Section 1

Cardiovascular Medicine

Questions

Item 1 [Basic]
A 42-year-old woman is evaluated in the emergency department. She has a 2-day history of nonexertional chest pain. The pain is sharp, substernal, and worse when lying down or with deep breaths. She denies shortness of breath. Her symptoms were preceded by a recent upper respiratory tract infection.

On physical examination, temperature is 37.9°C (100.3°F), blood pressure is 165/90 mm Hg, pulse rate is 102/min, respiration rate is 18/min, and oxygen saturation is 96% on ambient air. The cardiopulmonary examination is normal as is the remainder of the physical examination.

An electrocardiogram is shown. Echocardiogram shows a small pericardial effusion.

Which of the following is the most appropriate initial therapy?
(A) Clopidogrel
(B) Heparin
(C) Ibuprofen
(D) Prednisone

Item 2 [Basic]
A 38-year-old man is evaluated in the emergency department. He has a 2-week history of nonpleuritic, sharp, anterior chest pain. Each episode of pain lasts 3 to 10 hours. He describes the pain as being located mostly to the left of the sternum, although at times it radiates across the entire chest but not to his shoulders, arms, or back. The pain sometimes occurs at rest and is worsened with lateral movement of the trunk. It does not worsen with exertion. He has no other symptoms and no other medical problems. He does not use drugs and takes no medications.

On physical examination, temperature is 37.0°C (98.6°F), blood pressure is 132/70 mm Hg, pulse rate is 90/min, and respiration rate is 14/min. There is reproducible point tenderness along the left sternum. The remainder of the examination, including the cardiovascular examination, is normal.

Which of the following is the most likely diagnosis?
(A) Acute pericarditis
(B) Aortic dissection
(C) Costochondritis
(D) Unstable angina

Item 3 [Basic]
A 24-year-old man is evaluated for a 6-month history of episodic substernal chest pain. Episodes occur four to five times per week and are accompanied by palpitations and sweating. They resolve spontaneously after approximately 30 minutes. His symptoms are unrelied with antacids, can occur at rest or with exertion, and are non-positional. There are no specific precipitating factors. Lipid levels were obtained last year and were normal. The patient is a nonsmoker. He has no personal or family history of coronary artery disease, diabetes mellitus, hyperlipidemia, or hypertension. He is not taking any medications.
On physical examination, vital signs are normal. He has no cardiac murmurs and no abdominal pain. Complete blood count, serum thyroid-stimulating hormone level, and electrocardiogram are all normal.

**Item 5** [Basic]
A 50-year-old woman is evaluated for a 1-year history of recurrent left-sided chest pain. The pain is poorly localized and nonexertional and occurs in 1-minute episodes. There is no dyspnea, nausea, or diaphoresis associated with these episodes. The patient has not had dysphagia, heartburn, weight change, or other gastrointestinal symptoms. She has no other medical problems and does not smoke cigarettes.

On physical examination, vital signs are normal. The patient’s chest pain is not reproducible by palpation. The cardiac examination is unremarkable, as is the remainder of the physical examination.

Results of a lipid panel, a fasting plasma glucose test, and a chest radiograph are normal. An echocardiogram shows a normal ejection fraction, with no wall motion abnormalities. Results of an exercise stress test are normal.

**Which of the following is the most appropriate next step in management?**

(A) Ambulatory pH study  
(B) Endoscopy  
(C) Treatment with a nonsteroidal anti-inflammatory drug  
(D) Trial of a proton pump inhibitor

**Item 6** [Basic]
A 65-year-old man is evaluated because of chronic angina. He has a 10-year history of symptomatic coronary artery disease. The diagnosis was confirmed with an exercise stress test. Results of the test showed no high-risk features. His estimated left ventricular ejection fraction by echocardiography at that time was 56%. He occasionally has chest pain after walking four blocks. The pain is relieved by taking one sublingual nitroglycerin or by resting. His exercise capacity has not diminished, and the frequency, character, and duration of the pain have not changed. He denies shortness of breath, orthopnea, or paroxysmal nocturnal dyspnea. Current medications include simvastatin, aspirin, metoprolol, and sublingual nitroglycerin.

On examination, blood pressure is 122/82 mm Hg, pulse rate is 68/min, respiratory rate is 16/min, and body mass index is 27. There is no jugular venous distention, and there are no murmurs, gallops, rubs, or pulmonary crackles or peripheral edema.

**Which of the following is the most appropriate management?**

(A) Cardiac catheterization  
(B) Current medical management  
(C) Echocardiogram  
(D) Exercise stress test

**Item 7** [Basic]
A 60-year-old man is evaluated because of a 3-month history of intermittent chest pain. He has occasional substernal chest pressure when he exercises at the gym and occasionally after he eats a spicy meal. The pressure is not consistently relieved with rest and is occasionally relieved with antacid. He has no associated symptoms of shortness of breath, dizziness, or diaphoresis. His medical history includes hypertension and hyperlipidemia. Medications are lisinopril and pravastatin.

On physical examination, blood pressure is 128/80 mm Hg, pulse rate is 84/min, and respiration rate is 16/min. Findings on cardiovascular examination are normal.

