Complete Summary

GUIDELINE TITLE

Acute chest pain - no ECG or enzyme evidence of myocardial ischemia/infarction.

BIBLIOGRAPHIC SOURCE(S)

Stanford W, Yucel EK, Bettmann MA, Casciani T, Gomes AS, Grollman JH, Holtzman SR, Polak JF, Sacks D, Schoepf J, Jaff M, Moneta GL, Expert Panel on Cardiovascular Imaging. Acute chest pain: no ECG or enzyme evidence of myocardial ischemia/infarction. [online publication]. Reston (VA): American College of Radiology (ACR); 2005. 5 p. [39 references]

GUIDELINE STATUS

This is the current release of the guideline.

This guideline updates a previous version: American College of Radiology (ACR), Expert Panel on Cardiovascular Imaging. Acute chest pain - no ECG evidence of myocardial ischemia/infarction. Reston (VA): American College of Radiology (ACR); 2001. 5 p. (ACR appropriateness criteria).

The appropriateness criteria are reviewed annually and updated by the panels as needed, depending on introduction of new and highly significant scientific evidence.

COMPLETE SUMMARY CONTENT

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SCOPE

DISEASE/CONDITION(S)

Acute chest pain with no electrocardiogram (ECG) or enzyme evidence of myocardial ischemia/infarction

GUIDELINE CATEGORY

Diagnosis

CLINICAL SPECIALTY

Cardiology
Emergency Medicine
Family Practice
Internal Medicine
Nuclear Medicine
Radiology

INTENDED USERS

Health Plans
Hospitals
Managed Care Organizations
Physicians
Utilization Management

GUIDELINE OBJECTIVE(S)

To evaluate the appropriateness of initial radiologic examinations for patients with acute chest pain without electrocardiogram (ECG) or enzyme evidence of myocardial ischemia/infarction

TARGET POPULATION

Patients with acute chest pain with no electrocardiogram (ECG) or enzyme evidence of myocardial ischemia/infarction

INTERVENTIONS AND PRACTICES CONSIDERED

1. X-ray
    - Chest
    - Barium swallow and upper gastrointestinal (GI) series
    - Rib
    - Cervical spine
    - Thoracic spine
2. Computed tomography (CT)
    - Chest, multidetector (MDCT)
    - Chest, single detector
3. Magnetic resonance imaging (MRI), aortic
4. Magnetic resonance angiography (MRA)
    - Aortic
    - Pulmonary artery
5. Ultrasound (US)
    - Transthoracic echocardiography (TTE)
    - Transesophageal echocardiography (TEE)
    - Stress echocardiography

    - Gall bladder
    - Peripheral venous
6. Nuclear medicine (NUC)
    - Myocardial perfusion scan
    - Ventilation/perfusion (V/Q) scan
    - Bone scan
7. Positron emission tomography (PET), cardiac
8. Invasive (INV)
    - Catheter pulmonary angiography
    - Coronary angiography with left ventricular (LV) gram
9. Aortogram, thoracic

MAJOR OUTCOMES CONSIDERED

Utility of radiologic examinations in differential diagnosis

METHODOLOGY

METHODS USED TO COLLECT/SELECT EVIDENCE

Searches of Electronic Databases

DESCRIPTION OF METHODS USED TO COLLECT/SELECT THE EVIDENCE

The guideline developer performed literature searches of peer-reviewed medical journals, and the major applicable articles were identified and collected.

NUMBER OF SOURCE DOCUMENTS

The total number of source documents identified as the result of the literature search is not known.

METHODS USED TO ASSESS THE QUALITY AND STRENGTH OF THE EVIDENCE

Weighting According to a Rating Scheme (Scheme Not Given)

RATING SCHEME FOR THE STRENGTH OF THE EVIDENCE

Not stated

METHODS USED TO ANALYZE THE EVIDENCE

Systematic Review with Evidence Tables

DESCRIPTION OF THE METHODS USED TO ANALYZE THE EVIDENCE

One or two topic leaders within a panel assume the responsibility of developing an evidence table for each clinical condition, based on analysis of the current

literature. These tables serve as a basis for developing a narrative specific to each clinical condition.

