical angina** defined as a clinical syndrome that meets only two of the three criteria for typical angina. (Note: dyspnea, diaphoresis, dizziness, palpitations, nausea, or weakness occurring without chest discomfort, but relieved by rest, may be the presenting symptoms of ischemic heart disease or "anginal equivalents.")

- **Noncardiac chest pain** defined as chest pain that is characterized by one or none of the characteristics of typical angina. Potential etiologies of noncardiac chest pain include but are not limited to the following:

    - Costochondritis or soreness from weightlifting or exercising (tenderness frequently present over chest wall)

- Gastroesophageal reflux disease (symptoms frequently burning in quality and related to eating and relieved by antacids)

- Esophageal spasm (substernal symptoms that may be relieved by nitroglycerin, but not associated with exertion)

- Peptic ulcer disease (pain typically worse at night and relieved by eating)

- Cholecystitis (pain usually has abdominal component that is exacerbated by eating)

- Acute pericarditis (pain is exacerbated by coughing, swallowing, inspiration, or supine position, and is relieved by sitting upright but not by nitroglycerin)

- Spontaneous pneumothorax (usually presents as sudden severe chest pain with dyspnea, that is often unilateral with a pleuritic component and sometimes radiates to the neck)

- Pulmonary embolus (often presents with dyspnea without obvious etiology and at times with pleuritic chest pain)

- Aortic dissection (may present with acute chest pain with ripping sensation to the back)

- Cervical disc disease (frequently exacerbated by neck movement and detected by neurologic symptoms or signs)

- Herpes zoster (pain is usually severe, burning, and unilateral in a dermatomal pattern and may occur prior to the eruption of the vesiculopustular rash)

The evaluating health care provider should further describe inmates' anginal symptoms in accordance with the **Canadian Cardiovascular Classification System (CSC), Classes I through 4,** (See Definitions) and in accordance with the typical clinical presentations of **stable angina or unstable angina.** The identification of unstable angina is important prognostically, since the presence of unstable angina predicts a higher short-term risk of an acute coronary event. Unstable angina presents in one of three basic ways:

- **Rest angina** - "occurring at rest and prolonged, usually greater than 20 minutes."

- **New onset angina** of at least moderate severity, i.e., "angina results in marked limitations of ordinary physical activity. Angina occurs walking 1 to 2 blocks on level ground and climbing 1 flight of stairs under normal conditions at a normal pace.")

- **Increasing angina** in a patient with previously diagnosed angina with a stable pattern that has become "distinctly more frequent, longer in duration, or lower in threshold, i.e., has increased in severity by a least one Canadian Cardiovascular Society Class within 2 months of initial presentation to at least Class III severity."

The evaluating health care provider should also attend to signs and symptoms that may indicate an evolving MI.

- **Myocardial infarction**: The quality, severity, and duration of chest pain are very unreliable in differentiating angina from myocardial infarction (MI). The patient's symptoms are frequently characteristic of angina, but are more severe and prolonged and not relieved by nitroglycerin. The patient may express a fear of impending doom and localize chest pain with a clenched fist to the sternum "Levine's sign." Anxiety, pallor, and diaphoresis may accompany the chest discomfort. Nausea and vomiting may be prominent, particularly with an inferior wall MI.

Physical assessment: The evaluating health care provider should perform a physical assessment consistent with the provider's training and job description that may include:

- **Temperature**: Fever may be present when chest pain is precipitated by a co-morbid condition such as sepsis or hyperthyroidism.

- **Heart rate**: The pulse may be slow, normal, or rapid with an evolving MI or typical angina. A slow pulse is associated with an inferior wall myocardial infarction; a sustained tachycardia is associated with a higher mortality from myocardial infarction.

- **Blood pressure**: The blood pressure is often normal with an evolving MI or angina, but may be low when associated with congestive heart failure, or high with patient anxiety. A significant blood pressure differential between arms is suggestive of aortic dissection.

- **Respirations**: Respirations are usually normal with an evolving MI or typical angina, but may be increased if associated with congestive heart failure or with pulmonary embolus.

- **Examination of the chest wall:** The chest wall should be visualized for signs of trauma and palpated to detect point tenderness associated with trauma or costochondritis.

- **Cardiopulmonary examination:** The cardiopulmonary examination should include visualization of neck veins and auscultation of the chest and lungs. Jugular venous distention may be present from right sided ventricular failure from a right ventricular infarction associated with an inferior wall MI; or from biventricular failure. In an evolving MI, the first heart sound (S1) may be diminished due to decreased contractility, the third heart sound (S3) or S3 gallop is present in one third of patients and indicates left ventricular dysfunction, and the fourth heart sound (S4) or S4 gallop is commonly present. Poor prognostic signs in an evolving MI include an S3 gallop, the rales of pulmonary edema, and a systolic murmur associated with mitral regurgitation and papillary muscle dysfunction.

A harsh holosystolic murmur along the upper left sternal border frequently radiating to the carotid arteries is suggestive of aortic stenosis which may present clinically with new onset angina. A friction rub suggests acute pericarditis which has many etiologies unrelated to CAD, but may occur with a transmural infarction, usually appearing 48 to 72 hours after the infarction.

- **Examination of pulses and extremities:** The carotid, femoral, and abdominal aorta should be palpated and auscultated for bruits. The extremity pulses should be palpated. The presence of diminished pulses or bruits suggests peripheral vascular disease which is often associated with CAD. The legs should be examined for signs of pedal edema and deep vein thrombosis which are associated with heart failure and pulmonary embolus respectively

Electrocardiography (ECG): An electrocardiograph (ECG) should be obtained on all inmates acutely presenting with typical angina, atypical angina, or unstable angina; and on a case by case basis in consultation with a physician for inmates with chronic stable angina and with noncardiac chest pain. The ECG should be obtained, whenever feasible, during the episode of chest pain. The ECG for inmates with acute chest pain should initially be interpreted by a physician whenever possible; or otherwise by a trained health care provider who is approved by the Clinical Director to provide preliminary readings of ECGs.

