Clinical question.

In patients with suspected ACS (P), does the use of specific imaging techniques (e.g., CT angio/MRI/nuclear/ECHO) (I), compared with not using them (C), increase accuracy of diagnosis (e.g., of ACS) (O)?

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

State if this is a proposed new topic or revision of existing worksheet: New topic – no prior worksheet on this topic

Conflict of interest specific to this question

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

Search strategy (including electronic databases searched).

Key words: CT; CT angio; MRI; MRA; ECHO; radionucleotide imaging; cardiac nuclear scanning; MIBI; SPECT; nuclear cardiology; myocardial perfusion scintigraphy; diagnosis; ACS

Sources and dates of last search: Ovid MEDLINE (R) <1950 to May week 3 2008>
Pubmed/Medline – April 16/08; CT – 48 hits/22 for initial review of abstract; MRI 47 hits/ 34 for review; - Nuclear – 42 hits/ 5 for review; ECHO – 162 hits/47 for review
EMBASE – May 13/08 – CT – 27 hits- 7 for review; MRI – 31 hits -1; Nuclear – 7; ECHO – 194 hits -5
Manual search of references - May 16/08 – CT – 2; MRI – 1; Nuclear – 2
OVID/Cochrane - April 27/08 – ACS/ECHO – 16 hits; ACS/CT – 35 hits; ACS/MRI – 0 hits; ACS/radionucleotide; sestamibi; MIBI; cardiolite; myocardial perfusion scintigraphy; nuclear medicine scan – 1 hit – 0 articles for review

PUBMED: <1950 to October week 2 2009>

- “acute myocardial infarction” limits: humans = 33264
- “chest pain” limits: humans = 18459
- “acute coronary syndrome” limits: humans = 4663
- “Emergency department” limits: humans = 24473
- “diagnosis” limits: humans = 4831246
- (“acute myocardial infarction” OR “chest pain” OR “acute coronary syndrome”) AND “Emergency department” AND “diagnosis” limits: humans = 1449
- “computer tomography” limits: humans = 80722
- “CT” limits: humans = 161837
- “multi-detector CT” limits: humans = 119
- (“acute myocardial infarction” OR “chest pain” OR “acute coronary syndrome”) AND “Emergency department” AND “diagnosis” AND (“computer tomography” OR “CT” OR “electron beam computed tomography” OR “multi-detector CT”) limits: humans = 121
- “Magnetic resonance imaging” limits: humans = 194627
- “MRI” limits: humans = 218562
- (“acute myocardial infarction” OR “chest pain” OR “acute coronary syndrome”) AND “Emergency department” AND “diagnosis” AND (“Magnetic resonance imaging” OR “MRI”) limits: humans = 29
- “echocardiography” limits: humans = 86325
- “echo” limits: humans = 24448
- “ultrasound” limits: humans = 281050
- (“acute myocardial infarction” OR “chest pain” OR “acute coronary syndrome”) AND “Emergency department” AND “diagnosis” AND (“echocardiography” OR “echo” OR “ultrasound”) limits: humans = 109
- “perfusion imaging” limits: humans = 3188
- “MPI” limits: humans = 1348
- “nuclear scanning” limits: humans = 91
- (“acute myocardial infarction” OR “chest pain”) AND “Emergency department” AND “diagnosis” AND (“perfusion imaging” OR “MPI” OR “nuclear scanning”) limits: humans = 35
- (“acute myocardial infarction” OR “chest pain”) AND “Emergency department” AND “diagnosis” AND (“computed tomography” OR “CT” OR “electron beam computed tomography” OR “multi-detector CT”) OR (“Magnetic resonance imaging” OR “MRI”) OR (“echocardiography” OR “echo” OR “ultrasound”) OR (“perfusion imaging” OR “MPI” OR “nuclear scanning”)) limits: humans = 255 (67 Review) = 188 (Mar 09), 337 (Oct 09)

Cochrane Database:

