INTRODUCTION

Non-ST elevation acute coronary syndromes (NSTEMI and UA), the CMNW risk c-statistic is 0.466 (95% CI 0.345 to 0.586, asymptotic significance 0.616), TIMI 0.418 (CI 0.281 to 0.555, asymptotic significance 0.231).

Conclusions The CMNW score categorised more patients as higher risk, who suffered death at 30 days than the TIMI score.

ABSTRACT

Background Non-ST elevation acute coronary syndromes (NSTEACS) confer a broad range of risk of adverse outcomes following presentation to an emergency department. This study compares the Thrombolysis in Myocardial Infarction (TIMI) risk scoring system with the used but untested, Cheshire, Merseyside and North Wales Cardiac Network (CMNW) NSTEACS risk stratification system in predicting the adverse outcomes of re-admission to hospital with either a NSTEACS or death at 30 days post presentation.

Method Once a diagnosis of NSTEACS was made, patients were risk scored, then case notes were retrieved 30 days later. Primary adverse outcome of death and secondary adverse outcome of NSTEACS at 30 days was analysed using a ROC curve.

Results 104 patients were included in the study diagnosed as having NSTEACS. Of these patients, 11 (11%) were initially diagnosed as having unstable angina (UA) (troponin I negative, <0.07), 43 (41%) non-ST elevation myocardial infarction Group 1 (troponin I 0.07–0.49) and 50 (48%) had non-ST elevation myocardial infarction Group 2 (troponin I ≥0.50). For death at 30 days, the CMNW risk c-statistic is 0.845 (95% CI 0.728 to 0.962, asymptotic significance 0.02) and TIMI 0.670 (CI 0.493 to 0.847, asymptotic significance 0.25), NSTEACS at 30 days (including NSTEMI and UA), the CMNW risk c-statistic is 0.466 (95% CI 0.345 to 0.586, asymptotic significance 0.616), TIMI 0.418 (CI 0.281 to 0.555, asymptotic significance 0.231).

Conclusions The CMNW score categorised more patients as higher risk, who suffered death at 30 days than the TIMI score.

Comparison of two clinical scoring systems in risk stratification of non-ST elevation acute coronary syndrome patients in predicting 30-day outcomes

Charlotte Rawlings, Kieran Oglesby, Jim Turner, Aruni Sen

1Department of Emergency Medicine, Wrexham Maelor Hospital, Wales, UK
2Department of Cardiology, Wrexham Maelor Hospital, Wales, UK
3Department of Clinical Audit, Research, Effectiveness (CARE), Wrexham Maelor Hospital, Wales, UK

Correspondence to Charlotte Rawlings, Department of Emergency Medicine, Wrexham Maelor Hospital, Wales, Second Year Foundation Programme, 48 St Johns Road, Clifton, Bristol BS8 2HG, UK; charlie_rawlings@hotmail.com

Accepted 1 December 2010

INTRODUCTION

Non-ST elevation acute coronary syndromes (NSTEACS) confer a broad range of risk of adverse outcomes following presentation to an emergency department (ED) and hospital admission. Indeed, 9.5% of patients treated with antiplatelets following a NSTEACS will suffer a further non-fatal myocardial infarction, stroke or die from a cardiovascular cause within 30 days of initial presentation.1 Considering this degree of risk to NSTEACS patients and the range of interventions now available to clinicians, it is becoming increasingly important to accurately risk stratify patients as early as possible and efficiently target emergency medical and interventional treatment. This is particularly true where the combined antiplatelet therapy and the emergency percutaneous coronary interventions (PCI) carry their own risks of complications. Numerous scoring systems (eg, Thrombolysis in Myocardial Infarction (TIMI), Global Registry of Acute Coronary Events (GRACE), Platelet glycoprotein IIb/IIIa in Unstable Angina: Receptor Suppression Using Integrilin (PURSUIT)) have been developed to risk stratify the heterogeneous NSTEACS patient group during the first few hours of clinical presentation and so assist clinicians in selecting appropriate pharmacological therapies and percutaneous interventions in the acute setting.2–4

Numerous studies demonstrate that GRACE more consistently and accurately predicts adverse outcomes post NSTEACS than the more commonly employed TIMI.2–5 However, no national or international consensus currently exists regarding the risk stratification system of choice. This is especially significant in the ED setting where not all relevant information needed for risk stratification may be immediately available and so reliance on TIMI scores alone may be unwise.6 Early identification of high-risk patients is important to ensure prompt and appropriate treatment and to establish those patients requiring admission, dictating choice of specialist referral and the subsequent allocation of monitored inpatient beds.7

Since January 2005, a NSTEACS risk stratification system has been implemented by Cheshire, Merseyside and North Wales Cardiac Network (CMNW), to assist decision-making for individual patients. An advantage of the CMNW score is that it can be applied to undifferentiated chest pain patients who present to an ED. The primary assessment and risk score can be done and then modified when additional information becomes available. Some of the predictor variables require knowledge of previous findings, for example, a previously documented S3 heart sound. This information, like ‘known coronary artery stenosis of 50% or more from previous cardiac catheterisation’ in the TIMI risk score may be unavailable initially, but the majority can be completed at the bedside. The CMNW risk score system has been developed by the network cardiologists as a consensus scoring system, and is widely accepted as a practical useful tool by emergency physicians and cardiologists, but has yet to be validated. In practical terms, it has proved a useful tool in determining within the first 12 h of admission, whether medical management or additional angiography is indicated. This score, if completed in the ED, can aid the risk assessment of the patient so the ED and subsequently ward clinicians, can target
emergency medical and interventional treatment earlier. Coronary angiogram is needed partly for diagnostic reasons to confirm the presence of coronary artery disease, but more importantly as a means of identifying patients in whom coronary revascularisation by PCI or coronary artery bypass graft (CABG) would be appropriate. This has, on a practical level, superseded the use of other systems within the district general hospitals in the North West Region of England and North Wales.

