Complete Summary

GUIDELINE TITLE

Acute chest pain - suspected myocardial ischemia.

BIBLIOGRAPHIC SOURCE(S)

Stanford W, 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--suspected myocardial ischemia. [online publication]. Reston (VA): American College of Radiology (ACR); 2005. 5 p. [44 references]

GUIDELINE STATUS

This is the current release of the guideline.

This guideline updates a previous version: Stanford W, Bettmann MA, Boxt LM, Gomes AS, Grollman J, Henkin RE, Higgins CB, Kelley MJ, Needleman L, Pagan-Marin H, Polak JF. Acute chest pain--suspected myocardial ischemia. American College of Radiology. ACR Appropriateness Criteria. Radiology 2000 Jun;215(Suppl):7-13. [46 references].

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

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METHODOLOGY - including Rating Scheme and Cost Analysis
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SCOPE

DISEASE/CONDITION(S)

Acute chest pain, suspected myocardial ischemia

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 acute chest pain, suspected myocardial ischemia

TARGET POPULATION

Patients with acute chest pain, suspected myocardial ischemia

INTERVENTIONS AND PRACTICES CONSIDERED

1. Chest x-ray
2. Invasive (INV)
    - Coronary angiography
    - Left ventricular angiography
3. Ultrasound (US)
    - Transthoracic echocardiography (TTE)
    - Transesophageal echocardiography (TEE)
4. Nuclear medicine (NUC)
    - Myocardial perfusion
    - Ventriculogram
    - Infarct avid imaging
5. Computed tomography (CT), with contrast
    - Conventional
    - Electron beam
    - Multidetector ultrafast
6. Magnetic resonance angiography (MRA)
7. Magnetic resonance imaging (MRI)
8. Perfusion MRI
9. Position emission tomography (PET)

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 for reaching

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 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, Suspected Myocardial Ischemia

Radiologic Exam Procedure	Appropriateness Rating	Comments

Radiologic Exam Procedure	Appropriateness Rating	Comments
X-ray, chest	9	Plain films are needed to exclude other causes for chest pain.
INV, heart, angiography, coronary	8	Necessary to define extent of stenosis. Usually done late in the work-up.
US, heart, echocardiography transthoracic (TTE)	7	Indicated as a screening test to evaluate cardiac function. Inexpensive and portable.
INV, heart, angiography, left ventricular (LV)	7	Indicated to define ventricular function as part of the ischemia evaluation.
NUC, heart, myocardial perfusion	6	May be indicated to evaluate extent of ischemia. Usually done after initial screening tests suggest ischemia.
NUC, heart, ventriculogram	6	May be indicated to evaluate cardiac function.
NUC, heart, infarct avid imaging	5	May be indicated in questionable cases to confirm infarction.
US, heart, echocardiography, transesophageal (TEE)	4	May be indicated to evaluate cardiac function or to rule out aortic dissection.
CT, heart, electron beam, multidetector ultrafast, with contrast	4	Probably not indicated except for quantifying ventricular function. Noncontrast images may be useful in screening for coronary calcification.
MRA, heart	4	
CT, heart, with contrast	3	Little indication except for documenting other sources of chest pain.
MRI, heart	3	Little indication except for screening for possible aortic dissection. May have some applicability in evaluating cardiac function.
MRI, heart, perfusion studies	2	Research studies show some promise in evaluating infarction. Not extensively used clinically
PET, heart	2	See comments on MR perfusion studies.
Appropriateness Criteria Scale **1 2 3 4 5 6 7 8 9** **1 = Least appropriate 9 = Most appropriate**		

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

Patients with acute chest pain frequently present with classical symptoms consisting of chest tightness and left-arm pain. In the acute setting if these symptoms are present, they heavily favor the diagnosis of unstable angina, and a cardiac work-up is indicated. However, in stable patients chest pain may masquerade as indigestion, muscle spasm, or a myriad of other nonspecific complaints. In these patients the object of imaging is to exclude myocardial ischemia as the etiology of the chest pain.

In unstable patients myocardial infarction (MI) may be fatal, and establishing the diagnosis rapidly and accurately may be life saving. Thus the cardiac work-up usually consists of an electrocardiogram and serum markers, namely, CK-MB and/or cardiac troponins. These studies are widely and rapidly available. Imaging studies are indicated when there is a question as to whether or not the chest pain is ischemic in origin. The studies currently used in determining the etiology of acute chest pain in stable patients are the noninvasive or minimally invasive tests, including the chest film (CXR), transthoracic echocardiogram (TTE), transesophageal echocardiogram (TEE), conventional CT, electron beam (EBCT) and multidetector (MDCT) computed tomography, infarct avid imaging, myocardial perfusion imaging, radionuclide ventriculography (RNV), PET, and MRI wall motion and perfusion. In addition, cardiac catheterization, including coronary arteriography, may be necessary.