- “Emergency department” AND “diagnosis” = 667
- “acute coronary syndrome” OR “myocardial infarction” OR “chest pain” = 13258
- “echocardiography” OR “echo” OR “ultrasound” = 10766
- "Emergency department" AND "diagnosis" AND ("acute coronary syndrome" OR "myocardial infarction" OR "chest pain") AND ("echocardiography" OR "echo" OR "ultrasound") = 12 (Mar 09), 25 (Oct 09)
- "magnetic resonance imaging" OR "MRI" = 4749
- "Emergency department" AND "diagnosis" AND ("acute coronary syndrome" OR "myocardial infarction" OR "chest pain") AND ("magnetic resonance imaging" OR "MRI") = 2 (Mar 09), 6 (Oct 09)
- "perfusion imaging" OR "MPI" OR "nuclear scanning" = 318
- "Emergency department" AND "diagnosis" AND ("acute coronary syndrome" OR "myocardial infarction" OR "chest pain") AND ("perfusion imaging" OR "MPI" OR "nuclear scanning") = 10 (Mar 09), 14 (Oct 09)
- "computed tomography" OR "CT" = 18974
- "Emergency department" AND "diagnosis" AND ("acute coronary syndrome" OR "myocardial infarction" OR "chest pain") AND ("computed tomography" OR "CT") = 4 (Mar 09), 17 (Oct 09)

**EMBASE:**

- Emergency department AND diagnosis (limit: humans) = 4558
- Acute coronary syndrome OR myocardial infarction OR chest pain (limit: humans) = 84232
- Echocardiography OR echo OR ultrasound (limit: humans) = 196243
- Emergency department AND diagnosis AND (acute coronary syndrome OR myocardial infarction OR chest pain) AND (echocardiography OR echo OR ultrasound) (limit: humans) = 79 (Mar 09), 85 (Oct 09)
- Computed tomography OR CT (limit: humans) = 150792
- Emergency department AND diagnosis AND (acute coronary syndrome OR myocardial infarction OR chest pain) AND (computed tomography OR CT) = 55 (Mar 09), 66 (Oct 09)
- Perfusion imaging OR MPI OR nuclear scanning (limit: humans) = 3726
- Emergency department AND diagnosis AND (acute coronary syndrome OR myocardial infarction OR chest pain) AND (perfusion imaging OR MPI OR nuclear scanning) (limit: humans) = 17 (Mar 09), 17 (Oct 09)
- Magnetic resonance imaging OR MRI (limit: humans) = 217565
- Emergency department AND diagnosis AND (acute coronary syndrome OR myocardial infarction OR chest pain) AND (magnetic resonance imaging OR MRI) (limit: humans) = 18 (Mar 09), 18 (Oct 09)

**State inclusion and exclusion criteria**

**INCLUSION CRITERIA:**
- Studies which enrolled low-intermediate risk ED patients with symptoms suggestive of ACS; non-diagnostic ECG’s; and negative biomarkers
- Peer reviewed.
- Manuscript available to review.
- Human studies.
- Criteria for positive result of MDCT were explicitly defined as >50% diameter stenosis.
- Clinical follow-up was obtained in all patients concerning the presence of USA or NSTEMI and a positive clinical outcome was defined using actual clinical standards.

**EXCLUSION CRITERIA:**
- Abstract-only studies.
- Narrative review articles and case reports
- Studies that assessed imaging in stable CAD not ACS.
- Studies that did not address diagnosis specifically.
- Unknown status of biomarkers or positive markers at the time of imaging modality
- Imaging that occurred >24 hours after the onset of the acute event
- For CT studies, older generation scanners excluded (16-slice scanners) i.e. used articles that assessed 64-slice multi-detector scanners only.

**Number of articles/sources meeting criteria for further review:**
- 585 abstracts were reviewed; 117 complete manuscripts were reviewed
- All references were searched for relevance
- 12 articles through MEDLINE - final
- 0 article from Cochrane database - final
- 0 articles from Embase - final
- 0 articles were identified through a comprehensive search of reference citations
- Twelve (12) articles met inclusion criteria and were included after the completed final review
- Level of evidence (LOE): LOE D1 = 0 ; LOE D2 = 3 ; LOE D3 = 0 ; LOE D4 = 9 ; LOE D5 =0
## Summary of evidence

### Evidence Supporting Clinical Question – final articles 12

<table>
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### Level of evidence

- **A** = Return of spontaneous circulation
- **B** = Survival of event
- **C** = Survival to hospital discharge
- **D** = Intact neurological survival
- **E** = Imaging strategy

- **E¹** = nuclear scanning (myocardial perfusion imaging /SPECT)
- **E²** = MDCT
- **E³** = ECHO
- **E⁴** = MRI