METHODS USED TO FORMULATE THE RECOMMENDATIONS

Expert Consensus (Delphi)

DESCRIPTION OF METHODS USED TO FORMULATE THE RECOMMENDATIONS

Since data available from existing scientific studies are usually insufficient for meta-analysis, broad-based consensus techniques are needed to reach agreement in the formulation of the appropriateness criteria. The American College of Radiology (ACR) Appropriateness Criteria panels use a modified Delphi technique to arrive at consensus. Serial surveys are conducted by distributing questionnaires to consolidate expert opinions within each panel. These questionnaires are distributed to the participants along with the evidence table and narrative as developed by the topic leader(s). Questionnaires are completed by the participants in their own professional setting without influence of the other members. Voting is conducted using a scoring system from 1-9, indicating the least to the most appropriate imaging examination or therapeutic procedure. The survey results are collected, tabulated in anonymous fashion, and redistributed after each round. A maximum of three rounds is conducted and opinions are unified to the highest degree possible. Eighty percent agreement is considered a consensus. This modified Delphi technique enables individual, unbiased expression, is economical, easy to understand, and relatively simple to conduct.

If consensus cannot be reached by the Delphi technique, the panel is convened and group consensus techniques are utilized. The strengths and weaknesses of each test or procedure are discussed and consensus reached whenever possible. If "No consensus" appears in the rating column, reasons for this decision are added to the comment sections.

RATING SCHEME FOR THE STRENGTH OF THE RECOMMENDATIONS

Not applicable

COST ANALYSIS

A formal cost analysis was not performed and published cost analyses were not reviewed.

METHOD OF GUIDELINE VALIDATION

Internal Peer Review

DESCRIPTION OF METHOD OF GUIDELINE VALIDATION

Criteria developed by the Expert Panels are reviewed by the American College of Radiology (ACR) Committee on Appropriateness Criteria.

RECOMMENDATIONS

MAJOR RECOMMENDATIONS

ACR Appropriateness Criteria®

Clinical Condition: Acute Chest Pain: No ECG or Enzyme Evidence of Myocardial Ischemia/Infarction

Radiologic Exam Procedure	Appropriateness Rating	Comments
X-ray, chest	9	
NUC, myocardial perfusion scan	8	If myocardial etiology is suspected.
CT, chest, multi detector (MDCT)	8	Useful to rule out other sources for chest pain such as aortic dissection, pulmonary embolism, etc.
US, transthoracic echocardiography (TTE)	6	If CT is non-diagnostic.
US, transesophageal echocardiography (TEE)	6	To exclude aortic dissection. Especially if MDCT or MRI are not diagnostic and/or not available.
CT, chest, single detector	6	
MRI/MRA, aortic	6	
INV, catheter pulmonary angiography	6	If MDCT is non-diagnostic and pulmonary embolism is suspected.
NUC, V/Q scan	5	May be appropriate if contrast administration is contraindicated.
X-ray, barium swallow and upper GI series	4	
X-ray, rib	4	
X-ray, cervical spine	4	
X-ray, thoracic spine	4	
US, stress echocardiography	4	May be indicated if cardiac etiology is still suspected after negative CXR and MDCT.

Radiologic Exam Procedure	Appropriateness Rating	Comments
US, gall bladder	4	
US, peripheral venous	4	
MRA, pulmonary artery	4	
PET, cardiac	4	
Aortogram, thoracic	4	Unless results of less invasive tests are equivocal.
INV, coronary angiography with LV gram	4	Last choice for evaluation. Only if other tests are equivocal. Depends on noninvasive test.
NUC, bone scan	2	
Appropriateness Criteria Scale 1 2 3 4 5 6 7 8 9 1 = Least appropriate 9 = Most appropriate		

Note: Abbreviations used in the table are listed at the end of the "Major Recommendations" field.

Introduction

Patients frequently present to emergency departments with the classical anginal symptoms of chest tightness and left arm pain. If these symptoms are present and if an ECG shows evidence of ischemia, a cardiac etiology for the chest pain is favored. Ischemic pain can also masquerade as indigestion, muscle spasm, or myriad other complaints. Many patients, however, present with chest pain without strong evidence of a cardiac etiology, that is, with a normal or nondiagnostic ECG and serum markers (i.e., troponins). In such patients, other diagnoses need to be considered, and other imaging modalities need to be utilized.

