Acute Chest Pain — Low Probability of Coronary Artery Disease
EVIDENCE TABLE

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Strength of Evidence
1. Clinical policy for the initial approach to adults presenting with a chief complaint of chest pain, with no history of trauma. American College of Emergency Physicians. *Ann Emerg Med* 1995; 25(2):274-299.	15	N/A	Guideline.	N/A	N/A
2. Scientific Statements and Practice Guidelines Topic List. http://www.americanheart.org/presenter.jhtml?identifier=2158. Accessed March 4, 2008.	15	N/A	Guideline.	N/A	N/A
3. Antman EM, Hand M, Armstrong PW, et al. 2007 focused update of the ACC/AHA 2004 guidelines for the management of patients with ST-elevation myocardial infarction: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. *J Am Coll Cardiol* 2008; 51(2):210-247.	15	N/A	Update on guidelines for management of patients with ST-elevation myocardial infarction.	N/A	N/A
4. Hutter AM. Chest pain: how to distinguish between cardiac and noncardiac causes. Interview by Eric R. Leibovitch. *Geriatrics* 1995; 50(9):32-36, 39-40.	15 (Interview)	N/A	To present an algorithm for distinguishing between cardiac and non-cardiac causes for chest pain.	Classic angina presents as substernal pressure that begins with exertion and is relieved by rest. Angina must be differentiated from chest wall pain, pleurisy, gall bladder pain, hiatal hernia and chest pain associated with anxiety disorders. Careful examination of the chest wall is necessary and abnormal heart sounds are helpful in differentiating these etiologies. An electrocardiogram (ECG) will help in identifying the presence of ischemic heart disease and if it is abnormal the patient should undergo a stress thallium test. A coronary angiogram may also be indicated if an exercise ECG is abnormal.	N/A
5. Solinas L, Raucci R, Terrazzino S, et al. Prevalence, clinical characteristics, resource utilization and outcome of patients with acute chest pain in the emergency department. A multicenter, prospective, observational study in north-eastern Italy. *Ital Heart J* 2003; 4(5):318-324.	13	495	Prospective, multicenter study. Analysis of clinical data to evaluate the diagnostic accuracy and costs of the emergency department (ED) triage modalities of patients with acute chest pain.	The diagnosis of acute coronary syndrome (ACS) was confirmed in 79% of hospitalized patients. 68% were immediately sent back home and 32% required a brief clinical observation lasting 10 +/- 6 hours and including serial ECG and myocardial injury marker assessment. The average cost of the ED triage was 189 +/- 237.	2

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6. Jesse RL, Kontos MC. Evaluation of chest pain in the emergency department. *Curr Probl Cardiol* 1997; 22(4):149-236.	12	N/A	To review various imaging modalities and tests used in the evaluation of patients presenting to the ED with chest pain.	More than simple observation is required to evaluate patients with acute chest pain, but success has been reported with a number of strategies including emergency imaging with either radionuclides such as sestamibi or echocardiography. Early provocative testing, either stress or pharmaceutic, may also be effective.	3
7. Ioannidis JP, Salem D, Chew PW, Lau J. Accuracy of imaging technologies in the diagnosis of acute cardiac ischemia in the emergency department: a meta-analysis. *Ann Emerg Med* 2001; 37(5):471-477.	11	N/A	Systematic review and meta-analysis were conducted to evaluate accuracy of imaging technologies (including rest and stress echocardiography and technetium-99m sestamibi scanning) for the diagnosis of acute cardiac ischemia and acute myocardial infarction in the ED.	For ED studies only, rest echocardiography showed sensitivity of 93% and specificity of 66%. Tc-99m sestamibi scanning a showed sensitivity (range, 91.5%-100%) and specificity (range, 49.3%-84.4%) for acute myocardial infarction. For acute cardiac ischemia, the random-effects pooled sensitivity was 89%, and the pooled specificity was 77%.	1
8. Buenger RE. Five thousand acute care/emergency department chest radiographs: comparison of requisitions with radiographic findings. *J Emerg Med* 1988; 6(3):197-202.	13	5,000	To review the findings on chest radiographs in patients presenting to the ED with chest pain.	Of 5,000 radiographs of patients entering the ED, serious disease was found in 35% of patients with chest symptoms and in 27% of all patients examined. 18% of patients with non-cardiorespiratory symptoms had serious disease. The highest incidence of abnormal radiographs (42%-79%) occurred in patients with symptoms of congestive failure, dyspnea, hemoptysis, dysrhythmia, and hypertension. Asthma (14%) and trauma (5%) presented the lowest incidence of significant findings. Radiographs were abnormal in 25% of patients suspected of having pneumonia and in 52% of patients with congestive heart failure. Pneumonia was the diagnosis in 13% of patients presenting with cough. 24% of patients with dyspnea had radiographic findings of congestive heart failure. Chest radiographs are extremely important in the ED diagnosis of acute disease.	2
9. Johnson TR, Nikolaou K, Wintersperger BJ, et al. ECG-gated 64-MDCT angiography in the differential diagnosis of acute chest pain. *AJR* 2007; 188(1):76-82.	9	55	Evaluate ECG-gated 64-MDCT in assessing coronary arteries, aorta and pulmonary arteries in patients with acute chest pain. Compared findings on CT angiography with those on X-ray coronary angiography in 20 patients.	Cause for chest pain correctly identified in 37 patients (pulmonary embolism in 10, coronary stenosis in nine, and aortic dissection in one). Imaging quality for ECG-gated CT angiography of the entire chest is very good.	2