*Italics = Animal studies*
**Evidence Neutral to Clinical question**

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**Level of evidence**

A = Return of spontaneous circulation  
B = Survival of event  
C = Survival to hospital discharge  
D = Intact neurological survival  
E = other endpoint

**Italics** = Animal studies

Types of studies: CT; ECHO; MRI; Nuclear

**Evidence Opposing Clinical Question**

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**Level of evidence**

A = Return of spontaneous circulation  
B = Survival of event  
C = Survival to hospital discharge  
D = Intact neurological survival  
E = other endpoint

**Italics** = Animal studies

Types of studies: CT; ECHO; MRI; Nuclear
### REVIEWER’S FINAL COMMENTS AND ASSESSMENT OF BENEFIT / RISK:

The 2007 ACC/AHA UA/STEMI guidelines note that the use of stress testing should be considered in low risk patients prior to discharge from an ED or a chest pain unit. It also notes that the use of MRI and MSCT coronary angiography hold promise as alternative or supplementary imaging modalities for the assessment of patients presenting with chest pain syndromes with low to intermediate pretest probability of CAD in the setting of non-diagnostic ECG and negative cardiac biomarkers. However, although imaging tests are recommended for the intermediate risk patients, there are no guidelines for the use of these modalities and no assessment of whether their usage will effect a more efficient or safe diagnosis in patients with chest pain and suspected ACS.

The risk of overlooking an acute coronary syndrome remains an important challenge in patients who present to the ED with chest pain but non-diagnostic ECG’s.

Myocardial perfusion scintigraphy (MPS) has a high negative predictive value (NPV) for ruling out acute coronary syndrome (ACS) – 99% - in patients presenting to the emergency department (ED) with acute chest pain; non-diagnostic ECG and negative cardiac enzymes. MPS can also be used for risk stratification especially in low to intermediate likelihood of cardiac events according to traditional cardiac markers. This is supported particularly by the works of several case series (Paventi 2001, Conti 2005, Gallagher 2007 and Forberg 2009).

Paventi (2001)\(^9\) studied 655 patients in the ED. This study compared the use of MPS and two-dimensional echocardiography in patients who were either low or high risk for ACS. 470 patients underwent both modalities of investigation in the ED within 4 hours of presentation. Endpoints included myocardial infarction (MI), percutaneous transluminal coronary angioplasty (PTCA), and positive stress perfusion imaging. Concordance in patients who had MI or underwent coronary angiography was high at 90%. Importantly, both imaging techniques identified patients who were at high risk and required admission and those who could be safely discharged directly from the ED.

More recently in 2009 Forberg \(^4\) (Forberg 2009) conducted a smaller study of 40 patients in the ED with suspected low risk ACS. All patients underwent MPS in the ED. All 27 patients with a normal nuclear study were negative for ACS. Thus the negative predictive value for ACS was 100%. Hence, this study supported the hypothesis that acute nuclear studies in the ED can potentially reduce the number of admissions for low-risk patients in the ED with suspected ACS.

In addition, a meta-analysis by Ioannidis (2001)\(^6\) examined the role of MPI in the low-risk ED patients and found a high sensitivity and negative predictive value for its use in this population. This analysis evaluated 10 studies of rest echocardiography, 2 studies of stress echocardiography, and 6 studies of technetium-99m sestamibi scanning. MPS showed excellent sensitivity (range 91.5% to 100%) and good specificity (range 49.3% and 84.4%) for acute myocardial infarction.

MPS can be used as a means of triaging patients with suspected acute coronary syndrome (ACS) and is the most developed of all of the modalities being used since 1979. The patient populations best suited for an ED triage strategy with MPS are those in whom the initial history and ECG do not suggest a high or very low probability of ACS. Patients with normal MPS do not need to be hospitalized; patients with positive (abnormal) MPS have a high probability of ACS and justify hospital admission for early institution of treatment.

However, there continues to be limitations to the wide-scale utilization of imaging with radionucleotides. Some of these include isotope preparation, decay and licensing issues, a preponderance of a small number of labs with insufficient support to provide imaging 24 hours per day, and more recently isotope availability in many parts of the world. Given these issues, cardiovascular magnetic resonance imaging (CMR) has undergone a rapid pace of development in the past few years.

