STRESS ECHOCARDIOGRAPHY PREDICTS ALL-CAUSE MORTALITY IN PATIENTS ADMITTED WITH SUSPECTED ACUTE CORONARY SYNDROME, NON-DIAGNOSTIC ECG AND NEGATIVE TROPONIN

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Conflicts of interest

• None to declare for all authors
Introduction

• Chest pain is a common cause of presentation to the ED
• Many patients require admission for investigation, specifically to exclude acute coronary syndrome (ACS)
• However, the majority do not have ACS
• Clinical risk factors and risk scores provide insufficient risk stratification and thus functional testing is recommended

• Stress echocardiography is superior to ETT\(^1\) for:
  – Reduced number of inconclusive tests
  – Reduced number of normal angiograms
  – Reduced cost to diagnosis

\(^1\)Jeetley et al EHJ 2007;28:204-11
Purpose of the Study

• Several studies have reported the value of SE in acute CP patients in the ED. However, these had small patient numbers, limited follow-up and very small numbers of hard events.

• There are no reports of the value of SE when incorporated into a real-world clinical chest pain service.

• To determine the:
  - Feasibility
  - Safety
  - Impact on patient triaging
  - Accuracy of risk stratification

in patients admitted to our chest pain unit (CPU) with acute chest pain, non-diagnostic ECG & negative troponin.
Methods

• **Inclusion criteria of our CPU:**
  – Admitted with acute chest pain
  – ≥2 cardiovascular risk factors
  – Non-diagnostic / non-ischaemic ECG
  – Negative 12hr troponin

• Underwent SE within 24hrs of admission (Mon-Fri)

• **Retrospective follow-up for determination of:**
  – Length of stay
  – Re-admission rates
  – All-cause mortality
  – Hard events (death + acute non-fatal MI)
Methods

**Stress Echocardiography**

- Exercise stress preferred modality; if unable to perform ETT → dobutamine echocardiography
- Ultrasound contrast (*Luminity*) used to optimise endocardial border delineation if ≥2 contiguous segments poorly visualised

**Follow-Up**

- Mortality Databases (National / Hospital / GP)
- Letters to patients (x2)
- Phone calls to GPs & patients
Results

- **Timeframe** – April ‘07 – June ‘09: 875 patients underwent SE via the CPU

- **Feasibility** – 830 patients (94.8%) had a diagnostic SE test. 45 patients (5.2%) had inconclusive tests and were excluded. Of these, just 7 (<1%) were due to poor image quality.

- **Safety** – no patients had serious adverse effects

- **Follow-up** – 674/830 (81%) were available for follow-up:
  - Mean follow-up 18 ± 6 months
  - Follow-up > 365 days 97% patients
  - 22 hard events 19 deaths & 3 non-fatal MI
## Results - Demographics

<table>
<thead>
<tr>
<th>Patient characteristic</th>
<th>Number (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>(n = 674)</strong></td>
<td></td>
</tr>
<tr>
<td>Mean age (yrs±SD)</td>
<td>63±12</td>
</tr>
<tr>
<td>Male gender</td>
<td>358 (53.1)</td>
</tr>
<tr>
<td>Diabetes</td>
<td>221 (32.7)</td>
</tr>
<tr>
<td>Hypertension</td>
<td>465 (68.9)</td>
</tr>
<tr>
<td>Smoker</td>
<td>93 (13.7)</td>
</tr>
<tr>
<td>Hyperlipidemia</td>
<td>444 (65.8)</td>
</tr>
<tr>
<td>Family history of premature CAD</td>
<td>264 (39.1)</td>
</tr>
<tr>
<td>Previous AMI</td>
<td>181 (26.8)</td>
</tr>
<tr>
<td>Previous PCI</td>
<td>153 (22.7)</td>
</tr>
<tr>
<td>Previous CABG</td>
<td>73 (10.8)</td>
</tr>
<tr>
<td>Prior use of aspirin</td>
<td>413 (61.2)</td>
</tr>
<tr>
<td>Median(IQR) TIMI risk score</td>
<td>3.0 (2-4)</td>
</tr>
</tbody>
</table>

### TIMI Risk Group

- **Low risk (TIMI score 0-1)**: 126 (18.6)
- **Intermediate risk (TIMI score 2-4)**: 499 (74.1)
- **High risk (TIMI score 5-7)**: 49 (7.3)
## Results – Stress Echocardiography