Computerized readings of ECGs should not be relied upon as definitive interpretations. Similarly, ECG interpretation

services via fax or modem have the disadvantage of being interpreted by a physician who has limited clinical information, and should not be relied upon as the sole diagnostic tool when evaluating inmates with acute chest pain.

The following ECG findings should be considered when evaluating inmates with chest pain:

- A normal ECG does not preclude the presence of either a MI or angina.

- Most patients with angina or evolving MIs present with normal sinus rhythm on their ECGs, however, cardiac arrhythmias may either precipitate angina or occur as a result of myocardial ischemia or damage (sinus bradycardia is associated with an inferior wall MI).

- ECG evidence of left ventricular hypertrophy increases the likelihood that the chest discomfort represents angina.

- Reversible ST segment depressions or elevations (particularly if greater than 1 millimeter) and reversible nonspecific ST segment and T wave changes that occur with chest pain are suggestive of angina.

- Marked symmetrical T wave inversions in multiple precordial leads are suggestive of angina.

- T wave flattening or inversion of less than 1 mm in leads with a dominant R wave are usually not related to angina.

- ST-T elevations followed by Q wave development are classic ECG findings of an acute MI, but occur in fewer than 50% of patients with an acute MI.

- The presence of Q waves alone may indicate a previously undiagnosed MI, and increases the likelihood that the chest pain is from CAD (true angina).

- The development of new Q waves from an MI may be masked in patients with residual Q waves from an old MI or left bundle branch block (LBBB).

- Evidence of LBBB, right bundle branch block (RBBB), premature atrial contractions (PACs) and premature ventricular contractions (VPCs) are all nonspecific for CAD. The development of a **new** bundle branch block, however, may be indicative of an MI.

- In a lateral wall MI, there may only be ST depression in the lateral leads (I and aVL) and Q waves develop less frequently.

Diagnosis: The etiology of acute chest pain or discomfort is determined by a clinician on a case by case basis from the inmate's complaints, medical history, physical examination, and other relevant data such as ECG findings, and other diagnostic studies. All inmates presenting with acute chest pain or discomfort should be reviewed with a physician by the evaluating health care provider in a timely manner. The physician should determine (whenever feasible by personal evaluation) if the inmate has a suspected evolving MI, unstable angina, chronic stable angina, or noncardiac chest pain. If the inmate is diagnosed with angina, assessing the CCS classification (I - IV) is recommended. Since patients with suspected acute MI or unstable angina are at increased risk for life threatening arrhythmias and sudden death, the initial evaluation of these patients should occur in a setting best prepared to manage these potential complications.

The physician should weigh the following **special considerations** when diagnosing inmates with acute chest pain:

- The presence or absence of cardiac risk factors, in and of itself, should not be used to determine whether a person has angina.

- Certain patients have no chest symptoms but present solely with jaw, arm, neck, or epigastric discomfort. If symptoms are relieved by rest or nitroglycerin, they should be considered angina.

- Elderly patients, especially women, are more likely to present with atypical angina that may be expressed as unexplained exertional dyspnea, diaphoresis, or fatigue.

- Non-ST-segment elevation myocardial infarction (NSTEMI) presents clinically as unstable angina without ST segment electrocardiographic elevations.

- Variant or Prinzmetal's angina presents with chest discomfort that occurs at rest and is associated with ST segment elevation that is ordinarily reversible without evidence of myocardial injury. Variant angina is associated with vasospasm of the coronary artery that can be precipitated by physical exercise or mental stress, but has an extremely variable ischemic threshold. Anginal attacks are sometimes cyclical with symptoms reoccurring early in the morning. Patients with normal coronary arteries and

variant angina are more likely to be women and younger. Variant angina is associated with a history of migraine headaches, Raynaud's phenomenon, and may occur during recovery from myocardial infarction, or after angioplasty or coronary artery bypass surgery.

- Cardiac conditions other than CAD can cause typical or atypical angina including but not limited to cardiac arrhythmias, aortic stenosis, and hypertrophic cardiomyopathy.

- Co-morbid noncardiac conditions such as severe hypertension, anemia from gastrointestinal bleeding, thyrotoxicosis, and exacerbations of chronic obstructive pulmonary disease (COPD) can precipitate angina in persons with underlying CAD.

- Certain biochemical markers are indicative of myocardial damage. Lactate dehydrogenase (LDH) and aspartate aminotransferase (AST) enzymes that were historically used to diagnose MI are not as diagnostically useful as other available markers such as the MB fraction of creatinine phosphokinase (CK-MB), troponin I, and troponin T, which are sensitive and specific markers of myocardial injury, measurable 12 to 16 hours after the onset of a MI.

3. ACUTE CHEST PAIN: MEDICAL MANAGEMENT

Myocardial infarction: Early thrombolytic therapy for acute MI can prevent significant myocardial damage. Mortality from MI increases from 1%, when thrombolytic therapy is given immediately, to 10% when thrombolytic therapy is given after 6 hours from the onset of symptoms. Therefore inmates with clinical syndromes consistent with acute MI should be immediately transferred to a community hospital for evaluation and treatment.

(The transfer of inmates with symptoms of acute MI should not be delayed while awaiting results of biochemical markers diagnostic for MI). Rapid CK and troponin tests (so called "bedside tests") are only qualitative, or at best, semiquantitative, tests. These test methods are not routinely recommended for hospital emergency departments, and also have limited benefit in the prison setting.

The management of inmates with a suspected acute MI while awaiting emergent ambulance transfer to a community hospital should include the following whenever feasible:

- Baseline vital signs and targeted physical examination

- Continuous monitoring of cardiac rhythm with preparations for

CPR if needed

- Nasal prong oxygen at 2-4 L/min

- Nitroglycerin tablet (0.4 mg) administered sublingually (monitor blood pressure and if < 90/60, hold medication)

- Repeat nitroglycerin every 5 minutes up to a maximum of 3 total doses if chest pain persists and BP remains stable

- Aspirin (325 mg) administered orally unless medically contraindicated

- IV normal saline solution at 20-30 cc/hr (18 gauge/large bore IV catheter is preferred)

- Copy of the ECG forwarded to the community hospital upon inmate transfer

Unstable angina: The emergent medical management of unstable angina is similar to that of acute myocardial infarction. Inmates with unstable angina and the following characteristics are at high to intermediate risk for an acute MI or sudden death and should be aggressively managed as having significant risk for an evolving MI and transferred to a community hospital setting in a timely manner.