Regarding the use of MRI in low-risk ED patients with initially negative cardiac workup, there are two prospective observational cohort studies by Kwong (2003) and Cury (2008) that support its use in this population. Although these studies are limited by small numbers (62 and 161 respectively), they nevertheless demonstrate very high sensitivities and specificities for the diagnosis of ACS. Unfortunately at this point there are no higher quality studies comparing this modality and there may be limitations in access to MRI which limit generalizability of this data.

Kwong \(^9\) in 2003 undertook the first prospective study of comprehensive CMR imaging in patients with ACS in the ED. An intermediate risk population of 161 consecutive patients presenting to the ED with chest pain of >30 minutes, whose initial ECG was non-diagnostic were studied. Within 12 hours of presentation comprehensive CMR ( cine imaging of function; first-pass gadolinium-enhanced myocardial perfusion; and delayed gadolinium-enhanced infarct detection) was performed. Sensitivity and specificity of quantitative CMR for detecting ACS was 84 and 85% respectively. MRI was more sensitive than strict ECG criteria for ischemia (p<0.001), peak troponin-I (p<0.001), and the TIMI risk score (p=0.004); and MRI was more specific than an abnormal ECG (p<0.001).

The detection of NSTEMI by CMR was 100%. Finally, multivariate logistic regression analysis showed MRI was the strongest predictor of ACS and added diagnostic value over clinical parameters (p<0.001).

This is a prospective cohort series without a control group. The foremost limitation of this study is the inability for CMR to detect the difference between acute and chronic AMI. Despite this limitation, CMR does have both high sensitivity and specificity for the diagnosis of ACS in this study.
Cur 

There have been two high quality level 2 studies of MDCT (Vanhoenacker et al. 12 and Athappan 1) and also a high quality level 4 study (Hoffmann 7). The first of these studies was conducted by Vanhoenacker et al. 12 in 2007. This study was a level 2 meta-analysis. This study assessed the diagnostic performance of MDCT in the acute setting (ED patients) for the detection of ACS (NSTEMI and unstable angina). Only studies that compared MDCT with clinical outcome or coronary angiography were included. Additionally, only studies in which patients had initially normal cardiac enzymes were included. This resulted in the inclusion of nine (9) studies totaling 566 patients. One study was an RCT; eight were prospective cohort studies. Only 5 of these studies were done with 64-slice scanners. However, statistical analysis was consistent across scanner generation.

This was a high quality meta-analysis for a number of reasons: 1. Two reviewers independently graded the inclusion articles; inclusion of studies was guided by a formal system of quality evaluation,'Quality Assessment of Diagnostic Accuracy Studies' (QUADAS tool). Inter-observer agreement for study selection was evaluated with Cohen’s kappa test. 2. Study parameters were extracted initially independently and then by consensus. Data was extracted from the original articles taking into account the Standards for Reporting of Diagnostic Accuracy (STARD) checklist. 3. All studies were evaluated for potential heterogeneity with the Higgins and Thompson index which calculates the I² statistic. Heterogeneity was felt to be low. 4. Publication bias was assessed as per published methods and was expressed as an intercept level of 0.0 if no publication bias was constructed. Graphically, this was represented as a funnel plot, which revealed an inverted funnel for the data points indicating that publication bias is highly unlikely. 5. A random effects model was used to present the summary estimates which takes into account the variability between studies. 6. And, finally a multivariate logistic meta-regression was used to investigate the influence of multiple explanatory variables on the diagnostic performance of MDCT. This method minimized effect from different types of scanners that were used. The pooled sensitivity and specificity was 0.95 (95% CI 0.90-0.98) and 0.90 (95% CI 0.87-0.93). The pooled DOR was 131.81 (95% CI 50.93-341.31) – representing the likelihood of having ACS if your MDCT is positive versus having ACS if your MDCT was negative. The pooled NLR and PLR 0.12 (95% CI 0.06-0.21) (minimal likelihood of ACS) and 8.60 (95% CI 5.03 – 14.69) (moderate likelihood of ACS). Overall, the numbers from this pooled analysis were good to excellent.

While this was a very high quality meta-analysis, it is important to note that a limitation was that factors that technically limit MDCT were not mentioned in most studies. These include high calcium score, irregular rhythm, the presence of stents and dyspnea. The same criticism can be made of pre-test probability for patient populations. These issues may limit the potential to generalize the results to all patient populations.

