Worksheet No. ACS-006-2B.doc

**WORKSHEET for Evidence-Based Review of Science for Emergency Cardiac Care**

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**Date Submitted for review:**

- 10 May 2008
- Revised 03-December 2008 (ACS-006-2-B)
- Re-Revised 20-April 2009 (ACS-006-2-B)
- Re-Revised 26-October 2009 (ACS-006-2-B)
- Re-Revised 15-January 2010 (ACS-006-2-B)
- Re-Revised 26-January 2010
- Re-Revised 31-January 2010

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**Clinical question.**

In patients with suspected ACS (P), does the use of specific imaging techniques (eg. CT angio/MRI/nuclear testing/ECHO) (I), compared with not using them (C), improve outcome (eg. survival, length of ED stay, hospital admission rate, or cost) (O)?

**Is this question addressing an intervention/therapy, prognosis or diagnosis?**

Intervention

**State if this is a proposed new topic or revision of existing worksheet:** New

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**Conflict of interest specific to this question**

Do any of the authors listed above have conflict of interest disclosures relevant to this worksheet? No

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**Search strategy (including electronic databases searched).**

PubMed

- MRI, AMI, and diagnosis n=191, /limited in ED n=0
- RI , AMI , and diagnosis n=311, /limited in ED n=4
- Echocardiography, AMI, and diagnosis n=636, /limited in ED n=8
- CT, AMI, and diagnosis n=73, /limited in ED n=2
- MRI , ACS, and diagnosis n=97, /limited in ED n=6
- RI, ACS, and diagnosis n=33, /limited in ED n=4
- Echocardiography, ACS, and diagnosis n=72, /limited in ED n=6
- CT, ACS, and diagnosis n=59, /limited in ED n=2
- "chest pain", Cost, and echocardiography n=65, /limited in ED n=8
- "chest pain", Cost, and "radionuclide imaging" n=51 /limited in ED n=5
- "chest pain", Cost, and CT n=19 /limited in ED n=2
- "chest pain", Cost, and MRI n=8 /limited in ED n=0
- "myocardial infarction", Cost, and CT n=38 /limited in ED n=5
- "myocardial infarction", Cost, and echocardiography n=132 /limited in ED n=8
- "myocardial infarction", Cost, and "radionuclide imaging" n=134, /limited in ED n=5
- "myocardial infarction", Cost, and MRI n=26, /limited in ED n=0
- ACS, mortality, and RI n=4
- ACS, mortality, and MRI n=4
- ACS, mortality, and CT n=11
- ACS, mortality, and echocardiography n=18
- ACS, “infarct size”, and CT n=0
- ACS, “infarct size”, and echocardiography n=2
- ACS, “infarct size”, and MRI n=0
- ACS, “infarct size”, and RI n=2


- State inclusion and exclusion criteria
  - Studies which enrolled low-intermediate risk ED patients with symptoms suggestive of ACS (chest pain), non-diagnostic ECGs and negative biomarkers,
  - Outcome studies addressing size of infarct; LV function; survival, length of ED stay; hospital admission rate; and cost
  - Peer reviewed
  - Manuscript available for review
  - Human studies
  - Criteria for positive result of MDCT were explicitly defined as >50% diameter stenosis
  - Exclusion criteria:
  - Abstract-only studies
### Summary of evidence

#### Evidence Supporting Clinical Question

<table>
<thead>
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<th>Level of evidence</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
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A = Return of spontaneous circulation  
B = Survival of event  
C = Survival to hospital discharge  
D = Intact neurological survival  
E = Other endpoint (E1= shortening the hospital stay and cost effective, E2= avoiding inappropriate admission, E3=prevention of CAG, E4=decrease in radiation exposure)  
F=Method(F1=CTangiography, F2=MRI, F3=nuclear imaging, F4=echocardiography)

#### Evidence Neutral to Clinical question

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Evidence Opposing Clinical Question

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REVIEWER’S FINAL COMMENTS AND ASSESSMENT OF BENEFIT / RISK:

In ACC/AHA UA/NSTEMI guideline 2007, the following strategy is recommended. Patients who experience recurrent ischemic discomfort, evolve abnormalities should be admitted to the hospital {Anderson,2007,e148}. For low-risk patients with acute chest pain, no ST changes and normal biomarkers after 6 to 8 hour observation, nuclear perfusion imaging, echocardiography, magnetic resonance or coronary CT angiogram may be considered before discharge. However, the safety, diagnostic efficacy, and efficiency of imaging techniques including echocardiography, CT, MRI and radionuclide imaging are still remained to evaluate in the emergency department in the previous guidelines.