Chest Film

The utility of the chest film in patients with acute chest pain is to rule out pathological conditions that may masquerade as a myocardial infarction and to aid in the diagnosis of pulmonary edema that may accompany acute myocardial infarction. Among conditions that may mimic myocardial infarction are pneumothorax, fractured ribs, and pneumonia, all of which are usually diagnosable on the plain chest film. Other entities, such as ruptured aneurysms, aortic dissections, and pulmonary embolism, may be suggested from the plain chest film, but the sensitivity is less. Myocardial infarction will generally not be diagnosable on the CXR unless there is associated cardiac enlargement, congestive heart failure, or pulmonary edema. These findings are indicative of previous cardiac events, and the prevalence of ischemic pain is frequently higher in this group. Overall, the primary utility of the chest film is to raise the possibility of a nonmyocardial etiology for the chest pain.

Transthoracic Echocardiography

Myocardial ischemia frequently presents with abnormalities of left ventricular wall motion. Depending on the location, the wall motion abnormality may be identifiable on a TTE. Additional findings that would be helpful in establishing a diagnosis of ischemia would be the identification of left ventricular aneurysm or the presence of valvular dysfunction as a result of the ischemia (e.g., acute mitral regurgitation). TTE may also be helpful in diagnosing pericarditis or pericardial effusions as an etiology for the chest pain. If the cause of the chest pain was pulmonary embolism, an intracardiac source for the embolus might also be

identifiable. The embolus is directly visualizable in a central or peripheral pulmonary artery.

Exercise echocardiography or, if more appropriate for the patient, stress echocardiography both have a major role in demonstrating myocardium that becomes ischemic and has altered motion with increased myocardial oxygen demand. These studies can also demonstrate changes in both focal and global ventricular function and in valve function that may indicate myocardium at risk.

Transesophageal Echocardiography

Transesophageal echocardiography has little utility in the evaluation of acute chest pain of suspected myocardial ischemic origin. Its primary use is in ruling out aortic dissection, valvular dysfunction, intracardiac thrombus, and/or intracardiac shunts resulting from ischemic events. Because the prevalence of these findings is low in acute myocardial ischemia, TEE is generally not indicated in the work-up of the acute chest pain-suspected myocardial ischemia patient.

Conventional Computed Tomography

Conventional CT is useful in identifying aortic aneurysms and dissections and in verifying pulmonary parenchymal changes occurring from pulmonary embolism or pneumonia. Emboli can frequently be identified within pulmonary artery branches by CT. Pericardial effusions and/or pericardial thickening should also be identifiable. Again, the utility of CT would be in identifying or excluding nonischemic and nonmyocardial etiologies for the acute chest pain.

Electron Beam Computed Tomography, Helical (spiral) CT and Multidetector CT

MDCT and EBCT are probably also not indicated for the same reasons. These more rapid CT imaging approaches can demonstrate lung parenchymal disease, pericardial disease, and aneurysms and dissections of the aorta, and they also have utility in demonstrating coronary artery calcification as a manifestation of arteriosclerosis; however, because the extent of coronary calcification is not site specific for coronary artery stenosis, calcification should not be used as an indicator of the etiology of the chest pain. Scientific data confirm that the presence of calcification does correlate highly with the presence of coronary atherosclerotic lesions, and the extent of calcification and the number of vessels involved do correlate with an increased likelihood of coronary events. Current data also suggest that if there is no calcium in the coronary arteries, especially in patients presenting to the ER with chest pain, the chances of the chest pain being from a cardiac etiology are low. The ability to quantify cardiac function, demonstrate left ventricular aneurysms, and quantify ventricular filling and show coronary occlusion with CTA are additional advantages of MDCT and EBCT imaging.

Infarct Avid Imaging and Myocardial Enzymes

Infarct avid imaging can identify an acute myocardial infarct by the uptake of radioactive tracer in the area of the infarction. However, the imaging may not

become positive until approximately 12-36 hours after the infarction. Cardiac enzymes, and specifically the CK-MB fraction and cardiac troponins, are also indicative of infarcts, and these tests can be performed with more rapid results and less expense to the patient. Also, because the electrocardiogram and elevated cardiac enzymes can give an indication of acute ischemia, infarct avid imaging may only have utility in questionable cases. However, it does have substantial value in quantifying infarct size and in determining stunned or hibernating versus frankly infarcted myocardium.

Myocardial Perfusion Imaging

Myocardial perfusion using single photon emission computed tomography (SPECT) thallium scintigraphy is one of the important tests in assessing myocardial ischemia. A TL-201 perfusion deficit on exercise that decreases in size at rest is a classic finding in myocardial ischemia. SPECT studies have a long and attractive track record in assessing myocardial ischemia, and TL-201 and sestamibi scintigraphy are some of the better studies available. They are not expensive and are not associated with a significant morbidity or mortality. They do, however, require transport of the patient to the imaging suite, and false positive and negative studies are not infrequent.