The electrocardiogram is shown.

**Which of the following is the most appropriate diagnostic test to evaluate the patient’s chest pain?**

(A) Cardiac catheterization  
(B) Dobutamine echocardiography  
(C) Exercise echocardiography  
(D) Exercise electrocardiography

**Item 8** [Basic]
A 55-year-old woman is evaluated for symptoms of sharp, localized, left-sided chest pain for the last 3 weeks. The pain is unrelated to exertion and is associated with mild dyspnea and fatigue. Typically it lasts for 5 to 10 minutes and abates spontaneously. The pain is not pleuritic, positional, or related to eating. She has hypertension and hypercholesterolemia. Her father had a myocardial infarction at 54 years of age. Daily medications are hydrochlorothiazide, simvastatin, and aspirin.

On physical examination, blood pressure is 135/78 mm Hg, pulse rate is 78/min, and respiration rate is 14/min. Cardiac auscultation shows S1 but is otherwise normal, as is the remainder of her physical examination.
Electrocardiogram shows sinus rhythm, with a heart rate of 75/min and no ST-segment or T-wave abnormalities.

**Which of the following is the most appropriate diagnostic study?**

(A) Coronary angiography  
(B) Exercise echocardiography  
(C) Exercise electrocardiography  
(D) Pharmacologic stress test

**Item 9 [Advanced]**

A 68-year-old man is evaluated for exertional chest pain of 3 months' duration. He describes the chest pain as midsternal pressure without radiation that occurs with walking one to two blocks and resolves with rest or sublingual nitroglycerin. No symptoms have occurred at rest. His medical history is significant for myocardial infarction 3 years ago, hypertension, and hyperlipidemia. Medications are aspirin, metoprolol, simvastatin, isosorbide dinitrate, and sublingual nitroglycerin as needed for chest pain.

On physical examination, temperature is normal, blood pressure is 150/85 mm Hg, pulse rate is 80/min, and respiration rate is 12/min. The lungs are clear. Cardiac examination shows normal S₁ and S₂ with no extra heart sounds or murmurs. The remainder of the examination is unremarkable.

Electrocardiogram shows normal sinus rhythm, no left ventricular hypertrophy, no ST- or T-wave changes, and no Q waves.

**Which of the following is the most appropriate management?**

(A) Add diltiazem  
(B) Add ranolazine  
(C) Increase the metoprolol dosage  
(D) Refer the patient for coronary angiography

**Item 10 [Advanced]**

A 62-year-old man with coronary artery disease is evaluated for angina. He was diagnosed 4 years ago, and since that time, his symptoms have been well controlled with metoprolol and isosorbide mononitrate. He had exertional angina 8 months ago. His dosages of metoprolol and isosorbide were increased and long-acting diltiazem was added, with improved control of his symptoms. He has had increasing symptoms over the last 2 months and now requires daily sublingual nitroglycerin for relief of angina during exercise. He has not had any episodes of angina at rest. His medical history is significant for hyperlipidemia treated with atorvastatin.

On physical examination, the patient is afebrile, blood pressure is 110/60 mm Hg, pulse rate is 55/min, and respiration rate is 12/min. Results of cardiopulmonary examination are unremarkable, as are the remainder of the findings of the physical examination.

Electrocardiogram shows no acute ischemic changes.

**Which of the following should be the next step in this patient's management?**

(A) Coronary angiography  
(B) Exercise treadmill testing  
(C) Increase β-blocker dosage  
(D) Increase nitrate dosage
**Item 11 [Basic]**

A 68-year-old man is evaluated in the emergency department because of a 2-day history of intermittent chest pain. The pain is substernal, is not related to activity, and lasts less than 15 minutes. His medical history includes hypertension, hyperlipidemia, and type 2 diabetes. His medications include aspirin, metoprolol, lisinopril, simvastatin, and metformin. In the emergency department he received a dose of liquid antacid, and his chest pain partially resolved.

On physical examination, he is afebrile, blood pressure is 130/80 mm Hg, pulse rate is 70/min, respiration rate is 18/min, and oxygen saturation is 98% on ambient air. Results of cardiopulmonary examination are normal.

The electrocardiogram shows minor T-wave abnormalities. Troponin T measurement is less than 0.01 ng/mL (0.01 µg/L).

**Which of the following is the most appropriate management of this patient's chest pain?**

(A) Admission to the telemetry unit with serial electrocardiograms and troponin measurements

(B) Coronary angiography

(C) Discharge to home

(D) Esophageal pH probe

(E) Pharmacologic stress test with nuclear imaging

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**Item 12 [Advanced]**

A 58-year-old woman is evaluated in the emergency department for chest pain, diaphoresis, and shortness of breath of 4 hours’ duration. Three years ago she was diagnosed with a non-ST-elevation myocardial infarction and was treated medically. Additional medical history includes type 2 diabetes and hypertension. Her current medications are aspirin, lisinopril, atorvastatin, and glargine insulin.

On physical examination, she is afebrile, blood pressure is 125/60 mm Hg, pulse rate is 48/min, respiration rate is 18/min, and oxygen saturation is 98% on ambient air. Cardiac examination shows a normal S1 and S2 without murmurs. No peripheral edema is present.

