Evaluation and Diagnosis of Chest Pain

About the Guideline

- The guideline writing committee consisted of cardiac intensivists, cardiac interventionalists, cardiac surgeons, cardiologists, emergency physicians, epidemiologists, and a patient representative. Representatives from the American College of Cardiology (ACC), American Heart Association (AHA), American Society of Echocardiography (ASE), American College of Chest Physicians (CHEST), Society for Academic Emergency Medicine (SAEM), Society of Cardiovascular Computed Tomography (SCCT), and Society for Cardiovascular Magnetic Resonance (SCMR) were included.
- This document was reviewed by 16 official reviewers nominated by the ACC, the American College of Emergency Physicians, AHA, ASE, American Society of Nuclear Cardiology, CHEST, SAEM, SCCT, and SCMR, and by 39 other individual content reviewers. It was approved by the governing bodies of the ACC and the AHA and was endorsed by the ASE, CHEST, SAEM, SCCT, and SCMR.
- The goal was to develop a guideline for the evaluation of acute or stable chest pain or other anginal equivalents, in various clinical settings, with an emphasis on the diagnosis of ischemic causes.

Overview

- Chest pain is one of the most common reasons that people seek medical care. It should be considered *acute* when it is new onset or has changed from previous episodes; it should be considered *stable* when symptoms are chronic and related to consistent precursors, such as exertion or stress.
- Patients may use terms such as pressure, tightness, squeezing, heaviness, or burning to describe chest pain and they may also report the pain in another location, such as the back, neck, arm, shoulder, upper abdomen, or jaw.
- The use of the term 'atypical' is discouraged; 'noncardiac' should be used if heart disease is not suspected.

Key Clinical Considerations

Become familiar with the recommendations and best-practice statements provided in this guideline, especially if you work in an acute care or outpatient setting.

Initial evaluation

History

- Obtain a focused history, including characteristics and duration of symptoms, associated features, and cardiovascular risk factors.
- Women
    - Women are at risk for underdiagnosis; always consider potential cardiac causes for chest pain.
    - Pay close attention to accompanying symptoms that are more common in women with acute coronary syndrome (ACS):
        - Nausea

        - Fatigue
        - Shortness of breath
- Adults older than 75 years
    - Consider ACS when accompanying symptoms such as shortness of breath, syncope, or acute delirium are present, or when an unexplained fall occurs.
- Diverse patient populations
    - Cultural competence training is recommended to improve outcomes of those with diverse racial and ethnic backgrounds.
    - Address language barriers by using formal translation services for those whose primary language is not English.
- Educate all patients and bystanders to call 911 to initiate transport to the closest emergency department (ED) by emergency medical services (EMS) when acute chest pain occurs.

Physical examination

- Perform a focused cardiovascular examination.
    - Identify life-threatening causes of chest pain.
        - ACS: diaphoresis, tachypnea, tachycardia, hypotension, crackles, S3, mitral regurgitation murmur
        - Pulmonary embolism (PE): tachycardia and dyspnea; pain with inspiration
        - Aortic dissection: connective tissue disorders and extremity pulse differential; severe pain, abrupt onset, and widened mediastinum on chest x-ray; syncope and aortic regurgitation
        - Esophageal rupture: emesis, subcutaneous emphysema, pneumothorax, unilateral decreased or absent breath sounds
    - Other causes
        - Aortic stenosis: systolic murmur, tardus or parvus carotid pulse
        - Aortic regurgitation: diastolic murmur at right sternum, rapid carotid upstroke
        - Hypertrophic cardiomyopathy (HCM): increased or displaced left ventricular impulse, prominent *a* wave in jugular venous pressure, systolic murmur
        - Pericarditis: fever; pleuritic chest pain increased in supine position; friction rub
        - Myocarditis: fever, chest pain, heart failure, S3
        - Esophagitis, peptic ulcer disease, gallbladder disease: epigastric tenderness, right upper quadrant tenderness, Murphy sign
        - Pneumonia: fever, localized chest pain (may be pleuritic), friction rub, dullness to percussion, egophony
        - Pneumothorax: dyspnea and pain on inspiration, unilateral absence of breath sounds
        - Costochondritis, Tietze syndrome: tenderness of costochondral joints
        - Herpes zoster: pain in dermatomal distribution, triggered by touch; characteristic rash (unilateral and dermatomal distribution)