Radionuclide Ventriculography

Radionuclide ventriculography (RNV) is probably indicated in patients with acute chest pain of ischemic origin. It is inexpensive and reasonably accurate and can demonstrate decreases in left ventricular cardiac function secondary to ischemia. Because of its accuracy, low cost, wide availability, and minimal morbidity, RNV is indicated if other studies for suspected myocardial ischemia are inconclusive, or if assessment of left ventricular function is important in determining appropriate therapy.

Positron Emission Tomography

Positron emission tomography (PET) can reliably show myocardial blood flow using N13 ammonia. It can also document anaerobic metabolism using imaging with F18 fluorodeoxyglucose. This technology, however, is expensive, is not universally available, and is probably not indicated in the work-up of a suspected myocardial ischemia patient.

Magnetic Resonance Imaging

Magnetic resonance imaging has some utility in demonstrating abnormalities of wall motion and in demonstrating pericardial effusions. At times MRI may show intracardiac thrombus. MRI has little utility in the imaging of patients with suspected myocardial ischemia. Other tests such as RNV, TTE, or stress TTE can provide similar information about wall motion and at lesser expense. Magnetic resonance angiography (MRA) and MR plaque characterization are still investigational and are not yet in wide clinical use.

Magnetic Resonance Perfusion

Magnetic resonance perfusion imaging is also probably not indicated. Present contrast agents can demonstrate normal myocardium and demonstrate signal changes in areas of decreased perfusion. There is a potential for the use of these agents, but their utility in this clinical setting has not yet been proven. Access to the patient to deal with arrhythmias, cardiovascular instability, and claustrophobia are potential problems in using MR technology.

Cardiac Catheterization and Coronary Angiography

The gold standard in making a definitive diagnosis of coronary arterial obstruction as the probable cause for the chest pain is cardiac catheterization with coronary arteriography and left ventriculography. Although these tests may be indicated, cardiac catheterization is usually the last test that is performed. These tests are always indicated before a definitive surgical procedure or angioplasty.

Summary

The consensus of the panel and the literature review support the chest film in the initial screening of a patient with acute chest pain of suspected myocardial ischemic origin. The panel supports use of radionuclide scintigraphy in the evaluation of myocardial perfusion and in the evaluation of ventricular function. It also supports use of 2D echo in evaluating myocardial contractility. The definitive diagnosis is made by cardiac catheterization with coronary angiography and ventriculography. Continuing developments in the assessment of coronary blood flow and myocardial perfusion using magnetic resonance and PET may prove helpful in the future. The presence of coronary atherosclerosis and stenosis can be documented by the newer rapid CT technologies, such as EBCT or helical or MDCT, but their use in the evaluation of acute coronary syndrome patients has not been established.

Abbreviations

- CT, computed tomography
- INV, invasive
- LV, left ventricular
- MRA, magnetic resonance angiography
- MRI, magnetic resonance imaging
- NUC, nuclear medicine
- PET, positron emission tomography
- TEE, transesophageal echocardiography
- TTE, transthoracic echocardiography
- US, ultrasound

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 initial radiologic exam procedures to aid in differential diagnosis of patients with acute chest pain with suspected myocardial ischemia
- Myocardial infarction (MI) may be fatal, and establishing the diagnosis rapidly and accurately may be life saving.

POTENTIAL HARMS

- In myocardial perfusion imaging the false positive and negative studies are not infrequent.
- Potential problems in using magnetic resonance (MR) technology include access to the patient to deal with arrhythmias, cardiovascular instability, and claustrophobia.

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
Timeliness

IDENTIFYING INFORMATION AND AVAILABILITY

BIBLIOGRAPHIC SOURCE(S)

Stanford W, 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--suspected myocardial ischemia. [online publication]. Reston (VA): American College of Radiology (ACR); 2005. 5 p. [44 references]

ADAPTATION

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

DATE RELEASED

1995 (revised 2005)

GUIDELINE DEVELOPER(S)

American College of Radiology - Medical Specialty Society

SOURCE(S) OF FUNDING

The 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 (*Principal Author*); Michael A. Bettmann, MD (*Panel Chair*); 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

This is the current release of the guideline.

This guideline updates a previous version: Stanford W, Bettmann MA, Boxt LM, Gomes AS, Grollman J, Henkin RE, Higgins CB, Kelley MJ, Needleman L, Pagan-Marin H, Polak JF. Acute chest pain--suspected myocardial ischemia. American College of Radiology. ACR Appropriateness Criteria. Radiology 2000 Jun;215(Suppl):7-13. [46 references].

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

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 March 3, 2006.

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