1. CT angiogram: In a randomized controlled trial (LOE 1) {Goldstein,2007,863}, low-risk acute chest pain patients were randomized to MSCT (n=99) versus standard diagnostic evaluation (n=98). MSCT evaluation reduced diagnostic time compared with standard evaluation (3.4h vs 15.0 h) and lowered costs significantly. MSCT patients required fewer repeat evaluations for recurrent chest pain (2% vs 7%). Limitation in this study is inability to determine the intermediate severity coronary lesions using MSCT. MDCT-based strategy decreased hospital length of stay and reduced avoidable admissions in patients with an intermediate pretest probability for ACS without major adverse cardiac events at follow-up. Two LOE4 studies showed the decrease in length of hospital stay (LOS) {May,2009,150} ; the comparisons of standard of care (SOC) vs. SOC+CT vs. SOC+CT+immediate discharge showed 25.4hr vs. 14.3hr vs. 5.0hr in LOS. and showed SAFE DISCHARGE FROM THE ED{Hollander,2007,112}; no 30d cardiovascular events in patients discharged after negative MDCT.

2. Stress echocardiography: In randomized study {Nucifora,2007,1068}, the comparison of the cost-effectiveness between dobutamine-atropine stress echocardiography and electrocardiographic exercise testing was performed using randomized study for low-risk 119 patients presenting with acute chest pain (ACP) in ED. Dobutamine-atropine stress echocardiography in emergency department triage of low-risk patients with ACP is safe without follow-up events and reduces lengths of stay in the hospital and costs of care compared to electrocardiographic exercise testing. Four LOE4 studies examined the role of stress echo for the outcome variables {Bholasingh,2003,596, Buchsbaum,2001,196, Colon,1998,1282} {Colon,1999,171}.

3. Nuclear imaging: Two fair quality prospective, observational studies {Fesmire,2001,207, Forberg,2009,12} were supportive to clinical question. In low risk ED patients with an initial negative work-up of ACS with negative cardiac enzymes and non-diagnostic ECG’s who received SPECT perfusion imaging demonstrate low rates of CARDIAC EVENTS (defined variably in each study, including MI, PTCA/CABG, >70% stenosis not amenable to PTCA/CABG, cardiac-related death, or life-threatening complications) (Fesmire study: sensitivity 93.4%, specificity 94.7%, +LR 17.6, -LR 0.07 for 30day event rate; Forberg study: 100% NPV at 6 months), REDUCED COSTS (Forberg study: 267+-96EUR reduction per patient), and REDUCED LOS/BED OCCUPANCY (Forberg study: 0.8+-0.16days per patient).
4. MRI imaging: To date there are no studies that have assessed the use of MRI/MRA in the ED chest pain population to determine if there is any outcome benefit with respect to survival, ED or hospital length of stay or costs. This is likely due to MRI being a relatively new technology to aid clinicians in the diagnosis of ACS and that this is a future area of research.

**Assessment of risk/benefit:** Evidences from 2 prospective randomized clinical trials (LOE 1) and supportive evidence from 8 other studies (LOE 4) demonstrate that imaging techniques either multi-slice CT, stress echocardiography or resting myocardial perfusion imaging might be useful in ED triage decision making for patients with suspected acute coronary syndrome (low-risk, no or nondiagnostic ECG changes and normal Troponin value) to reduce unnecessary hospitalization and costs without increase in cardiac events. However, MDCT and nuclear imaging have similar radiation exposure doses for cardiac studies (8-12 mSv){Budoff,2006,1761}. MDCT requires retrospective gating associated with significantly greater radiation exposures to acquire images. The protocol with prospective ECG control is reported to reduce radiation exposure without decreasing diagnostic image quality. Therefore, for MDCT, dose modulation methods reduce radiation exposures and should be employed whenever possible{Budoff,2006,1761, Takakuwa,2009,866}. Recently, prospective ECG-triggering allows low-dose CTCA and provides high diagnostic accuracy in the assessment of CAD in patients with stable sinus rhythm and a low heart rate for stable coronary heart disease{Herzog,2008,3037} and acute chest pain{Takakuwa,2009,866}.

**Acknowledgements:**

None

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**Citation List**


LOE 4, good quality, supportive study, no industry funding. For the low risk chest pain with a normal or nondiagnostic electrocardiogram (ECG) and a negative serial troponin T, dobutamine stress echocardiography (DSE) was performed in 377 patients. DSE showed independent prognostic predictive value; positive DSE with 30.8% primary endpoint, and negative DSE with 4% for 6 month follow-up.


LOE 4, poor study, Small group (n=145) without controls, Supportive article. For low risk patients with chest pain, exercise stress echocardiography (ESE) showed abnormal in 7 patients and of those 3 patients had CAD. Only one of 138 patients with normal echocardiogram showed non Q-MI after discharge. Exercise stress echocardiography can be used to evaluate low-risk chest pain patients in the ED. Patients with a normal ESE may be considered for discharge with minimal risk of sequelae.