Finally, a clear disadvantage that should be mentioned is the radiation dose that goes with the examination. It is anticipated that given this, radiation-reducing protocols will become increasingly important impact in the future.

A more recent meta-analysis has been conducted by Athappan et al. 1 in 2009. Similar to Vanhoenacker et al. 12, it was a well-performed study that included 16 studies, totaling 1119 patients. Studies included were 1 RCT, 1 retrospective review, and 14 prospective cohort studies. Pooled DOR was 190.80 (95% CI 102.94-353.65). The pooled sensitivity and specificity was 0.96 (95% CI 0.93-0.98) and 0.92 (95% CI 0.89-0.94) respectively. The pooled NLR and PLR 0.09 (95% CI 0.06-0.14) and 10.12 (95% CI 6.73-15.22). This study has very similar results to the more rigorously performed analysis by Vanhoenacker et al. 12, showing that MDCT has an excellent diagnostic accuracy in detection of significant coronary artery stenosis in patients with acute chest pain. This diagnostic accuracy of MDCT has a potential for rapid triage of patients in the ED with low to intermediate risk chest pain, to rule out ACS.

Finally, a comment on a good quality, LOE 4 study by Hoffmann et al. 7 in 2009, known as the ROMICAT trial. This study was designed to determine the usefulness of coronary computed tomography angiography (CTA) in patients with acute chest pain. This was a blinded observational cohort study in low risk patients with normal initial Troponin and non-ischemic electrocardiograms. 64-slice scanning was performed to determine if coronary plaque and stenosis >50% were present. Outcomes were ACS during hospitalization and MACE during 6-mos follow-up. 368 patients were enrolled. Sensitivity and negative predictive value for ACS were 100% (95% confidence interval [CI]: 98% to 100%) and 100% (95% CI: 89% to 100%), respectively with the absence of CAD. Specificity of presence of plaque and stenosis for ACS were 54% (95% CI 49% to 60%) and 87% (95% CI: 83% to 90%), respectively. Only 1
ACS occurred in the absence of significant plaque. In this study 50% of patients who presented with chest pain to the ED and were considered low-to-moderate risk by conventional assessment had no CAD by coronary CTA, a finding which was 100% NPV. However, the PPV for the subsequent diagnosis of ACS and MACE was low. The sensitivity (77%) for the exclusion of significant coronary stenosis by coronary CTA was low for the detection of ACS. This was due to a number of false negative findings of lesions in small vessels. The PPV of coronary CTA is also limited in patients 65 years of age and over and in this study, elderly patients and patients with renal impairment were excluded. Given the high percentage of this population who has CAD this may under-represent the real-world clinical situation. Finally, it should be noted that the CTA exams were performed in this study by a dedicated research team with a high-level of experience with reading and performing this exam. This may be limit the reproducibility in other smaller centers.

Gallagher is the only study that compared the use of MDCT to another imaging modality. This study compared the accuracy of MDCT with stress nuclear imaging for the detection of ACS in 85 low risk patients. The sensitivity of nuclear testing was 71% (95% - 36-92) and MDCT was 86% (95% - 49-97%). However, the prevalence of disease in this study was low (n=7; 8%). This study, however, used an objective definition of ACS based on coronary stenosis and this may have excluded some unstable angina patients that would have been included in other studies using a less objective qualifier. The NPV of nuclear testing and MDCT were 97% and 99% respectively. Hence, in this study, the accuracy of MDCT is comparable to nuclear testing in the low risk ACS ED patient.

Myocardial contrast echocardiography (MCE) has been expected to be a useful modality for the early and accurate diagnosis of ACS in the ED.

Conti directly compared the performance of exercise Echo (ex-Echo) and exercise nuclear imaging (ex-SPECT) for the diagnosis of CAD in patients who had a delay from chest pain onset, recognizing that while myocardial scintography has a high sensitivity and NPV this sensitivity is likely most optimal within a few hours of chest pain. 503 patients were enrolled all of whom underwent ex-Echo and ex-SPECT within 24 hours of assessment. The specificity and PPV was better for ex-Echo than with ex-SPECT (0.92-0.97 versus 0.87-0.93 and 0.72-0.88 versus 0.58-0.75 respectively). Both techniques had a NPV of 97%. Therefore while ex-Echo and ex-SPECT were both able to distinguish patients at high risk from those at very low risk for ACS; ex-Echo was superior. Overall, 166 coronary angiograms were performed with a disease prevalence of 55%. The major drawback however identified in this study of ex-Echo for the work-up of chest pain in the ED was the 5% missed diagnosis rate.