<table>
<thead>
<tr>
<th>Stress Echocardiography Data</th>
<th>n = 674</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stress Modality</strong></td>
<td></td>
</tr>
<tr>
<td>Exercise (Treadmill)</td>
<td>151 (22.4%)</td>
</tr>
<tr>
<td>Pharmacological (Dobutamine)</td>
<td>523 (77.6%)</td>
</tr>
<tr>
<td>Trans-pulmonary contrast agent use</td>
<td>345 (51.1%)</td>
</tr>
<tr>
<td><strong>Stress Results</strong></td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>517 (76.7%)</td>
</tr>
<tr>
<td>Abnormal – inducible ischaemia</td>
<td>86 (12.8%)</td>
</tr>
<tr>
<td>Abnormal – resting RWMA but no ischaemia / structural disease</td>
<td>71 (10.5%)</td>
</tr>
</tbody>
</table>
Length of Stay (LOS) & Re-admissions

**NORMAL SE**

- Median LOS = 1 day (Mon – Fri)
- Median LOS = 2 days (Sat – Sun)

**RE-ADMISSIONS**

- 4 patients in 1st 30 days after discharge:
  - 2/517 (0.4%) in normal SE group
  - 2/157 (1.3%) in abnormal SE group
Impact on Angiography & Revascularisation

- 73/86 (85%) patients with inducible ischaemia during SE underwent angiography – significant CAD was found in 50 patients (69%)

- 6/517 patients with a normal SE underwent angiography (clinical decision) and none required revascularisation.

- Of the 30 patients that underwent revascularisation, 28/30 (93%) had inducible ischaemia on SE.
## Results – Event Rates

<table>
<thead>
<tr>
<th>FOLLOW-UP PERIOD</th>
<th>NORMAL SE (n = 517)</th>
<th>ABNORMAL SE (n = 157)</th>
<th>TOTAL (n = 674)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DEATH</strong></td>
<td></td>
<td></td>
<td>19</td>
</tr>
<tr>
<td>Annualized Mortality Rate</td>
<td>0.8%</td>
<td>3.5%</td>
<td>1.4%</td>
</tr>
<tr>
<td>Whole Population</td>
<td>8/517 (1.5%)</td>
<td>11/157 (7.0%)</td>
<td>19/674 (2.8%)</td>
</tr>
<tr>
<td>0-12 months</td>
<td>2/517 (0.3%)</td>
<td>9/157 (5.7%)</td>
<td>11/674 (1.6%)</td>
</tr>
<tr>
<td>12-24 months</td>
<td>5/515 (0.9%)</td>
<td>2/148 (1.3%)</td>
<td>7/663 (1.0%)</td>
</tr>
<tr>
<td>&gt;24 months</td>
<td>1/510 (0.1%)</td>
<td>0 (N/A)#</td>
<td>1/656 (0.1%)</td>
</tr>
<tr>
<td><strong>DEATH + NON-FATAL MI</strong></td>
<td></td>
<td></td>
<td>22</td>
</tr>
<tr>
<td>Annualized Event Rate</td>
<td>0.9%</td>
<td>3.8%</td>
<td>1.6%</td>
</tr>
<tr>
<td>Whole Population</td>
<td>10/517 (1.9%)</td>
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Survival Analysis

Kaplan-Meier Curve
ALL-CAUSE MORTALITY

Log rank p<0.001

Kaplan-Meier Curve
ALL HARD EVENTS

Log rank p<0.001
Results – Cox Regression Analysis

PREDICTORS OF ALL-CAUSE MORTALITY

UNIVARIATE

• Advancing age (HR 1.88, 95% C.I. 1.25-2.84, p 0.003)
• Family History IHD (p 0.003)
• Abnormal SE result (HR 4.96, 95% C.I. 1.99-12.3, p 0.001)

MULTIVARIATE

• Abnormal SE result (HR 4.52, 95% C.I. 1.81-11.3, p 0.001)
• Advancing age (HR 1.76, 95% C.I. 1.18-2.62, p 0.005)
PREDICTORS OF ALL HARD EVENTS

UNIVARIATE

- Advancing age  (HR 1.79, 95% C.I. 1.23-2.62, p 0.002)
- Family History IHD (p 0.003)
- Abnormal SE result  (HR 4.37, 95% C.I. 1.89-10.1, p 0.001)

MULTIVARIATE

- Abnormal SE result  (HR 4.02, 95% C.I. 1.73-9.36, p 0.001)
- Advancing age  (HR 1.70, 95% C.I. 1.18-2.44, p 0.005)
Conclusions

The incorporation of SE into a CPU for patients with suspected ACS demonstrates:

• **Excellent feasibility** – Approx. 95% diagnostic tests and >99% had diagnostic images

• **Excellent safety** – no SAE

• **Excellent triaging** – median length of stay 1 day (normal SE → home, abnormal SE → kept in hospital for further assessment).

• **Excellent risk stratification** – SE predicts hard events independently and beyond that predicted by clinical risk factors conventionally employed in such patients.
Thank You

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