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10. Laudon DA, Vukov LF, Breen JF, Rumberger JA, Wollan PC, Sheedy PF, 2nd. Use of electron-beam computed tomography in the evaluation of chest pain patients in the emergency department. *Ann Emerg Med* 1999; 33(1):15-21.	10	105	Prospective observational study to determine if electron beam CT (EBCT) could be used as a triage tool in patients presenting to the ED with chest pain.	Sensitivity of EBCT was 100% (95% CI, 77% to 100%), Specificity was 63% (95% CI, 54% to 75%). NPV was 100% (95% CI, 94% to 100%). Patients with normal cardiac enzymes, indeterminate ECG findings and no history of coronary artery disease (CAD) with negative electron beam CT calcium studies can be safely discharged from the ED without further testing or observation.	2
11. Olivetti L, Mazza G, Volpi D, Costa F, Ferrari O, Pirelli S. Multislice CT in emergency room management of patients with chest pain and medium-low probability of acute coronary syndrome. *Radiol Med (Torino)* 2006; 111(8):1054-1063.	10	31	Prospective study to evaluate diagnostic accuracy of multislice CT (MSCT) in patients with chest pain in medium to low risk of ACS. Coronary angiography was used as the gold standard.	MSCT identified significant occlusion and stenoses compared to coronary angiography with sensitivity 71.4%, specificity 99.6%, PPV 93.7%, NPV 97.7%, and accuracy of 97.5%. Because of its high NPV this technique can rule out occlusions or significant stenoses in patients with medium to low coronary risk. MSCT is an accurate indicator for need for coronary angiography.	2
12. White CS, Kuo D, Kelemen M, et al. Chest pain evaluation in the emergency department: can MDCT provide a comprehensive evaluation? *AJR Am J Roentgenol* 2005; 185(2):533-540.	10	69	To determine if MDCT can provide a comprehensive assessment of cardiac and noncardiac causes for chest pain in stable ED patients.	Sensitivity for a cardiac cause for the chest pain was 83%, specificity 96%; for all other causes for the chest pain the sensitivity was 87% and specificity 96%. ECG-gated MDCT is a feasible methodology for evaluating chest pain in ED patients.	2
13. Mochizuki T, Hosoi S, Higashino H, Koyama Y, Mima T, Murase K. Assessment of coronary artery and cardiac function using multidetector CT. *Semin Ultrasound CT MR* 2004; 25(2):99-112.	13	N/A	To review MDCT in assessment of coronary artery and cardiac function.	10 phases throughout 1 cardiac cycle are extracted for functional analysis by applying retrospective ECG-gating. Animated movies are generated by paging through these 2D and 3D images in cardiac phase order. Left ventricular end systolic and end diastolic volumes and ejection fractions can be generated.	3

