Section I

Cardiovascular Medicine

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High Value Care Recommendations

- Use of antioxidant vitamins or hormone replacement therapy in postmenopausal women is not recommended for CAD risk reduction.
- Testing homocysteine levels should not be performed as part of routine cardiovascular risk assessment.
- The American Heart Association and Centers for Disease Control and Prevention do not recommend routine measurement of hs-CRP, but measurement may be useful in patients with a moderate (10%-20%) 10-year risk of a first CAD event.
- Asymptomatic patients without cardiovascular risk factors should not undergo routine screening for CAD, either with electrocardiography or stress testing.
- CT-based coronary artery calcium scoring is an evolving technology with unclear benefit in predicting cardiovascular risk relative to traditional risk-prediction tools; it should therefore not be used routinely.
- Patients with a low probability of CAD do not require stress testing, and patients with a high probability of CAD should be started immediately on medical management, with consideration of coronary angiography if there is no response to therapy or if severe disease is suspected.
- PET with CT is a complex and expensive diagnostic modality and its appropriate role in evaluating chronic stable angina remains to be established.
- Patients with an abnormal stress test who do not have factors suggestive of severe CAD may benefit from initial medical management.
- Percutaneous coronary intervention (PCI; angioplasty and stent placement) has not been shown to reduce mortality or cardiovascular events in patients with stable CAD, but it has been shown to reduce angina and to improve quality of life. PCI is most appropriately used in patients who do not respond to medical therapy.
- Routine resting ECGs are not recommended if there have been no changes in symptoms, examination findings, or medications. A repeat stress test is indicated if there is a change in symptoms but should not be performed routinely.
- Although newer oral anticoagulant medications do not require routine monitoring of their anticoagulation effect and may have several other potential advantages, they are significantly more expensive than warfarin.
- Echocardiography should not be used to screen for heart failure in asymptomatic patients without murmurs.
- Do not routinely measure BNP in patients with typical signs and symptoms of heart failure.
- Once heart failure is diagnosed, serial chest radiographs are not sensitive to small changes in pulmonary vascular congestion and are not recommended.
- Combined treatment with an ACE inhibitor and an ARB is not recommended as additional benefit of using these two medications together is not well established.
- Spironolactone is usually first-line therapy due to clinical experience and cost considerations; however, the more receptor-specific eplerenone may be useful in individuals developing gynecomastia with spironolactone.
- Echocardiographic reassessment of ejection fraction is most useful when there is a notable change in clinical status rather than at regular or arbitrary intervals.
- Not all systolic murmurs are pathologic. Short, soft systolic murmurs (grade <3) that are asymptomatic often do not require further investigation.
- Routine serial echocardiography is not needed in asymptomatic patients with prosthetic heart valves.
- For most patients, imaging studies are not needed for routine monitoring of PAD, but may be indicated if intervention is felt to be needed.
- In patients with a low likelihood of disease, D-dimer testing may be useful in excluding the diagnosis of dissection.
- Screening for carotid stenosis is not recommended in the general population.
- Carotid artery stenting is usually associated with a higher risk of stroke than surgery and is not routinely performed in patients with carotid stenosis.
- Patients with a low clinical likelihood of DVT should undergo testing with D-dimer as the combination of a low clinical probability, and negative D-dimer rules out DVT.
- There is no indication for routine screening for DVT in asymptomatic patients at risk for VTE.
- Newer oral anticoagulation medications tend to be very expensive and their long-term safety remains to be established.
Chapter 1

Approach to Chest Pain

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Chest pain is one of the most common complaints in internal medicine. The differential diagnosis of chest pain includes cardiac, pulmonary, gastrointestinal, musculoskeletal, and psychiatric causes (Table 1). In outpatients, the most common cause is musculoskeletal chest pain, although up to 12% of patients may have chest pain secondary to myocardial ischemia. A prudent approach to treating patients with acute chest pain focuses the initial evaluation on six potentially lethal conditions (the “serious six”): acute coronary syndrome, pulmonary embolism (PE), pericarditis/pericardial tamponade, pneumothorax, aortic dissection, and esophageal rupture.

Cardiac Causes

Acute coronary syndrome (ACS) is an important cause of acute chest pain. Although only 15% to 30% of patients presenting to emergency departments with nontraumatic chest pain have ACS, the 28-day mortality rate of ACS may be as high as 10%. ACS refers to a spectrum of diseases, including unstable angina. Non-ST-segment elevation myocardial infarction, and ST-segment elevation myocardial infarction, based on electrocardiographic (ECG) changes and the presence of cardiac biomarkers (see Chapter 3). Patients with acute cardiac ischemia classically present with substernal pressure, tightness, or heaviness, with radiation to the jaw, shoulders, back, or arms. The pain may be accompanied by dyspnea, diaphoresis, and nausea. Up to 30% of patients, particularly those with diabetes mellitus, women, and the elderly, may present with atypical symptoms, such as dyspnea without chest pain. ACS should be particularly suspected in patients with atherosclerotic disease risk factors such as diabetes, hypertension, and hyperlipidemia.