Electrocardiogram shows ST-segment elevation and T-wave inversions in leads II, III, and aVF. The initial troponin T measurement is elevated.

The nearest hospital capable of percutaneous coronary intervention is more than 2 hours away. The patient has no contraindication to thrombolytic therapy.

**Which of the following is the most appropriate initial management for this patient?**

(A) Aspirin, heparin, clopidogrel, intravenous nitroglycerin, and thrombolytic therapy

(B) Aspirin, heparin, intravenous nitroglycerin, metoprolol, and thrombolytic therapy

(C) Heparin, clopidogrel, pravastatin, and intravenous nitroglycerin

(D) Immediate transfer for percutaneous coronary intervention

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**Item 13 [Basic]**

A 52-year-old woman was evaluated in the emergency department because of acute onset of dyspnea while shoveling snow this morning. The dyspnea resolved within 2 minutes of rest but recurred an hour later while she was watching television. Over the previous 10 days she has had several similar episodes of dyspnea with mild exertion, such as walking upstairs, and also at rest. She has no chest pain, palpitations, or orthopnea. She has a 15-year history of type 2 diabetes, hyperlipidemia, and hypertension treated with aspirin, metformin, chlorothalidone, ramipril, and rosvastatin.

On physical examination, temperature was 37°C (98.6°F), blood pressure was 110/70 mm Hg, pulse rate was 80/min, respiratory rate was 18/min, and oxygen saturation was 96% on ambient air. There was no jugular distention, normal cardiac sounds were present without extra sounds or murmurs, and the lungs were clear to auscultation.

The initial electrocardiogram showed ST-segment changes. The first troponin I level was 0 ng/mL (0 µg/L).

An hour after admission to the emergency department, she had an episode of acute dyspnea. A repeat electrocardiogram at this time is shown. Repeat troponin level is 0.8 ng/mL (0.8 µg/L).

**What of the following is the most appropriate next diagnostic test?**

(A) Cardiac catheterization

(B) Echocardiogram

(C) Exercise stress test

(D) Repeat of troponin I level

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**Item 14 [Advanced]**

A 78-year-old man is evaluated in the emergency department because of chest pain. He describes left substernal discomfort that began approximately 8 hours ago. He reports no similar episodes of chest pain. Medical history is significant for hypertension and a 30-pack-year history of ongoing tobacco use. His only medication is amlodipine.

On physical examination, the patient is afebrile, blood pressure is 130/80 mm Hg, pulse rate is 72/min, and respiration rate is 12/min. There is no jugular venous distention, the lung fields are clear, and cardiac examination shows a normal S1 and S2 without murmurs. No peripheral edema is present.

The initial troponin I level is 26 ng/mL (26 µg/L). Laboratory findings are otherwise normal.

Electrocardiogram shows sinus rhythm of 70/min and 2-mm ST-segment elevation in leads II, III, and aVF.

**Which of the following is the most appropriate treatment approach?**

(A) Coronary artery bypass surgery

(B) Intracoronary thrombolytic therapy

(C) Medical therapy

(D) Primary percutaneous coronary intervention
**Item 15** [Advanced]

A 70-year-old woman is hospitalized for an ST-elevation myocardial infarction involving the anterior wall. Her symptoms initially began 3 days before admission. The pain resolved spontaneously before she reached the hospital.

Two hours after presentation to the emergency department, she has acute onset of dyspnea and hypotension and requires emergent intubation. A portable chest radiograph shows cardiomegaly and pulmonary edema. Vasopressor therapy is initiated to support her blood pressure.

On physical examination, blood pressure is 90/60 mm Hg, pulse rate is 120/min, and respiration rate is 12/min. She has a grade 4/6 harsh holosystolic murmur at the right and left sternal borders associated with a palpable thrill. No S₃ or S₄ is heard. Crackles are heard bilaterally at the lung bases.

**Which of the following is the most likely diagnosis?**

(A) Aortic dissection  
(B) Free wall rupture  
(C) Right ventricular infarction  
(D) Ventricular septal defect

**Item 16** [Basic]

A 64-year-old man is evaluated in the emergency department because of chest pain. He describes the chest pain as nonradiating pressure in the midchest that began at rest 1 hour ago and is not associated with any symptoms. Medical history is significant for hypertension and type 2 diabetes mellitus. Medications are lisinopril and glipizide.

On physical examination, he is afebrile, blood pressure is 140/80 mm Hg, pulse rate is 78/min, and respiration rate is 16/min. There is no jugular venous distention, the lungs are clear, and the findings on heart examination are normal.

Electrocardiogram shows a normal sinus rhythm and T-wave inversions in leads V₂ through V₆ without Q waves.

Initial cardiac biomarkers are within normal limits.

He is given aspirin, clopidogrel, low-molecular-weight heparin, and a nitrate, with resolution of his chest pain.

**Which of the following is the most appropriate next step in management?**

(A) Add metoprolol  
(B) Add nifedipine  
(C) Coronary angiography  
(D) Thrombolysis

**Item 17** [Basic]

A 54-year-old man is evaluated in the emergency department for an acute coronary syndrome that began 30 minutes ago. His medical history is significant for hypertension and type 2 diabetes mellitus. Medications are lisinopril and glipizide.