- High risk for MI

- Accelerating tempo of ischemic symptoms in the preceding 48 hours (NOTE: The recent tempo of ischemic symptoms is the strongest predictor of risk of death)

- Prolonged chest pain at rest (> 20 minutes)

- Dynamic ST-segment changes of ≥ 1 mm

- Pulmonary edema secondary to ischemia

- Angina with a new or worsening mitral valve regurgitation murmur

- Angina with an S3 gallop or new or worsening pulmonary rales

- Angina with hypotension, bradycardia, or tachycardia

- New or presumed new bundle branch block

- Sustained ventricular tachycardia

- Age greater than 75 years

- Intermediate risk for MI

- Patients with worsening chest pain and prior MI, percutaneous transluminal coronary angioplasty (PTCA) or coronary artery bypass grafting (CABG)

- Prolonged rest angina (> 20 minutes), now resolved, with moderate or high likelihood of CAD

- Rest angina (< 20 minutes) or angina relieved with rest or sublingual nitroglycerin

- Age > 70 years

- T wave inversions

- Pathological Q waves

- Angina with underlying peripheral vascular disease or cerebrovascular disease

Other inmates with unstable angina may be at low risk for MI including those inmates with new-onset typical angina during the past 2 weeks without prolonged rest pain (> 20 minutes) who are hemodynamically stable with a normal ECG. Inmates with unstable angina at low-risk for an acute MI should be managed on a case by case basis by the evaluating physician either by urgent transfer to a community hospital or by expeditious management as an outpatient.

Stable angina: Inmates with acute chest pain and normal or unchanged ECGs who are diagnosed with chronic stable angina (i.e. no change in anginal frequency, pattern, threshold, or intensity), or atypical angina that is similarly stable should be managed on a case by case basis in consultation with a physician.

Noncardiac chest pain: Inmates diagnosed with noncardiac chest pain should be evaluated and treated in accordance with the specific suspected diagnosis. Treatment failure of suspected noncardiac chest pain should prompt reconsideration and evaluation of possible angina.

4. CHRONIC STABLE ANGINA: EVALUATION

Baseline evaluation: Inmates with chronic stable angina can be further evaluated as outpatients provided that the inmate remains clinically stable and is monitored frequently by a clinician. A physician should perform a baseline evaluation for inmates with chronic stable angina that includes:

- Medical history, including documentation of CCS classification

- Targeted physical examination

- 12 lead ECG

- Hemoglobin, fasting glucose, lipid profile

- Thyroid function tests if hyperthyroidism is suspected

- Chest X-ray with signs or symptoms of congestive heart failure, or suspected valvular heart disease, pericardial disease, aortic dissection, or other clinical indication (Note: the chest X-ray is frequently normal in persons with chronic stable angina and its benefit as a screening test is not well established without a specific indication).

The evaluating physician should try to identify conditions, medications, or other factors that might precipitate or exacerbate anginal episodes including but not limited to the following:

- Uncontrolled hypertension
- Hypoxemia
- Brady or tachyarrhythmias
- Profound anemia
- Vasoconstrictors or vasodilators
- Hyperthyroidism/excess thyroid hormone replacement
- Cocaine or methamphetamine abuse
- Sickle cell disease

An echocardiogram should be obtained if the clinician suspects valvular or pericardial disease as the cause of chest pain such as aortic stenosis, idiopathic hypertrophic cardiomyopathy, or pericarditis.

Exercise stress testing: The standard exercise stress test remains the diagnostic test of choice for evaluating patients with chest pain of uncertain origin with a normal ECG, but with a substantial likelihood of CAD. Exercise stress testing is simple, cost-effective, well standardized, and an effective diagnostic tool, particularly for men. The diagnostic utility of

exercise stress testing is less well defined for women, but remains the recommended first test for risk stratification of suspected CAD in women.

Other initial diagnostic studies must be considered for inmates who can not exercise or have certain conditions that limit the utility of exercise stress testing including the following:

- ST segment depression (1 mm or greater)
- LBBB
- Previously established CAD by angiography or prior MI
- Pre-excitation syndrome (Wolff-Parkinson-White)
- Electronically paced ventricular rhythm

The exercise stress test should be interpreted by assessing electrocardiographic changes, exercise tolerance, and the blood pressure response to exercising to provide important diagnostic and prognostic information. All inmates who undergo exercise stress testing should be classified as low, intermediate, or high risk based on their Duke Treadmill Score (DTS).

DTS = Exercise time (min) - [5 x ST segment deviation (mm)] - [4 x anginal index]

The Duke Treadmill Score equals the **exercise time in minutes** minus (**5 times the ST segment deviation in millimeters during or after exercise**) minus (**4 times the anginal index**). (Negative numbers are possible from this equation). The anginal index has a value of "0" with no angina, "1" with angina, and "2" if angina is the reason for stopping the stress test. Risk categories are defined as follows:

- **Low risk** (DTS ≥ +5): Patients with low risk Duke Treadmill Scores have a mortality rate of less than 1% per year and can be followed medically without further diagnostic testing. Repeat exercise stress testing should be considered every three years on a case by case basis.

- **Intermediate or moderate risk** (DTS -10 to +4): Patients with intermediate risk Duke Treadmill Scores have a mortality rate of 1% to 3% per year, and should ordinarily be referred for noninvasive cardiac imaging for further risk stratification, with the exception of those inmates with known left ventricular dysfunction, who should be referred directly for coronary angiography (bypassing noninvasive imaging tests).