Imaging modalities useful in evaluating patients presenting to the emergency department without ECG or troponin evidence of myocardial infarction/angina, but with suspected cardiac origin for the chest pain are chest film, TEE and TTE, thallium 201 and technetium 99m perfusion studies, positron emission tomography, technetium 99m pyrophosphate infarct avid imaging, radionuclide ventriculography, cardiac catheterization, and the CT determination of coronary calcium. Imaging modalities to evaluate what are thought to be noncardiac causes of chest pain include cervical and thoracic spine films, barium upper GI studies, radionuclide esophageal transit time studies, pulmonary angiography, V/Q scans, CT spine, aortic, and pulmonary artery studies, MRI spine and aortic studies, abdominal ultrasound, and possibly mammography.

Chest Film

The chest film is extremely important in evaluating patients presenting to the emergency room with chest pain, and it is usually the initial imaging study obtained. Plain chest films can be diagnostic in pneumothorax, pneumomediastinum, fractured ribs, acute or chronic infections, and malignancies. Other conditions producing chest pain, such as aortic aneurysms or dissections and pulmonary emboli, may be suspected from the chest film, but the overall sensitivity is very low.

Calcifications may indicate pericardial disease, ventricular aneurysms, intracardiac thrombi, or aortic disease. The presence of a Hampton hump, Westermark sign, or pulmonary artery enlargement may indicate pulmonary embolism. Mediastinal air may indicate a ruptured viscus or rupture of a subpleural bleb.

Transthoracic and Transesophageal Echocardiography

TTE and TEE with or without pharmacologic stress can help define a cardiac origin for chest pain when abnormalities of ventricular wall motion are present. TTE may additionally be helpful in diagnosing pericarditis, pericardial effusion, valvular dysfunction, and/or intracardiac thrombus. TTE is helpful in diagnosing aortic dissection, intracardiac thrombus, and valvular dysfunction. With TEE, the arch of the aorta and the upper abdominal aorta are less well visualized; however, the ascending and descending aorta are usually well seen. In a small number of patients, mitral valve prolapse may be the cause for the chest pain, and this condition could be recognized using transesophageal echocardiography. Pharmacologic stress can add an additional element of risk stratification to the echocardiographic examination, particularly if coronary artery occlusive disease remains a concern.

Conventional, Helical, and Electron Beam Computed Tomography

Conventional CT can be diagnostic in pneumothorax, pneumonia, malignancies, and chronic pulmonary disorders such as fibrosis and granulomatous disease. It can also help to confirm central pulmonary emboli, pulmonary infarcts, and aortic aneurysms and dissections. Complications of aortic aneurysms such as leaks are also identifiable with CT. Pericardial effusions, thickening, and calcifications are readily seen. Electron beam CT and helical CT are additionally helpful by diagnosing coronary artery calcification (atherosclerosis) as the possible cause of the chest pain, although specificity is low. Conversely, the absence of calcium is an excellent indicator of the absence of significant coronary stenosis. Both types of CT have additional utility in defining ventricular aneurysms, wall motion abnormalities, and thrombus resulting from myocardial infarction. CT angiography (CTA) is gaining utility in evaluating coronary stenosis and detecting the presence of anomalous coronary arteries. MDCT is the current standard rather than single-slice CT.

Cervical and Thoracic Spine Films

Films of the cervical and thoracic spine may be indicated to establish vertebral abnormalities (e.g., vertebral body collapse or fracture) as a cause of chest pain.

Radionuclide Studies

Myocardial perfusion studies using thallium 201, technetium 99m sestamibi, or tetrofosmin scintigraphy can identify perfusion abnormalities and help in establishing a cardiac cause for the chest pain.

Radionuclide ventriculography can also help establish a cardiac etiology for the chest pain by demonstrating abnormalities of ventricular wall motion secondary to ischemia/infarction.

Infarct avid imaging with technetium 99m pyrophosphate can identify acute myocardial infarction at 12-36 hours after infarct by showing radioactive tracer uptake at the infarction site.

Positron emission tomography can reliably show myocardial perfusion deficits using N13 ammonia agents and can document anaerobic myocardial metabolism using F18 fluorodeoxyglucose. Again, these tests may be of help in the patient suspected of having a cardiac etiology for the chest pain and in whom the ECG and troponin are nondiagnostic.