On physical examination, he is afebrile, blood pressure is 160/90 mm Hg, pulse rate is 80/min, and respiration rate is 12/min. Cardiovascular examination shows a normal S₁ and S₂ without an S₃ and no murmurs. Lung fields are clear.

On physical examination, he is afebrile, blood pressure is 140/80 mm Hg, pulse rate is 78/min, and respiration rate is 16/min. There is no jugular venous distention, the lungs are clear, and the findings on heart examination are normal.

Electrocardiogram shows a normal sinus rhythm and T-wave inversions in leads V₂ through V₆ without Q waves.

Initial cardiac biomarkers are within normal limits.

He is given aspirin, clopidogrel, low-molecular-weight heparin, and a nitrate, with resolution of his chest pain.

**Which of the following is the most likely diagnosis?**

(A) Aortic dissection  
(B) Free wall rupture  
(C) Right ventricular infarction  
(D) Ventricular septal defect

**Item 13**

[Graphical representation of an electrocardiogram with annotations and labels for leads V₁ through V₆, including a mention of "RHYTHM STRIP"]
Section 1

Cardiovascular Medicine

Answers and Critiques

Item 1  Answer:  C

Educational Objective:  Treat pericarditis with an NSAID.

The most appropriate initial therapy is ibuprofen. Acute pericarditis is the most likely diagnosis. Viral infection is the most common known cause of acute pericarditis. Diagnosis is most often made by confirming two of three classic findings: chest pain, often with a pleuritic component; friction rub; and diffuse ST-segment elevation on electrocardiography (ECG). This patient has chest pain and diffuse ST-segment elevation on ECG. A pericardial friction rub is virtually pathognomonic of acute pericarditis. It is best auscultated at the left lower sternal border during suspended respiration while the patient is leaning forward. The classic rub has three components and can be squeaky, scratchy, or swooshing. It is often transient. Although a pericardial friction rub is a highly specific sign of acute pericarditis, it is not very sensitive and its absence does not rule out the diagnosis. In acute pericarditis, epicardial inflammation causes upwardly concave ST-segment elevation in all leads except aVR. PR-segment depression in the limb leads (particularly lead II) or precordial leads and elevation in lead aVR may accompany ST-segment elevation. PR-segment shifts are highly specific but not sensitive findings for acute pericarditis. Echocardiography can detect very small pericardial effusions that may help with the diagnosis of pericarditis. More importantly, echocardiography can detect cardiac tamponade and heart failure that may complicate acute pericarditis.

Appropriate initial therapy for acute pericarditis is either aspirin or an nonsteroidal anti-inflammatory drug (NSAID), such as ibuprofen. Chest pain resulting from acute pericarditis usually resolves within 24 hours of treatment with anti-inflammatory medications. Nonrandomized and nonblinded studies support the use of colchicine as an alternative first-line agent or an adjunctive treatment for acute pericarditis.

In the absence of a specific indication for their use, a glucocorticoid, such as prednisone, should only be used in refractory cases of acute pericarditis or in patients with contraindications to aspirin, NSAIDs, and colchicine. Glucocorticoids increase the risk of recurrent pericarditis.

The nature of the chest pain and the findings of PR-segment depression on ECG and a small effusion on echocardiography are most consistent with acute pericarditis and make acute coronary syndrome or pulmonary embolism unlikely. Therefore, heparin and clopidogrel are not indicated.

**KEY POINT**

Appropriate initial therapy for acute pericarditis is either aspirin or an NSAID, such as ibuprofen.

Bibliography


Item 2  Answer:  C

Educational Objective:  Diagnose costochondritis.

This patient most likely has costochondritis. The cause of chest pain can be determined in most cases after a careful history and physical examination. Musculoskeletal chest pain has an insidious onset and may last for hours to weeks. It is most recognizable when it is sharp and localized to a specific area of the chest; however, it can also be poorly localized. The pain may be worsened by turning, deep breathing, or arm movement. Chest pain may or may not be reproducible by chest palpation (pain reproduced by palpation does not exclude ischemic heart disease), and the results of cardiovascular examination are often normal. Importantly, the patient’s findings are not consistent with an alternative cause of chest pain. Treatment is typically rest and use of anti-inflammatory drugs.

The chest pain associated with acute pericarditis is typically pleuritic and is worsened when the patient lies down. A two- or three-component friction rub is often present. This patient does not have any risk factors for pericarditis. Specifically, he has no history of recent viral infection, myocardial infarction, trauma, malignancy, medication use, connective tissue disease, or uremia. Therefore, pericarditis is highly unlikely.

Aortic dissection is generally described as a tearing or ripping pain with radiation to the back. It is more commonly seen in patients with a history of hypertension. This patient’s description of chest pain, the results of physical examination, and the absence of risk factors are inconsistent with aortic dissection.

This patient has no risk factors for cardiac disease. His history is inconsistent with descriptors that increase the probability of ischemic chest pain, including unstable angina. Specifically, there is no radiation to the arms, exertional component, relief with rest, diaphoresis, nausea, vomiting, or description of pressure. Considering the patient’s age and description of his chest pain, the probability of unstable angina or an acute coronary syndrome is low.