The most powerful clinical features that increase the probability of myocardial infarction (MI) include chest pain that simultaneously radiates to both arms (positive likelihood ratio = 9.7) and an S₃ (positive likelihood ratio = 3.2). Pain that increases with exertion is

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COPD = chronic obstructive pulmonary disease; CT = computed tomography; CXR = chest x-ray; ECG = electrocardiographic; MI = myocardial infarction; VTE = venous thromboembolism.
also suggestive of ACS. Features that make an ischemic cause less likely include a normal ECG result (negative likelihood ratio = 0.1-0.3), chest pain that is positional (negative likelihood ratio = 0.3), chest pain reproduced by palpation (negative likelihood ratio = 0.2-0.4), or chest pain that is sharp or stabbing (negative likelihood ratio = 0.3). Patients suspected of having ACS are hospitalized and evaluated with serial ECGs and cardiac biomarkers. Low-risk patients without evidence of MI are evaluated with exercise or pharmacologic stress testing, as indicated. Higher-risk patients or those with ST-segment elevations undergo urgent cardiac catheterization.

Cocaine use can cause chest pain and ST-segment changes due to vasospasm, even in patients without significant occlusive coronary artery disease, and may result in myocardial injury.

Pericarditis is characterized by sudden onset of sharp, stabbing, substernal chest pain with radiation along the trapezius ridge. Often, the pain is worse with inspiration and lying flat and is alleviated with sitting and leaning forward. A pericardial friction rub is present in 85% to 100% of cases at some time during the course of pericarditis. Given the ephemeral nature of the friction rub, its absence does not rule out pericarditis. The classic rub consists of three components: occurring during atrial systole, ventricular systole, and ventricular diastole. A confirmatory ECG reading will show diffuse ST-segment elevation and P-R segment depression, findings that are specific but not sensitive (Figure 1). An echocardiogram may be helpful if there is suspicion of significant pericardial effusion or pericardial tamponade. Acute pericarditis secondary to infection (viral or bacterial) may be preceded or accompanied by symptoms of an upper respiratory tract infection and fever. In patients with acute pericarditis, hospitalization is prompted by an associated MI, pyogenic infection, or tamponade. Outpatient management is appropriate if other potentially serious causes of chest pain are excluded, hemodynamic status is normal, and a moderate or large pericardial effusion is excluded by echocardiography. In the absence of a specific cause for acute pericarditis, anti-inflammatory therapy with nonsteroidal anti-inflammatory drugs (NSAIDs) is the mainstay of treatment.

Patients with dissection of the thoracic aorta typically present with abrupt onset of severe, sharp, or “tearing” chest pain often radiating to the abdomen, or with back pain. Although dissection is fairly rare compared to other chest pain causes (an incidence of 3 per 100,000 patients per year), it can be rapidly life threatening. Aortic dissection can be associated with syncope due to decreased cardiac output, stroke and MI caused by carotid or coronary artery occlusion/dissection, cardiac tamponade, and sudden death due to rupture of the aorta. Hypertension is present in 50% of patients and is not helpful diagnostically. A pulse differential (diminished pulse compared with the contralateral side) on palpation of the carotid, radial, or femoral arteries is one of the most useful findings but is uncommon (sensitivity of 30%; positive likelihood ratio = 5.7). An early diastolic murmur due to acute aortic insufficiency may be heard, particularly if the dissection involves the ascending aorta, but the presence or absence of a diastolic murmur is not useful in ruling in or ruling out dissection. Focal deficits on neurologic examination can be present in a few patients but are highly suggestive in the proper clinical context (positive likelihood ratio = 6.6–33.0).

In patients with dissection of the thoracic aorta, a wide mediastinum on a chest radiograph is the most common initial finding (sensitivity of 85%); the absence of this finding helps but does not completely rule out dissection (negative likelihood ratio = 0.3). When aortic dissection is suspected, imaging the aorta is indicated. Computed tomography or magnetic resonance imaging of the chest, transesophageal echocardiography, and aortic root angiography all have a high sensitivity and specificity for detecting a dissection flap; the specific diagnostic modality chosen depends on how quickly the examination can be performed and the patient’s stability. Because of an increased risk of coronary artery dissection and tamponade with dissection progression, dissections involving the ascending aorta and

Figure 1. Electrocardiogram showing sinus rhythm with diffuse ST-segment elevation consistent with acute pericarditis. Note also the PR-segment depression in leads I, II, and V4, V6.
Pulmonary Causes

Patients with PE may present with acute pleuritic chest pain (45% to 75% of cases), dyspnea, and, less often, cough and hemoptysis (see Chapter 8). Physical examination findings are nonspecific but may include tachypnea and tachycardia. ECG readings may also show findings of right ventricular strain, but the most common finding is sinus tachycardia. Well’s criteria can help predict pretest probability of PE and dictate further testing. A negative D-dimer, a test for PE with a high specificity but low sensitivity, can exclude the diagnosis when clinical suspicion is low. When suspicion is moderate or high, however, a spiral computed tomography scan or a ventilation-perfusion lung scan is an appropriate initial approach.

