Acute chest pain: Game changer or waste of resources?

Stress Imaging to rule out myocardial ischaemia

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Acute chest pain

No conflict of interest

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Acute chest pain evaluation

- 8 million visits/yr in ED for chest pain
- Majority of low risk population
- Missed ACS rate: 3%-5%; erroneously discharged
- Annual cost related to chest pain: $10 to $12 billion
- ECG, troponin and secondary testing
- Variety of strategies (provocative testing or imaging to identify significant CAD)
Medical imaging

- US Medicare on CV imaging: $ 4.7 billions
- Cost increase annually: 17% to 26%
- Availability, feasibility, accuracy, prognostic value, radiation exposure, cost-effectiveness
- Inappropriate use?
Availability
Application of appropriate use criteria to cardiac stress testing in the hospital setting

Chest pain or possible ACS: very low rate of inappropriate testing (2%)
Preoperative exam in low-risk patients: 77% of inappropriate tests

Gertz et al
Case

- 57-year old woman
- Negative estrogen status
- Atypical chest pain
- Diabetes treated by metformin
- LDL-C = 131 mg/dL
- Normal ECG
- Normal hs troponin (twice)
Case: pre-test probability

• 57-year old woman 3
• Negative estrogen status 3
• Atypical chest pain 3
• Diabetes treated by metformin 2
• LDL-C = 131 mg/dL 1
• Normal ECG
• Normal troponin
• Pre-test probability 12

Morise JACC 2003;42:42-50
Pre-test probability

• Low: < 8
• Intermediate: 8 – 15
• High: > 15
• The patient: score of 12
• Pre-test intermediate probability
• Indication of stress imaging (ESC Guidelines: I A)
ESC Guidelines

• Diagnostic tools:
  – Echo is the most important modality
    • LV function
    • Transient dyssynergy during ischaemia
    • DD: dissection, AS, HCM, pulmonary embolism, pericardial effusion
  – Stress imaging in patients with non-diagnostic ECG and normal cardiac biomarkers
  – CMR: function, perfusion, viability and scar in 1 session
  – CT: useful to exclude ACS or other causes of chest pain

She was submitted to stress echo 8h after admission
Semi-supine exercise echo
Induced posterior ischaemia; PCI of LCx
Incremental diagnostic and prognostic value of stress echo in a chest pain unit


78%DSE; 77%(618 of 802)normal SE
Time to any hard event in the first year for patients with normal and abnormal stress echo

Abnormal SE: strongest predictor of death or MI
HR=3.97 (95% CI, 1.87-8.4)

Time to any hard event for patients with normal and abnormal stress echo results over a 27±11-month period

Normal SE: annual mortality rate 1.02% annual hard event rate 1.24%

Myocardial perfusion and CFR-LAD during stress echo
SE protocol (High dose dipyridamole-atropine)

* Recovery contrast echocardiography was performed only when abnormal perfusion and/or function at stress was detected.

Contrast SE predicts hard and combined cardiac events
Comparative Prediction of Cardiac Events by Wall Motion, Wall Motion Plus Coronary Flow Reserve, or Myocardial Perfusion Analysis: A Multicenter Study of Contrast Stress Echocardiography

Gaibazzi et al JACC: Cardiovascular Imaging, 2013, 1 - 12
Acute chest pain: value of stress MPI

1,576 consecutive pts; stress SPECT within 24h
Normal SPECT in 91%: event rate 1.6%; hard event rate 0.5%

Incremental benefit of SPECT as compared to clinical variables and TIMI score in predicting cardiac events

Stress CMR reduces revascularization, hospital readmission, and recurrent cardiac testing in intermediate-risk patients with acute chest pain.

Randomized (n=105)

Allocation

Allocated to OU-CMR (n=52)
- Received CMR (n=49)
- Did not receive CMR (n=3)
- Excluded after randomization (n=0)

Allocated to usual care (n=53)
- Received inpatient care (n=46)
  - Discharged from ED (n=3)
  - Placed in OU (n=3)
  - Left the ED against medical advice (n=1)
- Excluded after randomization (n=0)

Follow-Up

Record review:
90 day record review (n=52)
Telephone:
90 day telephone follow up (n=47)
Only 30 day telephone follow up (n=3)
No telephone follow up (n=2)

Record review:
90 day record review (n=53)
Telephone:
90 day telephone follow up (n=51)
Only 30 day telephone follow up (n=0)
No telephone follow up (n=2)

Analysis

Analyzed (n=52)

Analyzed (n=53)
Outcomes and events through 90 days

<table>
<thead>
<tr>
<th>Event</th>
<th>Usual care (n=53)</th>
<th>CMR (n=52)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital admission</td>
<td>47 (89)</td>
<td>8 (15)</td>
<td></td>
</tr>
<tr>
<td>Composite primary outcome</td>
<td>20 (38)</td>
<td>7 (13)</td>
<td>0.004</td>
</tr>
<tr>
<td>Revascularization</td>
<td>8 (15)</td>
<td>1 (2)</td>
<td>0.31</td>
</tr>
<tr>
<td>Hospital readmission</td>
<td>12 (23)</td>
<td>1 (2)</td>
<td>0.33</td>
</tr>
<tr>
<td>Recurrent cardiac testing</td>
<td>9 (17)</td>
<td>2 (4)</td>
<td>0.028</td>
</tr>
<tr>
<td>ACS after discharge</td>
<td>3 (6)</td>
<td>0 (0)</td>
<td>0.24</td>
</tr>
</tbody>
</table>

Stress CMR reduces revascularization, hospital readmission, and recurrent cardiac testing in intermediate-risk patients with acute chest pain.