**KEY POINT**

Musculoskeletal chest pain has an insidious onset and may last for hours to weeks. It is most recognizable when it is sharp and localized to a specific area of the chest. The pain may be worsened by turning, deep breathing, or arm movement.

Bibliography

**Item 3**  
**Answer:** D  
**Educational Objective:** Manage panic disorder.

The most appropriate management of this patient is to prescribe a selective serotonin reuptake inhibitor. Panic disorder is a syndrome characterized by sudden panic attacks with acute onset of somatic symptoms that may include chest pain, palpitations, sweating, nausea, dizziness, dyspnea, and numbness. These symptoms usually last from 5 to 60 minutes. Approximately 50% of patients with panic disorder also have associated agoraphobia, with fears of being in crowds or in places from which escape would be difficult. Diagnosis is based on clinical descriptors and setting, but care should be taken to consider underlying medical disorders, such as cardiac disease, thyroid disease, or pheochromocytoma, particularly in patients who are at increased risk for one of these disorders. However, extensive testing is not necessary in most patients with a characteristic presentation and normal findings on physical examination and basic laboratory studies. Treatment options for panic disorder include medication and psychotherapy. Cognitive behavioral therapy (CBT) has been shown to be the most effective psychotherapeutic intervention in controlled trials. Selective serotonin reuptake inhibitors and serotonin-norepinephrine reuptake inhibitors have been shown to be effective. Panic disorder that is severe or refractory appears to be most amenable to a combination of CBT and pharmacotherapy compared with either treatment alone.

This patient has classic symptoms of panic disorder and no cardiac risk factors. It would be inappropriate to order further cardiac testing in the setting of a normal electrocardiogram and classic symptoms. This patient's symptoms are also atypical for gastroesophageal reflux disease, and so empiric proton pump inhibitor therapy would be inappropriate.

**KEY POINT**

Panic disorder is characterized by sudden panic attacks with acute onset of somatic symptoms that may include chest pain, palpitations, sweating, nausea, dizziness, dyspnea, and numbness.

**Bibliography**


**Item 4**  
**Answer:** B  
**Educational Objective:** Evaluate a patient with pleuritic chest pain.

This patient should undergo chest radiography. He has severe chronic obstructive pulmonary disease (COPD) and findings that are consistent with spontaneous secondary pneumothorax. These findings include sudden, sharp, nonradiating pleuritic chest pain and shortness of breath with hyperresonance, decreased breath sounds, and decreased chest wall expansion on the side of the pneumothorax in a patient with underlying lung disease. Pneumothorax should be considered in any patient who has sudden onset of pleuritic chest pain and dyspnea. The diagnostic test of choice if pneumothorax is suspected is an upright chest radiograph. Findings on chest radiograph include separation of the parietal and visceral pleura by a collection of gas and the absence of vessels in this space. This patient is at increased risk for pneumothorax because of his COPD. Pneumothorax occurring in patients without known lung disease or a clear precipitating cause is termed primary spontaneous pneumothorax (PSP). PSP tends to occur more often in men, smokers, and those with a family history of PSP. The clinical presentation is similar in both primary or secondary pneumothorax.

Chest computed tomography (CT) also can be used to diagnose pneumothorax. Chest CT may be more sensitive than a chest radiograph in delineating smaller collections of gas in the pleural space and providing more information about the pulmonary parenchyma and pleura. However, plain film radiography remains the initial test of choice for most patients, and chest CT should be reserved for cases when the chest radiograph does not provide information to guide further treatment or evaluation.

The patient’s history and physical examination are classic for pneumothorax, and his pain descriptors do not strongly suggest ischemia or other primary cardiovascular disease. Electrocardiogram and echocardiogram, which are the tests of choice to evaluate ischemic heart disease, valvular heart disease, or cardiomyopathy, would not be the first diagnostic tests of choice for suspected pneumothorax.

**KEY POINT**

Pneumothorax should be considered in any patient who has sudden onset of pleuritic chest pain and dyspnea. The diagnostic test of choice if pneumothorax is suspected is an upright chest radiograph.

**Bibliography**


**Item 5**  
**Answer:** D  
**Educational Objective:** Manage noncardiac chest pain.

This patient should receive twice-daily proton pump inhibitor (PPI) therapy for 8 to 10 weeks. Pain associated with gastroesophageal reflux can mimic ischemic chest pain. A cardiac cause should be carefully assessed and excluded in all patients with chest pain. This patient has nonanginal chest pain, no additional risk factors, and normal findings on exercise stress testing. Therefore, the likelihood of a cardiac cause of chest pain is low. Randomized controlled trials have shown that a therapeutic trial of twice-daily PPI treatment is effective in 50% to 60% of patients with noncardiac chest pain, indicating that gastroesophageal reflux disease is the underlying cause.

If the PPI trial is unsuccessful, further evaluation with endoscopy (to detect erosive esophagitis or achalasia), manometry (to detect esophageal motility disorders such as diffuse esophageal spasm), and ambulatory pH recording (to detect refractory reflux) would be reasonable.