Magnetic Resonance

MRI has utility in demonstrating spinal abnormalities and nerve root compression as a cause of chest pain. It also has utility in demonstrating myocardial wall motion abnormalities and/or pericardial thickening and effusion. At times intracardiac thrombi can be seen; however, other tests are usually better for establishing cardiac etiologies as the source of the chest pain. Magnetic resonance perfusion agents can show either a "cold spot" of myocardial infarction with the use of T1 enhancing agents or a "hot spot," using magnetic susceptibility agents. These techniques may be helpful in establishing a cardiac etiology for the chest pain where the ECG and troponin are either negative or nondiagnostic. MR imaging incorporating dobutamine and other pharmacologic stress agents increases sensitivity in determining a cardiac etiology for chest pain.

Cardiac Catheterization

Cardiac catheterization with coronary angiography is the "gold standard" for demonstrating coronary pathology. This is usually the final diagnostic test in defining heart disease, although MDCT has recently shown promise as an accurate noninvasive alternative, particularly if the diagnosis is in question.

Barium Swallow/Endoscopy

Esophageal disorders may be the cause of chest pain in patients presenting to the emergency department with symptoms typical of angina but with negative ECG and troponins. A barium swallow or endoscopy and, in some cases, radionuclide transit studies may be of help in diagnosing esophageal spasm or reflux as an etiology of the chest pain.

Abdominal Plain Films

In limited instances, cholecystitis or cholangitis, renal disease, perforated viscus, or diaphragmatic abnormalities may be an etiology for chest pain. These disorders can often be suspected from an abdominal plain film.

Abdominal Ultrasonography

Abdominal ultrasound may be indicated in establishing cholecystitis as a cause for the chest pain. Ultrasound is also helpful in evaluating pancreatitis and/or abscesses and other fluid collections.

Pulmonary Angiography

Pulmonary angiography had been considered to be the definitive test in patients with suspected pulmonary embolism. Multidetector CT angiography has largely replaced catheter pulmonary angiography. In addition to being noninvasive and having the ability to demonstrate smaller emboli, it has the added advantage of demonstrating other abnormalities that may be the cause of the chest pain, such as neoplasm or pulmonary airspace disease. The ventilation/perfusion scan is rapidly being replaced by MDCT. At times it can be additionally helpful in establishing pulmonary embolism as the etiology for the chest pain, although it is now generally reserved for patients who cannot undergo CT pulmonary angiography.

Mammography

On rare occasions fat necrosis or breast abscess can masquerade as angina. If these conditions are suspected, a mammogram, breast ultrasound, or MR studies may be indicated.

Aortography

As with pulmonary angiography, catheter-based aortography had been considered the definitive imaging procedure in patients with aortic dissection or aneurysmal disease. It has now been almost completely replaced by CTA or MRA, as both are rapid, noninvasive, and able not only to define the aortic lumen but also to characterize the aortic wall and other pathology.

Summary

Although the patient's history is the most important factor in establishing the etiology in patients presenting to the emergency department with chest pain, other imaging modalities are frequently used. The chest film is almost universally obtained; CT, MRI, radionuclide studies, barium swallow, spine studies, plain films, and angiography are useful when specific diagnoses are considered.

Abbreviations

- CT, computed tomography
- CXR, chest x-ray
- ECG, electrocardiogram
- GI, gastrointestinal

- INV, invasive
- LV, left ventricular
- MDCT, multidetector computed tomography
- MRA, magnetic resonance angiography
- MRI, magnetic resonance imaging
- NUC, nuclear medicine
- PET, positron emission tomography
- TEE, transesophageal echocardiography
- TTE, transthoracic echocardiography
- US, ultrasound
- V/Q, ventilation/perfusion scan

CLINICAL ALGORITHM(S)

Algorithms were not developed from criteria guidelines

EVIDENCE SUPPORTING THE RECOMMENDATIONS

TYPE OF EVIDENCE SUPPORTING THE RECOMMENDATIONS

The recommendations are based on analysis of the current literature and expert panel consensus.