Cumulative incidence curves demonstrate an early reduction in composite events that continued through 90 days in the OU-CMR group compared to the usual care group. OU, observation unit; CMR, cardiac magnetic resonance.

Stress cardiac MR imaging vs stress echo in pts with intermediate risk chest pain

<table>
<thead>
<tr>
<th>Interpretation and Modality</th>
<th>Sensitivity (%)</th>
<th>Specificity (%)</th>
<th>Accuracy (%)</th>
<th>Positive Predictive Value (%)</th>
<th>Negative Predictive Value (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Clinical interpretation</strong></td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Stress cardiac MR imaging</td>
<td>100 (8/8) [63, 100]</td>
<td>92 (48/52) [82, 98]</td>
<td>93 (56/60) [84, 98]</td>
<td>67 (8/12) [35, 90]</td>
<td>100 (48/48) [93, 100]</td>
</tr>
<tr>
<td>Stress echocardiography</td>
<td>38 (3/8) [9, 76]</td>
<td>96 (50/52) [87, 100]</td>
<td>88 (53/60) [77, 95]</td>
<td>60 (3/5) [15, 95]</td>
<td>91 (50/55) [80, 97]</td>
</tr>
<tr>
<td>( P ) value</td>
<td>.025</td>
<td>.41</td>
<td>.37</td>
<td>.79</td>
<td>NA*</td>
</tr>
<tr>
<td><strong>Blinded interpretation</strong></td>
<td></td>
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<td>88 (7/8) [47, 100]</td>
<td>90 (47/52) [79, 97]</td>
<td>90 (54/60) [79, 96]</td>
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<td>98 (47/48) [89, 100]</td>
</tr>
<tr>
<td>Stress echocardiography</td>
<td>63 (5/8) [24, 91]</td>
<td>92 (48/52) [81, 98]</td>
<td>88 (53/60) [77, 95]</td>
<td>56 (5/9) [21, 86]</td>
<td>94 (48/51) [84, 99]</td>
</tr>
<tr>
<td>( P ) value</td>
<td>.31</td>
<td>.71</td>
<td>.76</td>
<td>.90</td>
<td>.36</td>
</tr>
</tbody>
</table>

Adenosine stress cardiac MR: improved performance compared with stress echo
Logistic regression models utilizing blinded stress-imaging

Multivariate analysis: stress cardiac MR imaging was the strongest independent predictor of significant CAD (P=0.002)

![Table showing logistic regression models]

Model A: Clinical with stress cardiac MR imaging
- Total no. of cardiac risk factors: 1.17 (P=0.11)
- Stress cardiac MR imaging: 63.4 (P<0.001)

Model B: Clinical with stress echocardiography
- Total no. of cardiac risk factors: 1.18 (P=0.69)
- Stress echocardiography: 19.0 (P=0.001)

Model C: Clinical with both stress tests
- Total no. of cardiac risk factors: 0.87 (P=0.81)
- Stress cardiac MR imaging: 56.6 (P=0.002)
- Stress echocardiography: 15.7 (P=0.04)

Lower risk patients: CMR stress vs provider selected stress test

• 120 pts randomized
• PC: stress echo(62%), CMR(32%), Cath(3%), nuclear(2%), coronary CT(2%)
• No difference:
  – in length of stay: 24.2h vs 23.8h
  – cath without revascularization
  – 30-day ACS (both 3%)
Provider-directed imaging stress testing reduces health care expenditures in lower-risk chest pain patients presenting to the ED.

Mean costs: $2586 for CMR and $2050 for PC group

Miller et al
Patients from ROMICATE1
hsTnT Levels Between Patients With Normal and Abnormal SPECT-MPI
Median high-sensitivity troponin T (hsTnT) levels were significantly higher in patients with abnormal single-photon emission computed tomography–myocardial perfusion imaging (SPECT-MPI) compared with those with normal SPECT-MPI (9.41 pg/ml [interquartile range (IQR): 5.73 to 19.20 pg/ml] vs. 4.89 pg/ml [IQR: 2.34 to 7.68 pg/ml], p = 0.001).

hs TnT level predicts abnormal stress test


hs TnT: powerful triage tool in chest pain patients?
Conclusions 1

• There are few high-risk patients presenting with ACP

• Standard of care: serial biomarkers and subsequent stress testing

• Stress imaging increases sensitivity
Conclusions 2

• Optimal test remains unclear

• Future role of hs troponin?
  – Will + hs Tn negate the need for subsequent stress imaging?
  – Negative hs troponin: direct discharge; low level hs Tn: additional testing?

• Cost analysis is critical to define an optimal protocol