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14. Hoffmann U, Pena AJ, Moselewski F, et al. MDCT in early triage of patients with acute chest pain. *AJR Am J Roentgenol* 2006; 187(5):1240-1247.	10	40	To determine feasibility of MDCT to provide diagnosis of coronary stenosis. Patients studied were ED patients with normal ECG and cardiac enzymes.	• For significant coronary stenosis in ACS patients, MDCT had sensitivity of 100%. (95% CI, 49%-100%). • ACS was ruled out in 35 patients (87.5%). Significant coronary stenosis was excluded in 26 of the 35 patients without ACS by MDCT (specificity, 74% [CI, 75%-88%]). • MDCT was extremely useful in decreasing the number of admissions in patients who did not have ACS.	2
15. Hollander JE, Litt HI, Chase M, Brown AM, Kim W, Baxt WG. Computed tomography coronary angiography for rapid disposition of low-risk emergency department patients with chest pain syndromes. *Acad Emerg Med* 2007; 14(2):112-116.	10	54	To evaluate 30 day event rates using CTA in low-risk patients with chest pain.	Patients with Thrombolysis In Myocardial Infarction (TIMI) score of ≤2 without ECG acute ischemia underwent CTA. Outcomes were death and myocardial infarction within 30 days. Patients with negative CTA were discharged. 46 patients were immediately discharged without any 30 day cardiovascular complications. Eight patients were admitted because of their MDCT findings. MDCT useful in evaluating ED patients for early discharge.	2
16. Schroeder S, Kuettner A, Beck T, et al. Usefulness of noninvasive MSCT coronary angiography as first-line imaging technique in patients with chest pain: initial clinical experience. *Int J Cardiol* 2005; 102(3):469-475.	9	136	To evaluate MSCT coronary angiography in patients with known or suspected CAD and low to intermediate probability of severe coronary lesion. Results compared with conventional coronary angiography.	Significant stenosis excluded in 57%; coronary angiography was suggested in 43%. MDCT useful in reducing number of conventional coronary angiographies needed.	2
17. Di Pasquale P, Cannizzaro S, Scalzo S, et al. Sensitivity, specificity and predictive value of the echocardiography and troponin-T test combination in patients with non-ST elevation acute coronary syndromes. *Int J Cardiovasc Imaging* 2004; 20(1):37-46.	10	280	To determine the clinical utility, sensitivity and specificity of the combination of troponin-T test (TnT) levels and echocardiography (2DE) in patients presenting with chest pain, ST-depression, T-wave negative and no diagnostic ECG.	Combination of positive TnT and wall motion alterations showed a higher sensitivity, specificity and predictive values in comparison with either TnT or 2DE alone.	2

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18. Kontos MC, Arrowood JA, Paulsen WH, Nixon JV. Early echocardiography can predict cardiac events in emergency department patients with chest pain. *Ann Emerg Med* 1998; 31(5):550-557.	10	260	To evaluate the use of echocardiography in identifying patients with myocardial ischemia presenting to the ED with chest pain.	• The sensitivity of echocardiography was 91% (95%, CI: 79%-97%), as compared with ECG, which had a sensitivity of 40%. (95%, CI: 27%-55%). • Specificity of echocardiography was lower (75% [95%, CI: 69%-81%] compared to 94% [95%, CI: 90%-97%]; P<.001) for ECG. • Excluding patients with abnormal ECG (n=30) did not affect sensitivity (85%) or specificity (74%) of echocardiography. • Concludes that echocardiography has incremental value for identifying possible myocardial ischemia.	2
19. Lim SH, Sayre MR, Gibler WB. 2-D echocardiography prediction of adverse events in ED patients with chest pain. *Am J Emerg Med* 2003; 21(2):106-110.	10	1,112	To establish the efficacy of 2-D echocardiography in predicting adverse cardiac events in patients presenting to the ED with possible ACS.	Resting 2-D echocardiography did not predict cardiac adverse events in patients with possible ACS and non-diagnostic serial 12-lead ECG and normal serial CK-MB at the end of a 9-hour evaluation.	2
20. Ersoy H, Goldhaber SZ, Cai T, et al. Time-resolved MR angiography: a primary screening examination of patients with suspected pulmonary embolism and contraindications to administration of iodinated contrast material. *AJR* 2007; 188(5):1246-1254.	10	27	To evaluate the efficiency and reproducibility of a 3D MR angiographic technique in the diagnosis of pulmonary embolism.	3D MR angiography provides high temporal resolution and consistently yields arterial phase only images.	3

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Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Strength of Evidence
21. Hackshaw BT. Excluding heart disease in the patient with chest pain. *Am J Med* 1992; 92(5A):46S-51S.	12	N/A	To review the role of diagnostic studies in excluding heart disease in patients with chest pain.	Diagnostic modalities used in assessing myocardial ischemia include treadmill exercise testing, Holter monitoring and coronary angiography. Treadmill exercise testing has a relative low sensitivity for diagnosing coronary artery disease. The sensitivity can be improved by combining treadmill exercise with thallium-201 imaging, 2D echocardiography, PET. Thallium-201 scintigraphy and exercise echocardiography have sensitivities of 70%-80% and specificities of 50%-60% in low risk asymptomatic populations. PET has a sensitivity of 90% and a specificity of 90%-95% and is useful as a screening test. Holter monitoring is too insensitive and too nonspecific to be used as a screening test; however, Holter monitoring can help document ST-segment abnormalities occurring during episodes of chest pain. Coronary arteriography is the gold standard. It can assess coronary narrowing but is limited in evaluating coronary blood flow. Doppler flow studies can provide information regarding coronary flow reserve. Ischemia as a cause of chest pain is best diagnosed by correlating the clinical presentation with the presence of ECG abnormalities, thallium-201 perfusion deficits or echocardiographic wall motion abnormalities. The extent of stenoses would need to be determined by coronary angiography.	4
22. Hilton TC, Thompson RC, Williams HJ, Saylors R, Fulmer H, Stowers SA. Technetium-99m sestamibi myocardial perfusion imaging in the emergency room evaluation of chest pain. *J Am Coll Cardiol* 1994; 23(5):1016-1022.	10	102	To evaluate the use of Tc-99m sestamibi in predicting a cardiac cause for chest pain in patients with typical angina and a normal or non-diagnostic ECG.	Tc-99m sestamibi appears to be highly accurate in distinguishing between high and low risk patients with typical anginal pain and a normal or equivocal ECG.	2