- **High risk** (Less than -10): Inmates with high risk Duke Treadmill Scores have a mortality rate of greater than 3% per

year and should ordinarily be referred promptly and directly for further evaluation by coronary angiography.

Noninvasive cardiac stress imaging: Cardiac stress imaging is primarily indicated for patients at intermediate risk, based on DTS scores and an assessment of cardiac risk factors. Cardiac stress imaging is usually **not** indicated for patients with a low or high pretest probability for CAD, although for certain high risk patients imaging studies are selectively used to further assess risk status and prognosis. Noninvasive cardiac stress imaging should be considered for inmates with suspected chronic stable angina with the following conditions:

- Physically able to complete cardiac stress imaging studies, but unable to exercise to a high enough level to provide meaningful results on a standard treadmill or bicycle exercise stress test

- Abnormal, nondiagnostic ECG exercise stress tests with an intermediate risk Duke Treadmill Score

- Conditions that preclude effective exercise stress testing such as LBBB, electronically paced ventricular rhythm, or pre-excitation (Wolff-Parkinson-White) syndrome

- > 1 mm of resting ST-segment depression from baseline, including inmates taking digitalis and with left ventricular hypertrophy

- History of angina and revascularization procedures such as PTCA or CABG for whom localization of ischemia and myocardial function are clinically important

The specific type of noninvasive test should be selected in consideration of the following:

- **Radionuclide myocardial perfusion** (e.g. Thallium or Technetium) studies have the following advantages over stress echocardiography:

    - higher sensitivity, especially for single vessel CAD
    - higher technical success rate
    - more accurate for ischemia with multiple left ventricular wall abnormalities at rest

- **Stress echocardiography** has the following advantages over myocardial perfusion studies:

- Higher specificity
- Greater convenience, versatility, and efficacy
- More cost-effective

- **Vasodilator (adenosine or dipyridamole) myocardial perfusion imaging and dobutamine echocardiography** are noninvasive cardiac imaging studies that are used to evaluate patients who can not exercise and for patients who have LBBB or electronically paced ventricular rhythms.

Normal noninvasive cardiac imaging studies have a strong negative predictive value for future myocardial infarction or sudden cardiac death. Further diagnostic studies are ordinarily not warranted when the tests are normal except for patients with high risk Duke Treadmill Scores or left ventricular dysfunction. The predictive value of abnormal noninvasive cardiac imaging studies is highly variable and therefore abnormal test results should be assessed and interpreted on a case by case basis while weighing the specific results of the imaging study, the inmate's risk factors for CAD, and left ventricular function.

Coronary angiography: Coronary angiography is recommended for inmates with suspected angina or known CAD for diagnostic and risk stratification purposes for the following indications:

- Cardiac arrest survivors

- Current hospitalization for unstable angina or chest pain when a definitive diagnosis is deemed clinically important

- Suspected CAD and known left ventricular dysfunction

- Chronic stable angina that is disabling (CCS classes III and IV) despite medical therapy

- High risk status for CAD based on the Duke Treadmill Score or cardiac imaging studies regardless of anginal symptoms (Note: When the likelihood of CAD is high, direct referral for coronary angiography without noninvasive testing is cost-effective since the total number of tests is reduced)

- Suspected left main or three vessel CAD (The pretest probability of severe CAD increases with age and with the following parameters: male gender, typical angina, ECG evidence of MI, diabetes, and use of insulin. Direct referral for angiography may be more cost effective if multiple risk factors for severe CAD are evident)

- Anginal symptoms with inadequate prognostic information from noninvasive studies, such as a nondiagnostic but abnormal ECG stress test, when the benefit of a definitive diagnosis outweighs the associated risks of coronary angiography

- Suspected CAD in inmates who can not undergo noninvasive testing due to concurrent illness, disability, or morbid obesity

- Suspected coronary artery spasm (candidate for ergonovine challenge)

- Suspected nonatherosclerotic causes of myocardial ischemia based on young age at onset of symptoms, noninvasive imaging, or other clinical parameters, (e.g. coronary artery anomaly, Kawasaki's disease, primary coronary artery dissection, and radiation-induced valvuloplasty)

Coronary angiography is **not** indicated for patients with the following conditions:

- Chronic stable angina (CCS Classes I or II) that is well controlled on medical therapy and does not markedly limit physical activity (e.g. inmate is routinely able to perform activities of daily living without angina. Anginal pattern is stable and is precipitated only with significant exertion or walking > two blocks on level ground or climbing more than one flight of stairs)

- Significant comorbidities for whom the risks of this invasive procedure outweighs the potential benefits

- Absence of a specific medical indication

- **Risk stratification**: The extent and severity of CAD and left ventricular dysfunction identified on coronary angiography are the strongest predictors of long term patient outcomes. The Coronary Artery Surgery Study (CASS) described a 12 year survival rate in medically treated patients of 91% for patients with normal coronary arteries, 74% for one-vessel disease, 59% for two-vessel disease, and 40% for three-vessel disease. The 12 year survival based on left ventricular dysfunction was 73% for patients with ejection fractions of 0.50 to 1.00, 54% for ejection fractions of 0.35 to 0.49, and 21% for ejection fractions less than 0.35.

- **Limitations**: Despite the significant diagnostic utility of coronary angiography, the test is limited by its inability to identify those atherosclerotic plaques that will lead to acute

coronary events. For example, nondescript coronary artery plaques that appear as less than 50% stenosis on angiography commonly become unstable leading to angina or myocardial infarction.

5. CHRONIC STABLE ANGINA: MEDICAL MANAGEMENT

Risk factor modification: Clinicians should aggressively treat modifiable cardiac risk factors in inmates with CAD, since the future risk of a serious cardiac event is five to seven times greater in persons with known CAD than in previously healthy persons.

- **Smoking cessation** dramatically reduces the incidence of acute cardiac events in persons with CAD and should be a priority for risk factor modification.