Musculoskeletal chest pain has an insidious onset and may last for hours to weeks. It is most recognizable when it is sharp and localized to a specific area of the chest; however, it can also be poorly localized. The pain may be worsened by turning, deep breathing, or arm movement. Chest pain may or may not be reproducible by chest palpation (pain reproduced by palpation does not exclude ischemic heart disease), and findings on cardiovascular examination are often normal. This patient does not have the typical features of musculoskeletal chest pain. Therefore, treatment with an nonsteroidal anti-inflammatory drug is not the most appropriate first step in management.

**KEY POINT**

After cardiac causes have been excluded by comprehensive cardiac examination, an 8- to 10-week trial of proton pump inhibitor therapy is reasonable before further testing in patients with noncardiac chest pain who do not have concerning symptoms.

**Bibliography**

Item 6  Answer:  B  
Educational Objective:  Manage chronic stable angina.

Continuing the current management is the most appropriate action. Several large trials have compared revascularization with optimal medical therapy. These studies found that revascularization combined with aggressive medical therapy was not superior to aggressive medical therapy alone in reducing death or myocardial infarction. Based on these studies, current guidelines recommend reserving coronary angiography and revascularization for patients who continue to have symptoms despite optimal medical therapy, patients who are unable to tolerate the side effects of medications, and those who have high-risk findings on noninvasive testing. This patient’s pattern of angina is stable, he is tolerating his medications, and his original stress test showed no high-risk features. Therefore, a more aggressive intervention such as coronary angiography is not indicated as there would not be an expected improved outcome.

Routine follow-up electrocardiography, exercise stress testing (or other noninvasive imaging studies), and echocardiography are not indicated in patients with chronic stable angina. Although careful and frequent follow-up is indicated, disease assessment is conducted with a detailed history and physical examination. The history should focus on changes in physical activity and the frequency, severity, or pattern of chest pain. Reasonable laboratory monitoring includes periodic measurement of lipids and blood glucose levels. Follow-up electrocardiography should be considered when there are medication changes that could affect cardiac conduction; there is a change in the severity, frequency, or pattern of angina; symptoms that suggest dysthymia occur; or syncope develops. There are no indications for an electrocardiogram, an exercise stress test, or echocardiography.

**KEY POINT**
Routine follow-up electrocardiography, exercise stress testing (or other noninvasive imaging studies), and echocardiography are not indicated in patients with chronic stable angina.

Bibliography

Item 7  Answer:  D  
Educational Objective:  Diagnose chronic angina with an exercise stress test.

The most appropriate test to evaluate the patient’s chest pain is exercise electrocardiography.

A variety of noninvasive stress tests are available to determine whether a patient with cardiovascular symptoms has coronary artery disease (CAD). The decision to perform a specific test is based on the pretest probability of CAD, the patient’s ability to exercise, findings on resting electrocardiography (ECG), and comorbid conditions, such as reactive airways disease, that may influence the choice of a pharmacologic stress agent. Stress testing is most useful in patients with an intermediate pretest probability of CAD. For patients with a low pretest probability of CAD, stress testing is not useful because an abnormal test result is likely a false-positive finding and a normal test result only confirms the low pretest probability of CAD. For patients with a high pretest probability of CAD, stress testing is not useful to diagnose CAD and empiric medical therapy should be initiated. In this setting, a normal stress test result would likely be a false-negative finding and an abnormal stress test result would only confirm a high pretest probability of CAD.

Exercise ECG testing is the standard stress test for the diagnosis of CAD in patients with normal baseline ECG findings. If abnormalities that limit ST-segment analysis are present (left bundle branch block, left ventricular hypertrophy, paced rhythm, Wolff-Parkinson-White pattern), the results may be difficult to interpret. In patients with abnormalities on resting ECG that impair the ability to interpret ST-segment changes, imaging increases diagnostic accuracy and ability to determine the site and extent of ischemia. Exercise is preferred to pharmacologic stressors because it provides a gauge of functional capacity and a contextual understanding of symptoms as well as a record of the hemodynamic response to exercise. For patients who cannot exercise because of physical limitations or physical deconditioning, pharmacologic stressors can be used. These agents, recommended if the patient cannot achieve at least 5 metabolic equivalents, increase myocardial contractility and oxygen demand (dobutamine) or induce regional hypoperfusion through coronary vasodilation (adenosine, dipyridamole, and regadenoson).

This patient has atypical chest pain (subterminal pressure caused by exercise but not relieved with rest) and normal findings on ECG. The most appropriate diagnostic test to evaluate the patient’s chest pain is exercise electrocardiography. Because he is a candidate for the preferred type of stress test, alternative methods, including imaging with echocardiography or pharmacologic stress testing with dobutamine, are not indicated.

Cardiac catheterization would not be an appropriate intervention given the patient’s intermediate risk for cardiovascular disease. It might be appropriate if he had a high pretest probability of coronary artery disease or he had specific findings of coronary occlusion on stress testing.

**KEY POINT**
Exercise electrocardiography is the standard stress test used to diagnose coronary artery disease in patients who have normal findings on baseline electrocardiogram and are able to exercise.