Diagnostic testing

- Considerations by setting

  - Perform an electrocardiogram (ECG) in the office for patients with stable chest pain; if an ECG is unavailable, refer the patient to the emergency department (ED).
  - Transport (via EMS) patient with evidence of ACS or other life-threatening causes of acute chest pain to the ED.
  - For any patient with acute chest pain, regardless of setting, perform an ECG and review for ST-segment–elevation myocardial infarction (STEMI) within 10 minutes of arrival.
  - Measure high-sensitivity cardiac troponin (cTn) as soon as possible on any patient presenting to ED with acute chest pain and suspected ACS.
  - Avoid delayed transfer to the ED for cTn or other diagnostic testing for any patient with acute chest pain and suspected ACS who presents initially to the office setting.
- ECG
  - If initial ECG is nondiagnostic, perform serial ECGs when clinical suspicion for ACS is high, symptoms persist, or clinical condition deteriorates.
  - If ECG is consistent with ACS, treat according to STEMI if ST elevation is present, or according to non-ST-elevation MI (NSTE)-ACS guidelines if ST depression is identified.
  - If the initial ECG is nondiagnostic and intermediate to high suspicion for ACS, evaluating leads V7 to V9 can be done to rule out posterior MI.
- Chest x-ray
  - Chest x-ray may be used to screen for other causes of symptoms, including cardiac, pulmonary, and thoracic causes.
    - Heart failure: used to assess heart size and pulmonary congestion, and potential pulmonary causes that may contribute to symptoms
    - Aortic dissection: may demonstrate a widened mediastinum
    - Pulmonary embolism (PE): pleural effusions, pulmonary artery enlargement, and infiltrates
    - Other causes: pneumonia, pneumothorax, or rib fractures
- Biomarkers
  - Use serial cTn I or T levels to identify abnormal values or patterns indicative of acute myocardial injury.
  - High-sensitivity cTn is the preferred biomarker as it enables more rapid detection or exclusion of myocardial injury.
  - Be familiar with the cTn reference limits that define myocardial injury at your institution.
  - Creatine kinase myocardial (CK-MB) and myoglobin are not useful for diagnosing acute myocardial injury.

Cardiac testing

Consider site expertise, availability, usefulness, and cost when choosing testing modalities.

<u>Anatomic testing</u>

- Coronary computed tomography angiography (CCTA)

    - CCTA can visualize and help diagnose the extent and severity of nonobstructive and obstructive coronary artery disease (CAD), as well as plaque composition and high-risk features
- Invasive coronary angiography (ICA)
    - ICA can characterize and detect high-grade obstructive stenosis to inform the feasibility and necessity of percutaneous or surgical revascularization

Diagnostic testing

- Exercise ECG involves the patient performing graded exercise until fatigue, limiting chest pain or discomfort, marked ischemia, or a drop in blood pressure occurs.
- Echocardiography/stress echocardiography
    - Transthoracic echocardiogram (TTE) allows visualization of left ventricular (LV) and right ventricular (RV) function and regional wall motion abnormalities and can aid in differential diagnoses, which may help guide clinical decision-making.
    - Stress echocardiography can help define ischemia severity and stratify risk.
- Stress nuclear positron emission tomography (PET) or single-photon emission computed tomography (SPECT) myocardial perfusion imaging (MPI) can help detect perfusion abnormalities, provide measures of left ventricular function, and reveal high-risk findings, such as transient ischemic dilation.
- Cardiovascular magnetic resonance (CMR) imaging can accurately assess global and regional left and right ventricular function, detect and localize myocardial ischemia and infarction, determine myocardial viability, and detect myocardial edema and microvascular obstruction.

Considerations for pregnant, postpartum, and childbearing persons

- The risks and benefits of invasive angiography, SPECT, PET, or CCTA should be discussed with the patient.
- The lowest effective dose of ionizing radiation should be used, including considerations for tests with no radiation exposure.
- The use of gadolinium contrast should be discouraged and used only when necessary to guide clinical management and is expected to improve outcome.

Algorithms for Acute Chest Pain

Acute Chest Pain and Suspected ACS (not STEMI)

- Clinical decision pathways should be used to categorize the patient as low, intermediate, or high risk.
- After initial troponin sample collection, repeat measurements should be at 1 to 3 hours for high-sensitivity troponin (hs-cTn), and 3 to 6 hours for conventional troponin assays.
- A protocol for troponin sampling should be based on the particular assay available at the institution.
- When available, previous testing should be considered and incorporated into the clinical decision pathway.
- For patient with acute chest pain, normal ECG, and symptoms of ACS that began at least 3 hours before arrival in ED, a single hs-cTn below the limit of detection excludes myocardial injury.