Pleuritic chest pain can also be a manifestation of pneumonia and is associated with fever, chills, cough, purulent sputum, and dyspnea (see Chapter 57). The physical examination may show wheezing or crackles and signs of consolidation, such as dullness to percussion, egophony, and bronchophony. Chest x-ray is considered the gold standard for pneumonia diagnosis and is an appropriate initial diagnostic test for any case of chest pain with a possible pulmonary etiology.

Pneumothorax should be considered in any patient with sudden onset of pleuritic chest pain and dyspnea (see Chapter 91). It is most common in smokers, especially those with chronic obstructive pulmonary disease. The physical examination may reveal decreased breath sounds on the affected side; if a tension pneumothorax is present, hypotension and tracheal deviation to the opposite side of the pneumothorax may be noted. Chest radiography shows a lack of lung markings on the affected side. In tension pneumothorax, there is a shift of the mediastinum away from the side of the pneumothorax, whereas hydropneumothorax is identified by the presence of concomitant pleural fluid.

Gastrointestinal Causes

Gastroesophageal reflux disease (GERD) can also cause chest pain. Although sometimes difficult to differentiate from ischemic cardiac chest pain, GERD pain often lasts minutes to hours and resolves spontaneously or with antacids (see Chapter 18). Chest discomfort associated with GERD may also depend on the patient’s position, being worse when lying down and after meals or upon awakening the patient from sleep. Other symptoms may include heartburn, regurgitation, chronic cough, sore throat, and hoarseness. On physical examination, patients may exhibit wheezing, halitosis, dental erosions, and pharyngeal erythema. In unclear cases, it is most appropriate to exclude cardiac causes of chest pain before evaluating gastrointestinal causes. For patients with a high probability of GERD, empiric treatment with a proton pump inhibitor for 4 to 6 weeks is an appropriate initial diagnostic and therapeutic approach.

Patients with spontaneous esophageal rupture typically have severe retching and vomiting followed by excruciating retrosternal chest and upper abdominal pain. These symptoms are followed by the rapid development of odynophagia, tachypnea, dyspnea, cyanosis, fever, and shock. Many cases are related to excessive alcohol ingestion. Chest radiography may show pneumomediastinum, although computed tomography is more sensitive for making this diagnosis. Patients with acute cholecystitis frequently present with right upper quadrant and lower chest pain that may radiate to the right shoulder and is associated with nausea, vomiting, and fever (see Chapter 23). On physical examination, deep palpation during inspiration can elicit pain in the right upper quadrant and cause inspiratory arrest (Murphy sign).

Musculoskeletal Causes

Musculoskeletal causes of chest pain are more common in women than in men. Frequent causes of musculoskeletal chest pain include costochondritis, arthritis, and shoulder rotator cuff injuries. Musculoskeletal chest pain has an insidious onset and may last for hours to weeks. It is most recognizable when 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. The cardiovascular examination often is normal. For musculoskeletal chest pain, the history and physical examination are keys to the diagnosis; selected radiographic studies and laboratory tests may be indicated depending on the clinical circumstances.

Psychiatric Causes

Chest pain can be a manifestation of severe anxiety and panic attacks. Patients may complain of sweating, trembling, or shaking; sensations of choking, shortness of breath, or smothering; nausea or abdominal distress; or feeling dizzy, unsteady, or lightheaded. On physical examination, tachycardia and tachypnea may be present, but the cardiovascular and pulmonary examinations are otherwise unremarkable. Generalized anxiety and panic attacks may be treated with cognitive behavioral therapy and selective serotonin reuptake inhibitors or venlafaxine. Panic disorder stands alone among the anxiety spectrum disorders as a condition for which there is evidence that the combination of cognitive behavioral therapy and pharmacotherapy is superior to either treatment modality alone. Psychosomatic chest pain is a clinical diagnosis; other causes of chest pain are usually excluded by a careful history and physical examination.

Skin Causes

Herpes zoster can present in patients with thoracic dermatomes and lead to chest pain. Pain is classically described as intense, burning, and localized to the dermatome involved. Physical exam reveals unilateral vesicular lesions, although pain often precedes the appearance of these classic lesions. Pain persisting after the disappearance of the skin findings (postherpetic neuralgia) is also common.

Bibliography