Acknowledgements:
None

Citation List

   LOE D2. Supportive. Quality fair. Meta-analysis/systematic review of over 1000 patients; acute ED setting and used clinical outcomes measures. 16 studies were included

   Assessment of patients with low-risk chest pain in the emergency department: Head-to-head comparison of exercise stress echocardiography and exercise myocardial SPECT.
   LOE D4. Supportive. Quality fair. N=500; cohort was enrolled consecutively; no randomization and each patient served as their own control. No healthy controls used. No clearly identified reference standard.

3. Ricardo C. Cury, MD; Khalid Shash, MD; John T. Nagurney, MD, MPH; Guido Rosito, MD, PhD; Michael D. Shapiro, DO; Cesar H. Nomura, MD; Suhny Abbara, MD; Fabian Bamberg, MD; Maros Ferencik, MD, PhD; Ehud J. Schmidt, PhD; David F. Brown, MD; Udo Hoffmann, MD, MPH; Thomas J. Brady, MD
   Cardiac Magnetic Resonance With T2-Weighted Imaging Improves Detection of Patients With Acute Coronary Syndrome in the Emergency Department (Circulation. 2008;118:837-844.)
   LOE D4. Supportive. Quality good. Prospective cohort study – clinical outcome = ACS. Concluded that new MRI protocol had good sensitivity to detect ACS in acute ED patients and that it added value over clinical assessment alone. This is really a study of
4. Jakob L Forberg*1, Catarina E Hilmersson1, Marcus Carlsson2, Håkan Arneden2, Jonas Björk3, Krister Hjalte4 and Ulf Ekelund1

**Negative predictive value and potential cost savings of acute nuclear myocardial perfusion imaging in low risk patients with suspected acute coronary syndrome: A prospective single blinded study BMC Emergency Medicine 2009, 9:12**

LOE D4. Supportive. Quality fair. Confounders likely not accounted for based on very low prevalence of ACS (2/40). Bias likely. Very small sample size. Outcomes are not well identified and described.


**The Diagnostic Accuracy of 64-Slice Computed Tomography Coronary Angiography Compared With Stress Nuclear Imaging in Emergency Department Low-Risk Chest Pain Patients**

LOE D4. Supportive. Quality poor. Prospective cohort study for nuclear and CT to look at diagnostic accuracy. This is a study to compare the accuracy of CT in this patient population to nuclear testing. It is not really a test to diagnose outcomes per se. Each patient had both tests so the patient served as their own control. Outcomes – ACS and 30 day MACE. N=92. Short follow up; no mention of confounders; outcomes were really to compare the two tests.

6. Udo Hoffmann, MD, MPH; John T. Nagurney, MD, MPH; Fabian Moselewski, MD; Antonio Penas, MD; Maros Ferencik, MD, PhD; Claudia U. Chae, MD, MPH; Ricardo C. Manini, MD; John H. Nichols, BA; Stephan Achenbach, MD; Thomas J. Brady, MD (Circulation. 2006;114:2251-2260.)

**Coronary Multidetector Computed Tomography in the Assessment of Patients With Acute Chest Pain**

LOE D4. Supportive. Quality good. Study of diagnostic yield. Studied patients prospectively but had no reference standard and no control group. Follow-up 5 months. Outcomes were measured in an objective way. Outcomes – determine the CT angiographic appearance of CAD; and secondary outcome was to compare the use of CT with traditional methods of assessing ACS patients to see if it is a good triage tool for ACS patients presenting to the ED.