Class IIa, Level of evidence B recommendation for its use in low-risk patients. 64 slice machines have sensitivities 82-100% and specificities 82-98% for detecting significant coronary stenosis. MDCT is reasonable for the assessment of obstructive disease in symptomatic patients and may help avoid invasive angiography.
Radiation exposure during MDCT: 8-13 mSv comparing with CAG doses of 2.1-2.3mSv and nuclear imaging doses of 8-12mSv. For CT angiography, use of the higher radiation exposure tests in asymptomatic persons for screening purpose is not currently recommended.


LOE 4, poor study, supportive. Stress echocardiography (Exercise 71% or Dobutamine 29%) testing was performed in 105 patients presenting with atypical chest pain, no prior history of coronary artery disease, a nondiagnostic electrocardiogram (ECG), negative serial creatine phosphokinase level. Stress echocardiography can be performed safely in patients presenting with atypical chest pain. A negative stress echocardiogram carries an excellent 3-year prognosis and thus identifies patients who may forgo hospital admission and further cardiovascular workup.


LOE 4, poor study, supportive. For low risk chest pain patients with negative repeat ECG, CPK and myoglobin, stress exercise or pharmacological using dobutamine) echocardiography was performed.


LOE 4, fair study without control, supportive study, Stress SPECT was compared with rest TI imaging and showed a sensitivity and specificity for 30-day ACS of 93.4% and 94.7%, respectively (positive likelihood ratio 17.6; negative likelihood ratio 0.07). A strategy of using selective dual nuclear scanning once high- and intermediate-risk ACS has been ruled out with our 2-hour evaluation both reliably identifies and reliably excludes 30-day ACS.


LOE 4, Supportive and fair article. For low risk chest pain with a normal or non-ischemic ECG and no previous myocardial infarction, nuclear myocardial perfusion imaging (MPI) was performed in 40 ED patients. 27 patients with normal MPI were discharged from ED and those result showed the reduction of the number of admissions and decrease overall costs for low-risk ED patients with suspected ACS. Very small sample size.


LOE 1, good study, RCT (limitation: single center and small number n=197), and supportive article. MSCT for low-risk acute chest pain vs standard of care including serial ECGs and cardiac enzymes followed by RI imaging were compared. Outcomes: safety (freedom from major adverse events over 6 months), diagnostic efficacy, and time and cost of care. MSCT can establish or exclude coronary disease (75% of patients with chest pain) and reduce diagnostic time and lower costs. Limitation is inability to determine the intermediate severity coronary lesions.


Excluded from ACS-Evidences because of a study for stable chest pain. Prospective ECG-triggering allows low-dose CTCA of 2.1mSv with high sensitivity of 100%, specificity 89%, positive predictive value 86%, and negative predictive value 100%.

LOE 4, poor study (no controls). Supportive. For low-risk 54 chest pain patients without acute ischemia on an electrocardiogram, CT coronary angiography was performed in the ED. The main outcomes were death and myocardial infarction within 30 days of ED discharge. 46 patients (85%) were immediately released from the ED, and none had cardiovascular complications within 30 days. CT coronary angiography may safely allow rapid discharge of patients with negative studies.


LOE 4, fair study, supportive article. In 53 low-risk patients with chest pain in an emergency department, cardiac CT early in the standard-of-care workup was performed. Standard of care (SOC) vs. SOC+CT vs. SOC+CT and immediate discharge if normal = $7597 vs. $6153 vs. $ 4251 respectively), decreases mean length of stay (LOS) (May study: SOC vs. SOC+CT vs. SOC+CT+immediate discharge = 25.4hr vs. 14.3hr vs. 5.0hr), In low-risk patients with chest pain, discharge from the emergency department based on negative cardiac CT, enzyme tests, and ECG may significantly decrease both length of stay and hospital charges compared with the standard of care.


LOE 1, Good study, RCT, supportive article, The comparison of the cost-effectiveness between dobutamine-atropine stress echocardiography (DASE) and electrocardiographic exercise testing was performed using randomized study for low-risk 119 patients presenting with acute chest pain (ACP) in ED. Dobutamine-atropine stress echocardiography in emergency department triage of low-risk patients with ACP is safe without followup events and reduces lengths of stay in the hospital and costs of care compared to EET.


Deleted from outcome assessment because of no data for biomarkers. A retrospective analysis of coronary CTA examinations was performed on a 64-MDCT scanner for 267 consecutive low- to moderate-risk emergency department patients with suspected ACS. The use of ECG-based tube current modulation in 95 patients reduced radiation doses by more than 50% without loss of image quality.