- **Obesity** is an increasingly prevalent condition that compounds the cardiac risks factors of hypertension, diabetes, and lipid disorders. Weight reduction decreases myocardial oxygen demand and improves long term outcomes in persons with CAD.

- **Hypertension** should be treated in accordance with the most recent National Institutes of Health JNC (Joint National Conference) guidelines and other current recommendations. Persons with CAD should be treated for systolic blood pressures > 130 and for diastolic blood pressures > 85. Stricter blood pressure control (< 130/80) should be targeted for inmates with CAD who also have diabetes mellitus. Treatment strategies for controlling blood pressure include lifestyle modifications and dietary alterations, then progressing to anti-hypertensive medications as necessary.

- **Lipid control** reduces the risk of nonfatal and fatal myocardial infarction and the need for revascularization in persons with CAD. Inmates should be instructed on dietary choices that limit fat intake to < 30% of total calories, saturated fat intake to < 7% of total calories and cholesterol intake to < 200 mg/day. Inmates with LDL cholesterol of > 130 mg/dL despite adherence to dietary recommendations should be treated with lipid-lowering medications, usually an HMG-CoA reductase inhibitor, with a target LDL cholesterol of **< 100 mg/dL**. Since low HDL cholesterol levels are also a risk factor for CAD, inmates with adequate LDL cholesterol levels, but low HDL cholesterol (< 40 mg/dL) should ordinarily be treated with gemfibrozil, niacin, or another effective agent.

- **Glucose control** should be maximized in diabetic inmates with

CAD.

- **Exercise:** Inmates with chronic stable angina should be given recommendations for exercising on a case by case basis depending on their cardiac status and co-morbid conditions. Aerobic exercise reduces weight in obese patients, aids lipid control, results in dosage reductions in antianginal medications, and gives patients an overall improved sense of well-being.

Pharmacologic therapy: Medical therapy for chronic stable angina should be attempted prior to evaluation for revascularization unless specific indications exist that would otherwise yield a definitive survival advantage with revascularization over medical therapy alone. The worsening of anginal symptoms, development of left ventricular dysfunction, or other poor prognostic factors despite the initiation of medical therapy, warrants the timely reconsideration of inmate evaluation for revascularization. The goal of medical therapy should be to eliminate or nearly eliminate anginal symptoms that allows the patient to return to normal activities of daily living and a functional capacity of CCS Class I angina. Treatment goals must also be individualized based on the inmate baseline health status and co-morbid medical conditions.

- **Anti-platelet and anticoagulation interventions: Aspirin** in oral doses of 75 to 325 mg/day should be prescribed indefinitely for all inmates with CAD (i.e., stable angina, unstable angina, or MI) in the absence of specific contraindications. Inmates with contraindications to aspirin therapy, should ordinarily be prescribed **clopidogrel** 75 mg/day. Chronic anticoagulation therapy (e.g. **coumadin**), rather than aspirin therapy, is indicated for inmates with CAD associated with persistent atrial fibrillation, paroxysmal atrial fibrillation, and left ventricular thrombus or left ventricular wall motion abnormalities associated with previous MI. Dipyridamole can worsen exercise-induced myocardial ischemia in patients with stable angina and therefore should **not** be used as an anti-thrombotic agent in this setting.

- **Beta-blockade:** Beta-blockers provide a protective effect for patients with CAD by reducing myocardial oxygen demand by decreasing heart rate, contractility, and arterial blood pressure. Beta-blockers should be prescribed for all inmates with chronic stable angina, unstable angina, and histories of MI in the absence of specific contraindications. Inmates with anterior or large MIs should be maintained on a beta-blocker indefinitely since beta-blockade increases long term survival by 40% in such patients. All other inmates with MIs should be

administered beta-blockers for at least six months after MI and should be strongly considered for indefinite therapy. Absolute contraindications to beta-blocker therapy include severe bradycardia, advanced, unstable left ventricular dysfunction, sick sinus syndrome, and a preexisting high degree of atrioventricular heart block. Relative contraindications to beta-blocker therapy include asthma, chronic obstructive pulmonary disease with an asthmatic component, severe depression, and peripheral vascular disease. Beta-blockers are not recommended for patients with variant angina, since they increase the frequency of anginal attacks. Beta-blockers are recommended for diabetic inmates with CAD, but patients must be monitored closely, particularly when taking insulin, since beta-blockers can mask hypoglycemic effects.

Despite the large number of beta-blockers available, all beta-blockers are equally effective in the management of stable angina. The selection of a specific beta-blocker should be based on the inmate's co-morbid conditions, and the drug's pharmacologic properties, side effect profile, ease of administration, formulary availability, and cost. The dosage of the beta-blocker should ordinarily be titrated to achieve a heart rate of 55 to 60 beats/minute in patients with stable angina, and to < 50 beats/minute in patients with severe angina if tolerated without symptomatic drug-induced bradycardia or heart block.

- Calcium antagonists: Calcium antagonists increase coronary blood flow through coronary artery dilation and decrease myocardial oxygen demand by decreasing systemic vascular resistance. Immediate-release or short-acting dihydropyridine calcium antagonists, such as nifedipine, although effective in treating angina, should be avoided because of potential serious adverse cardiac effects. Long-acting dihydropyridines (e.g. amlodipine) slow-release dihydropyridines (e.g. sustained-release nifedipine), or nondihydropyridines (e.g. verapamil and diltiazem) provide relief from anginal symptoms without adverse cardiac events. Calcium antagonists further improve anginal symptoms when used in combination with beta-blockers. Calcium antagonists are indicated as second line therapy for the treatment of angina if beta-blocker therapy does not adequately control symptoms; and as first line therapy for the treatment of angina for inmates with contraindications to beta-blocker therapy, nocturnal or rest symptoms suggestive of vasospasm (variant angina), and severe peripheral vascular disease with ischemic symptoms at rest. Long-term calcium antagonists may be preferable to long-acting nitrates for treating angina due to their lack of drug tolerance that allows sustained drug effectiveness over a twenty-four hour time period.