BENEFITS/HARMS OF IMPLEMENTING THE GUIDELINE RECOMMENDATIONS

POTENTIAL BENEFITS

Selection of appropriate radiologic imaging procedures for evaluation of patients with acute chest pain with no electrocardiogram (ECG) or enzyme evidence of myocardial ischemia/infarction

POTENTIAL HARMS

Not stated

QUALIFYING STATEMENTS

QUALIFYING STATEMENTS

An American College of Radiology (ACR) Committee on Appropriateness Criteria and its expert panels have developed criteria for determining appropriate imaging examinations for diagnosis and treatment of specified medical condition(s). These criteria are intended to guide radiologists, radiation oncologists, and referring physicians in making decisions regarding radiologic imaging and treatment. Generally, the complexity and severity of a patient's clinical condition should dictate the selection of appropriate imaging procedures or treatments. Only those exams generally used for evaluation of the patient's condition are ranked. Other imaging studies necessary to evaluate other co-existent diseases or other medical consequences of this condition are not considered in this document. The availability of equipment or personnel may influence the selection of appropriate

imaging procedures or treatments. Imaging techniques classified as investigational by the U.S. Food and Drug Administration (FDA) have not been considered in developing these criteria; however, study of new equipment and applications should be encouraged. The ultimate decision regarding the appropriateness of any specific radiologic examination or treatment must be made by the referring physician and radiologist in light of all the circumstances presented in an individual examination.

IMPLEMENTATION OF THE GUIDELINE

DESCRIPTION OF IMPLEMENTATION STRATEGY

An implementation strategy was not provided.

IMPLEMENTATION TOOLS

Personal Digital Assistant (PDA) Downloads

For information about availability, see the "Availability of Companion Documents" and "Patient Resources" fields below.

INSTITUTE OF MEDICINE (IOM) NATIONAL HEALTHCARE QUALITY REPORT CATEGORIES

IOM CARE NEED

Getting Better

IOM DOMAIN

Effectiveness

IDENTIFYING INFORMATION AND AVAILABILITY

BIBLIOGRAPHIC SOURCE(S)

Stanford W, Yucel EK, Bettmann MA, Casciani T, Gomes AS, Grollman JH, Holtzman SR, Polak JF, Sacks D, Schoepf J, Jaff M, Moneta GL, Expert Panel on Cardiovascular Imaging. Acute chest pain: no ECG or enzyme evidence of myocardial ischemia/infarction. [online publication]. Reston (VA): American College of Radiology (ACR); 2005. 5 p. [39 references]

ADAPTATION

Not applicable: The guideline was not adapted from another source.

DATE RELEASED

1998 (revised 2005)

GUIDELINE DEVELOPER(S)

American College of Radiology - Medical Specialty Society

SOURCE(S) OF FUNDING

American College of Radiology (ACR) provided the funding and the resources for these ACR Appropriateness Criteria®.

GUIDELINE COMMITTEE

Committee on Appropriateness Criteria, Expert Panel on Cardiovascular Imaging

COMPOSITION OF GROUP THAT AUTHORED THE GUIDELINE

Panel Members: William Stanford, MD; E. Kent Yucel, MD (Panel Chair); Michael A. Bettmann, MD; Thomas Casciani, MD; Antoinette S. Gomes, MD; Julius H. Grollman, MD; Stephen R. Holtzman, MD; Joseph F. Polak, MD, MPH; David Sacks, MD; Joseph Schoepf, MD; Michael Jaff, MD; Gregory L. Moneta, MD

FINANCIAL DISCLOSURES/CONFLICTS OF INTEREST

Not stated

GUIDELINE STATUS

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GUIDELINE AVAILABILITY

Electronic copies: Available in Portable Document Format (PDF) from the American College of Radiology (ACR) Web site.

ACR Appropriateness Criteria® Anytime, Anywhere™ (PDA application). Available from the ACR Web site.

Print copies: Available from the American College of Radiology, 1891 Preston White Drive, Reston, VA 20191. Telephone: (703) 648-8900.

AVAILABILITY OF COMPANION DOCUMENTS

The following is available:

- ACR Appropriateness Criteria®. Background and development. Reston (VA): American College of Radiology; 2 p. Electronic copies: Available in Portable Document Format (PDF) from the American College of Radiology (ACR) Web site.

PATIENT RESOURCES

None available

NGC STATUS

This summary was completed by ECRI on February 20, 2001. The information was verified by the guideline developer on March 14, 2001. This summary was updated by ECRI on July 31, 2002. The updated information was verified by the guideline developer on October 1, 2002. This summary was updated by ECRI on March 17, 2006.

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