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Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Strength of Evidence
23. Kontos MC, Jesse RL, Anderson FP, Schmidt KL, Ornato JP, Tatum JL. Comparison of myocardial perfusion imaging and cardiac troponin I in patients admitted to the emergency department with chest pain. *Circulation* 1999; 99(16):2073-2078.	9	620	Comparison of myocardial perfusion and cardiac Troponin I to identify patients with ACS in patients presenting to the ED with chest pain.	Sensitivity for detecting myocardial infarction was not significantly different between perfusion imaging (92%) and cTnI (90%), and both were significantly higher than the initial cTnI (39%). Perfusion identified more patients who had significant CAD but had a lower specificity. Both tests provide complementary information.	2
24. Swinburn J, Lahiri A. Can nuclear cardiology really help in the emergency departments of the 21st century? *Rev Port Cardiol* 2000; 19 Suppl 1:I47-52.	12	N/A	To review usefulness of nuclear perfusion in ED patients.	Nuclear perfusion imaging provides an instantaneous assessment of perfusion at the time of injection.	3
25. Udelson JE, Beshansky JR, Ballin DS, et al. Myocardial perfusion imaging for evaluation and triage of patients with suspected acute cardiac ischemia: a randomized controlled trial. *JAMA* 2002; 288(21):2693-2700.	8	2,475	Prospective randomized controlled trial to determine whether incorporating myocardial perfusion imaging into an ED evaluation protocol for patients with symptoms suggestive of acute cardiac ischemia would improve clinical decision making.	In patients with acute myocardial infection there were no differences in ED triage decisions between those receiving standard evaluation and those whose evaluation was supplemented by a sestamibi scan. Sestamibi perfusion imaging improves ED triage decision-making.	1
26. Varetto T, Cantalupi D, Altieri A, Orlandi C. Emergency room technetium-99m sestamibi imaging to rule out acute myocardial ischemic events in patients with nondiagnostic electrocardiograms. *J Am Coll Cardiol* 1993; 22(7):1804-1808.	10	64	To determine the role of Tc-99m sestamibi in patients with chest pain.	Tc99m sestamibi had 100% sensitivity in demonstrating acute myocardial ischemia.	2
27. Williams KA, Garvin AA, Taillon LA. Clinical nuclear imaging techniques for the diagnosis and evaluation of acute myocardial infarction. *Compr Ther* 1992; 18(2):6-10.	12	N/A	To review the role of radionuclide scintigraphy in the diagnosis of acute myocardial infection.	Infarct-avid imaging with Tc-99m-PYP can be used to rapidly determine the size and location of the acute transmural myocardial infarction.	4
28. Just RJ, Castell DO. Chest pain of undetermined origin. *Gastrointest Endosc Clin N Am* 1994; 4(4):731-746.	12	N/A	To identify diagnostic tools used for the evaluation of chest pain of undetermined origin.	Diagnostic tools used in the evaluation of chest pain include ambulatory intraesophageal pH monitoring, esophageal manometry with provocative testing, intraesophageal pressure monitoring, upper GI barium examinations and/or endoscopy.	4
29. American College of Radiology. *Manual on Contrast Media*. Available at: http://www.acr.org/SecondaryMainMenuCategories/quality_safety/contrast_manual.aspx.	15	N/A	Guidance document on contrast media to assist radiologists in recognizing and managing risks associated with the use of contrast media.	N/A	3

Evidence Table Key

Study Type Key

Numbers 1-7 are for studies of therapies while numbers 8-15 are used to describe studies of diagnostics.

1. Randomized Controlled Trial — Treatment
2. Controlled Trial
3. Observation Study
    a. Cohort
    b. Cross-sectional
    c. Case-control
4. Clinical Series
5. Case reviews
6. Anecdotes
7. Reviews

8. Randomized Controlled Trial — Diagnostic
9. Comparative Assessment
10. Clinical Assessment
11. Quantitative Review
12. Qualitative Review
13. Descriptive Study
14. Case Report
15. Other (Described in text)

Strength of Evidence Key

- Category 1 - The conclusions of the study are valid and strongly supported by study design, analysis and results.
- Category 2 - The conclusions of the study are likely valid, but study design does not permit certainty.
- Category 3 - The conclusions of the study may be valid but the evidence supporting the conclusions is inconclusive or equivocal.
- Category 4 - The conclusions of the study may not be valid because the evidence may not be reliable given the study design or analysis.