Side effects of calcium antagonists include hypotension, worsening heart failure, peripheral edema, and constipation. The nondihydropyridine calcium antagonists slow the heart rate through decreasing conduction through the atrioventricular (AV) node. Therefore, the nondihydropyridines are contraindicated in patients with AV block and bradycardia, and should be used cautiously in combination with beta-blockers due to the potential for bradyarrhythmias.

- Nitroglycerin and other nitrates: Nitrates reduce myocardial oxygen requirements and improve myocardial perfusion through their vasodilatory actions that improve the blood supply to the myocardium and reduce the work load of the heart by decreasing arterial pressure and left ventricular volume. Nitrates also provide a beneficial anti-platelet effect for persons with CAD. Nitrates independently improve exercise tolerance in persons with stable angina, and improve the anti-anginal and anti-ischemic effects of beta-blockers and calcium antagonists when used in combination with either class of medications.

Inmates with angina should be given short-acting sublingual nitroglycerin with specific instructions for its use in treating anginal symptoms and as a prophylactic agent if angina is predictable. Short-acting sublingual nitroglycerin can be used safely on a chronic basis and is nonaddictive. Prescription supplies must be replaced every 6 to 9 months, since nitroglycerin losses efficacy over time with exposure to heat and light.

Long-term nitrate preparations, such as isosorbide dinitrate, mononitrates, and transdermal nitroglycerin patches, are effective antianginal medications indicated for patients with stable angina who fail to respond to beta-blocker medications or calcium channel antagonists or who have rest or nocturnal angina suggestive of vasospasm. All long-acting nitrates are equally effective. The use of nitroglycerin and long-acting nitrates on a chronic basis can lead to drug tolerance with a reduction in the drug's beneficial effects. Administering nitrates with a nitrate-free period of 8 to 12 hours per day is the most effective method for preventing tolerance. The administration of long-acting nitrates should be timed to maximize the period of drug availability during the patient's symptoms.

- Other pharmacologic agents: Angiotensin converting enzyme (ACE) inhibitors are not recommended to treat angina alone, since their effectiveness for this indication is poorly established. ACE inhibitors, however, provide significant clinical benefits for patients with CAD and concurrent heart failure, diabetes, and

hypertension. Hormone replacement therapy for post-menopausal women should be considered on a case by case basis while considering associated risks and benefits in consultation with the inmate. Dipyridamole, long term antibiotics, and chelation therapy are **not** recommended for the treatment of stable angina.

Revascularization procedures: Revascularization procedures should be considered for inmates with angina that can not be adequately controlled with medical therapy alone and for those inmates with specific indications for which revascularization improves long-term survival. Both PTCA and CABG are effective revascularization procedures that improve anginal symptoms in the majority of patients and are equally cost effective after five years of care. PTCA requires a shorter hospital stay, however, patients develop restenosis in 30%-40% of treated lesions within 6 months of PTCA that frequently need repeat revascularization. CABG requires a prolonged hospitalization and has a higher procedural mortality than PTCA, however, the need for follow-up revascularization is less frequent. Aggressive lipid control and the use of arterial grafts has markedly reduced occlusion rates following CABG.

- **CABG**: Major surgical intervention through CABG should be strongly considered for the following subsets of inmates, since CABG improves long-term survival when compared to treatment with medical therapy (Note: PTCA for this subset of patients is either less effective than CABG or uncertain):

  - Left main artery CAD

  - Three-vessel CAD, particularly if LV function is impaired (ejection fraction < 50%) or the patient is severely symptomatic

  - Two-vessel CAD with significant proximal left anterior descending artery (LAD) disease, and either abnormal LV function (ejection fraction < 50%) or ischemia on noninvasive testing

  - Diabetic patients who are candidates for revascularization

  - One or two-vessel CAD without significant proximal LAD disease who survive sudden cardiac death or ventricular tachycardia

- **PTCA** should be considered for inmates with the following:

- Two or three vessel CAD with significant proximal LAD disease, who have anatomy suitable for catheter-based interventions, normal LV function, and do not have diabetes

- **CABG or PTCA** should be considered for inmates with the following characteristics:

  - Patients unsuccessfully treated by medical therapy who can undergo revascularization with acceptable risk

  - One-vessel disease affecting the proximal LAD

  - One or two-vessel CAD without significant proximal LAD disease but with a moderate to large area of viable myocardium and demonstrable ischemia on noninvasive testing

  - Recurrent stenosis following prior PTCA with a large area of myocardium at risk and/or high risk criteria on noninvasive testing

  - Symptomatic patients on a case by case basis in consultation with a cardiologist while considering the severity of anginal symptoms, the amount of myocardium at risk by noninvasive studies, the appearance of lesions on coronary angiography, and the risks and benefits of revascularization for the specific patient

- CABG or PTCA should **not** be performed on inmates with the following characteristics:

  - Insignificant coronary artery stenosis (≤ 50%)

  - Borderline coronary artery stenosis (50%-60%)in locations other than the left main coronary artery and no demonstrable ischemia on noninvasive testing

  - One or two-vessel CAD without significant proximal LAD disease, who have symptoms that are atypical for angina or have not received adequate treatment with medications; and have either no demonstrable ischemia on noninvasive testing, or have only a small area of myocardium at risk

6. CHRONIC STABLE ANGINA: PERIODIC EVALUATIONS

Inmates with known CAD should be periodically monitored in chronic care clinics by a clinician in accordance with Bureau policy, while conducting more frequent evaluations for those medically complex inmates who are undergoing diagnostic

evaluations, have been recently hospitalized with myocardial infarction or angina, or who are receiving complicated medication regimens. Recurring evaluations of inmates with CAD should include the following:

Medical history: The evaluating clinician should take a directed medical history that addresses the following areas:

- Assessment of inmate's level of physical activity and anginal symptoms, pattern, and threshold since the inmate's last evaluation, while specifically identifying changes in the inmate's anginal class per the Canadian Cardiovascular Society (CCS) classification system

- Determination if the inmate is adhering to prescribed medications or experiencing new drug side effects since the last evaluation

- Assessment of how well the inmate has modified risk factors since the last evaluation

- Determination if new medical or mental health problems have developed since the last evaluation and their affect on anginal control

Physical examination: The physical examination should be targeted based on the inmate's medical history but generally include:

- Vital signs and weight

- Examination of the heart and lungs for location of the apical pulse, the development of new murmurs or gallops, and the quality of breath sounds

- Visualization of the jugular venous pulse and palpation and auscultation of the carotid arteries and abdominal aorta

- Extremity examination of the pedal pulses and assessment for pedal edema

Laboratory and other diagnostic studies: Diagnostic studies should be pursued in consideration of the following:

- Screening fasting blood glucose levels should be obtained periodically (e.g. once every three years) particular in persons with risk factors for diabetes.