7. Udo Hoffmann, MD, MPH,*† Fabian Bamberg, MD, MPH,† Claudia U. Chae, MD, MPH,† John H. Nichols, BA,* Ian S. Rogers, MD, MBA,* Sujith K. Seneviratne, MBBS,* Quynh A. Truong, MD,* Ricardo C. Cury, MD,*† Suhny Abbara, MD,*† Michael D. Shapiro, DO,* Jamaluddin Molooy, MD,* Javed Butler, MD, MPH,* Maros Ferencik, MD, PhD,* Hang Lee, PhD,§ Ik-Kyung Jang, MD, PhD,§ Blair A. Parry, BA, David F. Brown, MD, James E. Udelson, MD,† Stephan Achenbach, MD,# Thomas J. Brady, MD,†‡ John T. Nagurney, MD, MPH (J Am Coll Cardiol 2009;53:1642–50)

**Coronary Computed Tomography Angiography for Early Triage of Patients With Acute Chest Pain: The ROMICAT (Rule Out Myocardial Infarction using Computer Assisted Tomography) Trial**

LOE D4. Supportive. Quality good. Prospective cohort study of CT scans. Outcomes - ACS during index visit ; MACE at 6 months Concluded that the presence of coronary plaque and then stenosis on angiography component were both predictive of ACS. If no CAD on CT and low to intermediate risk, by risk scoring then, these patients had very low risk of MACE and could be discharged safely. Study of diagnostic yield without a control group; reference standard not used i.e. coronary angiography. Outcomes were clinical and well defined. Follow up was good at 6 mos. LOE D4; quality is good (3/3)


**Accuracy of Imaging Technologies in the Diagnosis of Acute Cardiac Ischemia in the Emergency Department: A Meta-Analys**
The 3 ECHO studies used in the analysis were Peels, Kontos, and Sabia – all were very poor quality and not included in this analysis. Similar situation with the nuclear studies. Also studies of old data – 1966-1998 the meta-analysis included here. Only 2 studies looked at diagnostic outcome. All of the rest of the studies looked at the diagnostic accuracy of the tests themselves.

9. Raymond Y. Kwong, MD; Adam E. Schussheim, MD; Suresh Rekhraj, MD; Anthony H. Aletras, PhD; Nancy Geller, PhD; Janice Davis, RN; Timothy F. Christian, MD; Robert S. Balaban, PhD; Andrew E. Arai, MD (Circulation. 2003;107:531-537.)

Detecting Acute Coronary Syndrome in the Emergency Department With Cardiac Magnetic Resonance Imaging

LOE D4. Supportive. Quality fair. Consecutive patients with chest pain in the ED. No control. Outcomes – detection of ACS. Used logistic regression to see if the MRI added anything over the traditional workup alone. This is similar methodology to Korosoglou – it is really a study of the diagnostic yield of a test, but is not related to clinical outcomes. Known confounders not identified and controlled for i.e. previous MI in weeks prior to ED presentation.


LOE D4; Supportive. Quality Good. 655 patients were identified and 470 had echo and MPI within 4 hours of presentation. Concordance between the two modalities was 90% and endpoints were the same (MI, PTCA and positive stress perfusion imaging). Similar study involving 100 less patients was published in a non-peer reviewed journal and has similar findings.

11. Ronen Rubinshtein, MD; David A. Halon, MB, ChB; Tamar Gaspar, MD; Ronen Jaffe, MD; Basheer Karkabi, MD; Moshe Y. Flugelman, MD; Asia Kogan, MD; Reuma Shapira, MD; Nathan Peled, MD; Basil S. Lewis, MD, FRCP (Circulation. 2007;115:1762-1768.)

Usefulness of 64-Slice Cardiac Computed Tomographic Angiography for Diagnosing Acute Coronary Syndromes and Predicting Clinical Outcome in Emergency Department Patients With Chest Pain of Uncertain Origin

LOE D4; Supportive. Quality fair. Prospective cohort study. Small number of patients (n=58). This article fits under both diagnosis AND prognosis as the initial part of the study discusses diagnosis and the later 15-month follow-up more accurately addresses prognosis. LOE 4, fair quality (outcome assessors not blinded, no strict AHA criteria for ACS applied).


LOE D2 (included only prospective cohort studies and 1 RCT); supportive. Quality good. Studies of CT in the ED department setting; included studies of outcome. Only studies with negative cardiac enzymes were included. 9 studies of 566 patients; 1 RCT and 8 prospective cohort studies; 5 studies used 64-slice CT’s. Of these 5 – Gallagher 2007; Hoffman 2006; Goldstein 2007; Meijboom 2007; Rubinshtein 2007 – these were all included in our review.