- Low risk patients are those with a 30-day risk of death or major adverse cardiovascular events (MACE) less than 1%; discharge to home is reasonable and shared decision-making is beneficial to improve understanding and facilitate risk communication.
- For intermediate risk patients, prompt use of TTE is recommended; management in an observation unit is reasonable. Shared decision-making is beneficial to improve understanding and reduce low-value testing.
    - Patients with no known CAD
        - Anatomic testing may include CCTA or invasive coronary angioplasty (ICA).
        - Stress testing may include exercise ECG, stress echocardiography, stress PET/SPECT MPI, or stress CMR.
        - Additional diagnostic testing may include fractional flow reserve with CT (FFR-CT).
    - Patients with known CAD
        - Optimize guideline-directed medical therapy (GDMT) before additional cardiac testing is performed.
        - For those with worsening frequency of symptoms and a history of significant left main, proximal left anterior descending stenosis, or multivessel CAD on prior anatomic testing or history of prior coronary revascularization, ICA is recommended.
        - Other diagnostic tests may include CCTA, FFR-CT, or PET/SPECT MPI, CMR, or stress echocardiography.
- High risk patients include those with new ischemic changes on the ECG, troponin-confirmed acute myocardial injury, new-onset left ventricular systolic dysfunction (ejection fraction less than 40%), newly diagnosed moderate-severe ischemia on stress imaging, and/or a high-risk score on clinical decision pathways.
    - ICA is recommended.
    - If CAD has been excluded by CCTA or ICA, CMR or echocardiography can be used to examine for alternative causes.
- Patients with prior coronary artery bypass graft (CABG) surgery
    - Use stress imaging to evaluate for ischemia or CCTA to assess for graft stenosis or occlusion.
    - For patients for whom stress imaging features are equivocal or nondiagnostic for the presence of myocardial ischemia, ICA is reasonable when the findings will impact therapeutic decisions.
- For patients who experience acute unremitting chest pain during dialysis, transfer to an acute care setting via EMS is necessary.
- It is reasonable to consider cocaine and methamphetamine use as a cause of acute chest pain.

<u>Nonischemic cardiac pathologies</u>

- TTE is recommended for diagnosis.
- Suspected acute aortic syndrome (e.g., aortic dissection)
    - Computed tomography angiography (CTA) of the chest, abdomen, and pelvis is recommended.

    - If CT is contraindicated or unavailable, transesophageal echocardiography (TEE) or CMR should be performed.
- Suspected PE
    - CTA using a PE protocol is recommended.
    - Further testing should be guided by pretest risk stratification.
- Suspected myopericarditis
    - CMR with gadolinium contrast can distinguish myopericarditis from other causes, including myocardial infarction and nonobstructive coronary arteries (MINOCA).
    - CMR is useful if there is diagnostic uncertainty or to determine the presence and extent of myocardial and pericardial inflammation and fibrosis.
    - TTE can be used to determine the presence of ventricular wall motion abnormalities, pericardial effusion, valvular abnormalities, or restrictive physiology.
    - Noncontrast or contrast cardiac CT scan may be reasonable to assess pericardial thickening.
- Valvular heart disease (VHD)
    - TTE can help determine the presence, severity, and cause of VHD
    - TEE can be used if TTE diagnostic quality is inadequate.
    - CMR is reasonable as an alternative if TTE or TEE is nondiagnostic.

Suspected noncardiac causes

- If acute myocardial injury is ruled out, evaluate patients with persistent or recurrent symptoms for alternative diagnoses, including gastrointestinal syndromes and anxiety and other psychosomatic considerations.
- In patients with sickle cell disease, transfer via EMS to an acute care setting is recommended; ACS should be ruled out.

Stable chest pain

Patients with no known CAD

- Low risk patients
    - Use of validated scores to predict the pretest probability of obstructive CAD may be useful to identify low-risk patients for whom testing may be deferred.
    - When available, coronary artery calcium (CAC) testing or exercise testing without imaging are reasonable first-line tests.
- Intermediate-high risk patients
    - CCTA is effective for CAD diagnosis, risk stratification, and guiding treatment decisions.
    - Stress testing may include stress echocardiography, PET/SPECT MPI, CMR or exercise ECG.
    - TTE is appropriate to assess left ventricular function.
    - If results are positive or inconclusive, further testing may include FFR-CT, CCTA, CAC, further stress imaging, or ICA.

Patients with known CAD

- Optimize GDMT and preventive therapies.

- For patients with obstructive CAD, ICA is recommended.
    - CCTA can be used to evaluate bypass graft or stent patency.
    - Stress testing may include stress PET/SPECT MPI, CMR, or echocardiography for patients with stable chest pain; exercise treadmill testing can be useful as well.
    - Secondary testing may include calculation of myocardial blood flow reserve (MBFR).
- For patients who have had CABG surgery and whose noninvasive stress tests show moderate to severe ischemia, or who have indeterminate/nondiagnostic stress test results, ICA is recommended. Stress imaging or CCTA are also reasonable to evaluate for myocardial ischemia or to assess the graft.
- For patients with known nonobstructive CAD, CCTA is reasonable for determining plaque burden and progression to obstructive CAD, and guiding therapeutic decision-making.
    - If coronary stenosis is 40% to 90% on CCTA, FFR (FFR) assessment can be useful for diagnosis and decision-making regarding the use of ICA.
    - Stress imaging may include PET/SPECT, CMR, or echocardiography.
- For patients with suspected ischemia and no obstructive CAD (INOCA), it's reasonable to consider invasive coronary function testing, stress PET MPI with MBFR, stress CMR with MBFR measurement, and stress echocardiography.

Reference:

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