- Lipid profiles should be obtained as necessary based on baseline lipid studies and the need for medical follow-up.

- The following studies are **not** routinely indicated unless otherwise medically indicated: hemoglobin, thyroid function studies, oxygen saturation, serum chemistries, and chest radiographs.

- Routine exercise stress testing in the absence of changes in the patient's symptoms or physical examination is of unproven benefit and should be pursued on a case by case basis for inmates at low to moderate risk for future cardiac events. Annual exercise stress testing should be considered for inmates at high risk for subsequent cardiac events who are candidates for further interventions, including those inmates with an ejection fraction < 50%, diabetes and three vessel CAD who have not undergone CABG, and significant CAD affecting one or more major vessels.

- Worsening or refractory anginal symptoms while on medical therapy warrants a diagnostic evaluation to further assess risk and the need for revascularization. If follow-up diagnostic studies have been done previously, the same stress and imaging methods should be used, whenever feasible, for comparison purposes.

Patient education: Ongoing patient education is important for risk factor modification, adherence to prescribed treatments, and for patient identification of relevant symptoms. Health care providers should provide individualized and group educational efforts as necessary based on the inmate's understanding of his or her disease process, the severity of the heart disease, and overall patient compliance. Relevant patient educational information is available as listed in Appendix 1: Resources for the Medical Management of Coronary Artery Disease.

Continuity of care: The Clinical Director and Health Services Administrator should implement systems that ensure continuity of medical care for inmates with CAD who are newly received at the institution, transferred to another correctional facility or community corrections program, or directly released to the community. Inmates who have been recently hospitalized with CAD or are undergoing diagnostic evaluations should ordinarily not be transferred to another BOP facility. If the transfer of a high-risk inmate is necessary for security reasons, the Clinical Director should ensure that the inmate is medically stable for transfer and that the receiving Clinical Director is briefed on the inmate's condition.

ATTACHMENTS

Appendix 1: Resources for the Medical Management of Coronary Artery Disease

Appendix 2: Provider Self Assessment - Coronary Artery Disease

Resources for the Medical Management of Coronary Artery Disease

National Institutes of Health
National Heart, Lung, and Blood Institute
www.nhlbi.nih.gov
1-301-792-8573.
Heart Health Information Line - 1-800-575-WELL

American Heart Association
1-800-AHA-USA1
www.americanheart.org

American College of Cardiology
www.acc.org

Centers for Disease Control and Prevention (CDC)
National Center for Chronic Disease Prevention and Health Promotion - Cardiovascular Disease
http://www.cdc.gov/health/cardiov.htm

American Association of Cardiovascular and Pulmonary Rehabilitation
401 N. Michigan Ave
Suite 2200
Chicago, IL 60611
312-321-5146
http://www.aacvpr.org/heartlung/index/html

Mended Hearts, Inc.
7272 Greenville Avenue
Dallas, TX 75231
1-800-AHAUSA1
http://www.mendedhearts.org

PROVIDER SELF-ASSESSMENT - CORONARY ARTERY DISEASE

Question 1. Which of the following is **NOT** characteristic of typical angina?

A. Described as "squeezing or heavy"
B. Poorly localized
C. Sharp pain that changes with respiration
D. Radiates to jaw
E. Usually precipitated by exertion

Question 2. Match the cause of noncardiac chest pain with the classic symptom presentation.

A. Dyspnea with pleuritic chest pain
B. Parasternal pain with point tenderness
C. Sudden ripping pain radiating to the back
D. Unilateral burning pain radiating to back lasting hours
E. Pain lying down and with coughing, relieved sitting up

Choices: herpes zoster, aortic dissection, pulmonary embolus, costochondritis, pericarditis

Question 3. What is the class of angina as described by the Canadian Cardiovascular Society as angina that occurs on walking 1 to 2 blocks on level ground or climbing one flight of stairs in normal conditions and at a normal pace; and activities of daily living are markedly limited?

A. Class I
B. Class II
C. Class III
D. Class IV

Question 4. Which of the following is false?

A. Persons with an acute MI most frequently have normal sinus rhythm on their ECG.
B. Profound anemia in and of itself can precipitate angina.
C. Elderly women are more likely to present with atypical angina.
D. Aortic stenosis can cause angina without significant CAD
E. Pain isolated to the neck and relieved by rest and nitroglycerin is unlikely to be angina.

Question 5. Which of the following findings on ECG in a person with chest pain does not increase the likelihood that the chest pain is from CAD?

A. Old RBBB
B. ECG findings consistent with left ventricular hypertrophy
C. Old Q waves
D. Reversible ST segment depressions that occur with chest pain
E. Symmetric T wave inversions across the precordium

Question 6. Which of the following statements is false regarding the management of inmates presenting with chest pain?

A. If MI is suspected aspirin should be administered unless medically contraindicated.
B. If the inmate has new onset chest pain and a new LBBB emergent referral to the emergency room is indicated.
C. If MI is suspected clinically, but the EKG is normal, cardiac enzymes should be drawn and obtained prior to referral to an emergency room.
D. Whenever feasible, serial ECGs with and without pain should be obtained if chest pain is intermittent.

Question 7. Which of the following statements is false regarding exercise stress testing?