Bibliography

Item 8  Answer:  C  
Educational Objective:  Evaluate a woman with atypical chest pain.

This patient should undergo exercise electrocardiography (ECG). She has several risk factors for coronary artery disease (CAD), including hypertension, hypercholesterolemia, and a family history of premature CAD. Her symptoms are not typical of angina (her chest discomfort is localized, sharp, and not reproducible with exertion), and the resting ECG is normal. Because this patient has multiple risk factors and atypical symptoms, the pretest probability that CAD is the cause of her symptoms is intermediate. The results of exercise ECG testing, whether normal or abnormal, will significantly affect the
posttest probability of CAD. Exercise testing is recommended as the initial test in patients with an intermediate pretest probability of CAD based on age, sex, and symptoms, including patients with right bundle branch block or ST-segment depression of less than 1 mm at baseline. In addition, the results of the exercise ECG test will provide prognostic information about the risk of death and myocardial infarction on the basis of exercise duration, angina, and the magnitude of ST-segment depression.

Coronary angiography is not appropriate for this patient because the pretest probability of CAD is intermediate, which is too low to warrant immediate coronary angiography as the initial diagnostic test.

Although exercise ECG testing has been found to have lower specificity and a higher false-positive rate in women than in men, the routine use of exercise testing with echocardiography to assess left ventricular regional wall motion or perfusion imaging is not recommended for either women or men in the absence of baseline ECG abnormalities. Although echocardiography increases the sensitivity of the ECG results, the use of stress echocardiography as the initial test has not been found to reduce cardiovascular events compared with exercise ECG testing alone.

Pharmacologic stress testing is not indicated because this patient is physically able to exercise. Pharmacologic agents include dobutamine (which increases heart rate and myocardial contractility) and vasodilators (which cause relative increases in coronary blood flow in myocardial regions that are not supplied by stenotic vessels). Exercise is preferred over pharmacologic treatment because of the additional diagnostic and prognostic information provided by exercise testing.

**KEY POINT**

Although exercise electrocardiography is associated with a higher false-positive rate in women, it is the recommended modality for noninvasive diagnostic testing in women who are able to exercise and have interpretable electrocardiograms.

**Bibliography**


**Item 9**  **Answer:** C

**Educational Objective:** Treat continuing angina in a patient with chronic stable coronary artery disease.

In this patient with coronary artery disease and continuing angina, the medical therapy should be optimized by increasing the dosage of β-blocker. Physical examination is notable for blood pressure and heart rate that would allow further up-titration of the β-blocker dosage. Complete β-blockade typically results in a resting pulse rate of approximately 55 to 60/min. Therefore, the pulse rate of 80/min suggests that the dosage of metoprolol should be increased. β-blockers are particularly effective antianginal medications because they decrease heart rate, myocardial contractility, and systemic blood pressure, thereby lowering myocardial oxygen demand.

Calcium channel blockers are first-line antianginal therapy in patients with contraindications to β-blockers. In patients with continuing angina despite optimal dosages of β-blocker and nitrates, a calcium channel blocker may be added. A calcium channel blocker such as diltiazem is not indicated in this patient because his dosage of metoprolol is not yet optimal.

Ranolazine should be considered only in patients who remain symptomatic despite optimal dosages of β-blockers, calcium channel blockers, and nitrates. Ranolazine decreases angina symptoms but is significantly more expensive and less effective than the usual antianginal medications.

Coronary angiography may be indicated in a patient who is receiving maximal medical therapy with continued symptoms of angina that affect quality of life. Referral for coronary angiography is not indicated for this patient because he is not currently receiving optimal medical therapy.

**KEY POINT**

In the treatment of chronic stable angina, the β-blocker dose is adjusted to achieve a resting pulse rate of approximately 55 to 60/min.

**Bibliography**


**Item 10**  **Answer:** A

**Educational Objective:** Evaluate chronic stable angina.

Coronary angiography is the most appropriate option in this patient who has had continued symptoms of angina despite optimal medical therapy. Although it has been shown that a routine strategy of coronary angiography and revascularization provides no benefit compared with optimal medical therapy in patients with chronic stable angina, coronary angiography may be of benefit in patients who are highly symptomatic despite optimal medical therapy, such as this patient. Coronary angiography allows direct evaluation of the coronary anatomy, with possible percutaneous coronary intervention or surgical revascularization if indicated. Coronary revascularization has been shown to be beneficial in patients with chronic stable angina and the following conditions: angina pectoris that is refractory to medical therapy; a large area of ischemic myocardium and high-risk criteria on stress testing; high-risk coronary anatomy, including left main coronary artery stenosis or three-vessel disease; and significant coronary artery disease with reduced left ventricular systolic function. In appropriately selected patients, revascularization, with either percutaneous coronary intervention or coronary artery bypass grafting surgery, has been shown to reduce angina, increase longevity, and improve left ventricular performance.

Exercise treadmill stress testing would not be useful in the management of this patient because it would only confirm the known diagnosis of coronary artery disease. Results of an exercise stress test would not influence therapeutic decisions.

