American College of Radiology
ACR Appropriateness Criteria®

Clinical Condition: **Acute Chest Pain—Suspected Myocardial Ischemia**

Radiologic Procedure	Rating	Comments	RRL*
X-ray chest	9	Plain films are needed to exclude other causes for chest pain.	Min
INV angiography coronary	8	Necessary to define extent of stenosis. Usually done late in the work-up.	IP
INV left ventriculography	7	Indicated to define ventricular function as part of the ischemia evaluation.	IP
US echocardiography transthoracic	7	Indicated as a screening test to evaluate cardiac function. Inexpensive and portable.	None
NUC myocardial perfusion scan	6	May be indicated to evaluate extent of ischemia. Usually done after initial screening tests suggest ischemia.	High
NUC radionuclide ventriculography (RNV)	6	May be indicated to evaluate cardiac function.	Med
NUC infarct avid imaging	5	May be indicated in questionable cases to confirm infarction.	Low
MRA heart	4		None
US echocardiography transesophageal	4	May be indicated to evaluate cardiac function or to rule out aortic dissection.	None
CT heart with contrast	4	Probably not indicated except for quantifying ventricular function. Noncontrast images may be useful in screening for coronary calcification.	High
MRI heart	3	Little indication except for screening for possible aortic dissection. May have some applicability in evaluating cardiac function.	None
FDG-PET heart	2	See comments on MR perfusion studies.	High
MRI heart perfusion studies	2	Research studies show some promise in evaluating infarction. Not extensively used clinically.	None
Rating Scale: 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

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Summary of Literature Review

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 workup 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 workup 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 computed tomography (CT), electron beam (EBCT) and multidetector (MDCT) computed tomography (CT), infarct avid imaging, myocardial perfusion imaging, radionuclide ventriculography (RNV), positron emission tomography (PET), and magnetic resonance imaging (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 (eg, 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 workup of the acute chest pain-suspected myocardial ischemia patient.

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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 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
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 workup 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

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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.

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