A. The Duke Treadmill Score provides an accurate estimate of mortality risk.
B. An inmate with a low risk (high) Duke Treadmill Score (DTS) can be followed medically with repeat exercise stress testing every 3 years or more.
C. An inmate with an intermediate Duke Treadmill Score (DTS) should usually be referred for noninvasive cardiac imaging.
D. An inmate with a high risk (low) Duke Treadmill Score (DTS) should usually be referred directly to coronary angiography.
E. Exercise stress testing is particularly effective for a patient with suspected angina and an electronically paced ventricular rhythm.

Question 8. Which of the following inmates would ordinarily NOT be a candidate for noninvasive cardiac imaging?

A. Inmate with an abnormal, nondiagnostic, exercise stress test with a DTS of 3.
B. Inmate with a sore knee that limits his ability to complete the exercise stress test.
C. Inmate with suspected angina and LBBB
A. Inmate with a low or high pretest probability for CAD.

Question 9. Which of the following statements is false regarding coronary angiography?

A. An inmate with new onset CAD and left ventricular failure is a strong candidate for coronary angiography.
B. An inmate with a Canadian Cardiovascular Society anginal classification of III despite medical therapy should ordinarily be referred for coronary angiography.
C. The extent and severity of CAD and left ventricular dysfunction identified on coronary angiography are strong predictors of long term patient outcomes.
D. Coronary plaques associated with < 50% stenosis of the coronary arteries are rarely associated with unstable angina or myocardial infarction.
E. An inmate with a DTS of (-12) should be referred directly for coronary angiography.

Question 10. Which of the following is routinely recommended for persons with chronic stable angina?

A. LDL cholesterol < 100 mg/dL
B. Blood pressure < 130/85
C. Aspirin
D. Beta-blocker
E. All of the above

Question 11. Which of the following statements is false regarding the medical management of chronic stable angina?

A. Beta-blockers are contraindicated in diabetics
B. Dipyridamole is not recommended.
C. Beta-blockers should be titrated to a heart rate of 55 beats/minute
D. Short-acting calcium antagonists should be avoided
E. Patients may develop tolerance to long-acting nitrates if administered continuously

Question 12. Which of the following statements is false regarding revascularization procedures?

A. PTCA and CABG are equally cost effective when managing patients on a long-term basis.
B. A diabetic inmate with angina and significant two vessel CAD accessible to angioplasty is a good candidate for PTCA.
C. Arterial grafts have a lower occlusion rate than venous grafts following CABG.
D. An inmate with three vessel CAD and an ejection fraction of 35% should be referred for CABG not PTCA.

Self-Assessment Answers - Coronary Artery Disease

1. Answer is C: Typical angina is a heavy, squeezing, chest pain or discomfort that is precipitated by exertion and relieved with rest. The discomfort or pain is classically substernal, but is often poorly localized and may radiate to the arm, jaw, or other location. A sharp, well-localized pain is not characteristic of angina, but is more characteristic of chest wall pain, pulmonary embolus, spontaneous pneumothorax, pneumonia, or other etiology.

2. Answers:

A. Pulmonary embolus
B. Costochondritis
C. Aortic dissection
D. Herpes zoster
E. Acute pericarditis

3. Answer is C, Class III

4. Answer is E

5. Answer is A

6. Answer is C: Mortality from MI increases from 1%, when thrombolytic therapy is given immediately, to 10% when thrombolytic therapy is given after 6 hours from the onset of symptoms. Therefore inmates with clinical syndromes consistent with acute MI should be immediately transferred to a community hospital for evaluation and treatment. (The transfer of inmates with symptoms of acute MI should not be delayed while awaiting results of biochemical markers diagnostic for MI). Patients with unstable angina and a new LBBB, or bradycardia or tachycardia, or signs of congestive heart failure are at high risk for an evolving MI and should also be treated as medical emergencies. The early administration of aspirin during an evolving MI significantly improves related mortality and is the single most important intervention while awaiting emergency transfer of the inmate. The detection of ischemic ECG changes with chest pain, such as ST segment changes > 1 mm, suggests ongoing ischemia that warrants emergency evaluation in the setting of unstable angina.

7. Answer is E: The Duke Treadmill Score (DTS) is clinically helpful in obtaining a risk assessment of mortality for patients with suspected angina. The Duke treadmill score equals the exercise time in minutes minus (5 times the ST segment deviation in millimeters during or after exercise) minus (4 times the anginal index). The anginal index has a value of "0" with no

angina, "1" with angina, and "2" if angina is the reason for stopping the stress test. By determining the inmate's DTS, the clinician can develop a strategy for further diagnostic testing. The exercise stress test has limited utility in a person with an electronically paced ventricular rhythm since ST segment changes can not be adequately assessed.

8. Answer is D: Noninvasive cardiac imaging is mainly indicated for patients with suspected CAD who either can not physically complete the exercise stress test or are at intermediate risk of having CAD based on the DTS and cardiac risk factors. Patients at low risk for CAD usually can be monitored clinically without further diagnostic studies; whereas patients at high risk for CAD (DTS scores < -10) should be referred directly for coronary angiography.

9. Answer is D: The extent and severity of CAD and LV dysfunction are the strongest overall predictors of long term outcomes in patients with CAD, however, coronary angiography is not a reliable predictor of the functional significance of any individual coronary artery blockage. Relatively minor plaques causing < 50% stenosis of the coronary artery commonly are responsible for future acute coronary events; therefore inmates with angiograms with insignificant CAD who later present with symptoms of unstable angina or MI should be treated aggressively.

10. Answer is E

11. Answer is A: Although beta-blockers may mask some symptoms of hypoglycemia and therefore complicate treatment in diabetic patients, diabetic patients with angina should still receive a beta-blocker if tolerated, because of its significant life-sustaining effects. Close monitoring of blood glucose is warranted.

12. Answer is B: Diabetics who have angiographic findings which warrant a revascularization procedure (PTCA or CABG) should ordinarily be referred for CABG, as PTCA appears to be less effective in diabetics.