Although β-blockers and nitrates are effective antianginal medications, the patient is receiving near-maximal doses of both drugs, as indicated by his pulse rate, which shows effective β-blockade, and his blood pressure, which likely would not tolerate an increase in the dosage of either medication.

**KEY POINT**

Coronary angiography is indicated in patients with chronic stable angina who have lifestyle-limiting angina despite optimal medical therapy.

**Bibliography**

Item 11  
Answer:  A

Educational Objective:  
Manage chest pain in the emergency department.

The most appropriate management of this patient’s chest pain is admission to the telemetry unit and ongoing assessment with serial electrocardiograms and troponin measurements. Based on this patient’s age and the substernal nature of his chest pain, there is at least an intermediate likelihood of an acute coronary syndrome. The decision to hospitalize a patient with chest pain is challenging. The goal is to identify patients with life-threatening disease who require immediate attention while minimizing unnecessary evaluation and treatment in others. A rapid clinical determination of the likelihood of an acute coronary syndrome is the essential first task and should guide the admission decision. In addition, the physician should consider the likelihood of short-term adverse outcomes, including death and nonfatal myocardial infarction, in patients with acute coronary syndrome. When acute coronary syndrome is suspected, the patient should be admitted for evaluation and management. Low-risk patients can be further stratified with stress testing.

At this point, the patient does not have an indication for coronary angiography and acute intervention. If further chest pain develops in association with ST-segment or T-wave changes on electrocardiography or elevated cardiac enzyme levels and the patient is considered high risk according to his TIMI (Thrombolysis in Myocardial Infarction) score, cardiac angiography would be reasonable.

The most common gastrointestinal cause of chest pain is gastroesophageal reflux disease (GERD). Although the pain associated with GERD is often described as burning, it can mimic angina and may be relieved by nitroglycerin. It generally is worsened with bending over or recumbency and is relieved with antacids, histamine-2 blockers, or proton pump inhibitors. Because acute coronary syndrome is a life-threatening condition, this diagnosis must be addressed first. In addition, the preferred initial diagnostic test for GERD is a therapeutic trial of a proton pump inhibitor, not esophageal pH monitoring.

Cardiac stress testing can be highly valuable in identifying significant coronary insufficiency, and it would be the best test of choice to diagnose stable angina. However, in the acute setting, stress testing is contraindicated in a patient with possible acute coronary syndrome. Once the patient is stabilized and acute coronary syndrome is excluded, stress testing can be used to further stratify risk in a low- or intermediate-risk patient. In this patient, the preferred cardiac stress test is an exercise stress test, not a pharmacologic stress test with nuclear imaging.

Item 12  
Answer:  A

Educational Objective:  
Treat an ST-elevation myocardial infarction with thrombolytic therapy.

The most appropriate initial management of this patient consists of aspirin, heparin, intravenous nitroglycerin, and thrombolytic therapy. This patient has evidence of an ST-elevation myocardial infarction (STEMI) with acute ST-segment changes present in the inferior leads and an elevated troponin T level. The treatment of choice for STEMI is reperfusion therapy. Reperfusion for patients with STEMI can be achieved with thrombolytic therapy or primary percutaneous coronary intervention (PCI). Many patients with STEMI in the United States present to non-PCI-capable hospitals; as a result, thrombolytic therapy and transfer for primary PCI are the available treatment options. The time to achieve balloon inflation is a major determinant of the benefits of PCI versus thrombolytic therapy. If PCI must be delayed, then thrombolytic therapy should be considered. Observational data from community hospitals within the United States have found that fewer than 5% of patients achieve the guideline-suggested door-to-balloon time of less than 90 minutes. A projected 2-hour delay to a PCI facility makes thrombolytic therapy the best option for this patient.

β-Blockers reduce mortality and should be given to all patients with acute coronary syndrome except those with heart failure, systolic blood pressure of less than 90 mm Hg, bradycardia (<50/min), or second-degree atrioventricular block. Because this patient’s heart rate is 48/min, metoprolol should not be administered. Treatment with heparin, clopidogrel, pravastatin, and intravenous nitroglycerin without thrombolytic therapy does not address the need for immediate myocardial reperfusion and is not adequate treatment for this patient.

**KEY POINT**

The time to achieve balloon inflation within 90 minutes is a major determinant of the benefits of percutaneous coronary intervention versus thrombolytic therapy.

**Bibliography**


Item 13  
Answer:  A

Educational Objective:  
Manage non-ST-elevation myocardial infarction.

The most appropriate next test is cardiac catheterization. Although chest pain is the most common presenting symptom for an acute coronary syndrome, women and patients with diabetes are more likely to have atypical angina symptoms, such as fatigue, dyspnea, and nausea. Acute coronary syndromes include unstable angina, non-ST-elevation myocardial infarction (NSTEMI), and ST-elevation myocardial infarction (STEMI). Patients with ischemic chest pain and STEMI benefit from reperfusion therapy, either thrombolytic therapy or primary angioplasty. Patients with NSTEMI or unstable angina are a heterogeneous group and require risk stratification (determination of their risk of death or nonfatal myocardial infarction) to direct therapy. Although patients with unstable angina may have similar electrocardiographic findings to those with NSTEMI, they can be differentiated by the lack of elevation in serum cardiac biomark-