AIMS AND OBJECTIVES

The primary aim of the study was to compare the validated TIMI risk scoring system with the unvalidated CMNW risk scoring system for NSTEACS in predicting the adverse outcomes of re-admission to hospital with a NSTEACS and death at 30 days post presentation. The TIMI risk score was chosen for comparison because of its simplicity of use and international recognition. A primary adverse outcome was defined as death within 30 days of an admission with a NSTEACS diagnosis. Secondary adverse outcome was defined as a recurrent NSTEACS during the same admission or a new presentation within 30 days. Although the TIMI risk score has been validated as predictive for 14-day outcomes, a 30-day outcome was used. This was used because 9.5% of patients treated with antiplatelets following a NSTEACS will suffer a further non-fatal myocardial infarction, stroke or die from a cardiovascular cause within 30 days of initial presentation.1

METHODOLOGY

This risk scores were calculated prospectively by two researchers at Wrexham Maelor Hospital from information available during their ED visit, over a 22-week period from 1 September 2008 to 31 January 2009. For a case to be included, a diagnosis of NSTEACS must have been documented by the admitting emergency medicine clinician, consultant physician or cardiologist in patient case notes. To avoid misdiagnosis, the diagnosis at admission was compared to the diagnosis on the discharge letter. If the discharge diagnosis was no longer NSTEACS then the patient was excluded from the study. As the study population excluded ST elevation myocardial infarction (STEMI), the only way in which non-ST elevation myocardial infarction (NSTEMI) could be diagnosed was by using troponin I values. NSTEACS was divided into ‘unstable angina’ (UA) with a 12 h troponin I value <0.07 mg/l and NSTEMI with a 12 h troponin I value ≥0.07 mg/l.8

A diagnosis of NSTEACS was re-afﬁrmed by the researchers based on the documented clinical history, examination, admission (or subsequent) 12-lead ECG and cardiac enzyme levels, and troponin I in Wrexham Maelor Hospital. Selection bias was avoided because every patient who attended with possible NSTEACS was reviewed for inclusion into the study. Cases were excluded at the outset if the diagnosis was considered non-cardiac or if there was acute, persistent ST segment elevation or acute Q wave myocardial infarction (MI) on ECG. Risk scores were subsequently calculated using the CMNW and TIMI criteria at the time of documented diagnosis, as outlined in appendix 1. The risk scores calculated were then categorised into the three risk groups—low, intermediate and high (see table 1):

The risk groups for the CMNW risk score were determined by the CMNW guidelines and are the risk categories that dictate subsequent management and treatment. The TIMI risk scores are normally distributed so the categories reflect the small number of patients with extreme risk scores; patients with 0–2 risk factors and 5–7 risk factors were combined.

Case notes were retrieved at least 50 days after first admission with diagnosis of NSTEACS. The primary adverse outcome of death was defined as MI being stated on an issued death certificate, with or without postmortem information. The secondary adverse outcome was defined as either re-admission within 30 days of original admission or recurrence during the admission with discreet symptoms consistent with re-infarction, new ECG changes or rise in cardiac biomarkers—troponin I if after 6 days from the original NSTEACS or using other markers (CK-MB) if symptoms recurred within 6 days. The primary outcome was independent of both scores. The secondary outcome was included if it was considered independent of both scores and only related to events that occurred after the patient’s initial presentation.

RESULTS AND ANALYSIS

The test cohort for the study was 104 patients, 49 women and 55 men (mean age 72.5 years, median age 73 years, range 35.4–95.1 years). Of these patients, 11 (11%) were diagnosed as having UA (troponin I negative, <0.07), and 93 (89%) as having NSTEMI group 1 (troponin I ≥0.50). See table 2 for overall outcomes at 30 days and table 3 to compare the number of patients within each risk category who had an adverse outcome at 30 days.

ROC curve analysis using raw scores

Primary adverse outcome of death at 30 days:

CMNW risk c-statistic is 0.845 (95% CI 0.728 to 0.962, asymptotic significance 0.02), TIMI 0.670 (CI 0.493 to 0.847, asymptotic significance 0.25) (see figure 1).

DISCUSSION

This prospective cohort study aimed to compare the TIMI risk score with the CMNW risk score in predicting 30-day outcomes, due to the hypothesis that the CMNW risk score, which has been widely in use in the North West Region of England and North Wales since 2005, supersedes other risk scores. The study found that a high CMNW risk score identified more of the patients who had a primary adverse event of death at 30 days, than the TIMI risk score.

Statistical analysis showed significantly that the area under the ROC graph, analysing the primary adverse outcome of death at 30 days, for the CMNW risk score was 0.845 (p=0.02) as opposed to the TIMI equivalent of 0.670 (p=0.25). The non-significant ROC analysis of a correlation between risk score and

<table>
<thead>
<tr>
<th>Event</th>
<th>Number of patients</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No adverse outcome</td>
<td>65</td>
<td>62.5</td>
</tr>
<tr>
<td>Death</td>
<td>4</td>
<td>3.8</td>
</tr>
<tr>
<td>NSTEMI</td>
<td>17</td>
<td>16.2</td>
</tr>
<tr>
<td>UA</td>
<td>9</td>
<td>8.6</td>
</tr>
<tr>
<td>Total patients admitted with adverse outcome</td>
<td>30</td>
<td>28.6</td>
</tr>
</tbody>
</table>

NSTEMI, non-ST elevation myocardial infarction; UA, unstable angina.

Table 1 Subdivision categories within risk scores

<table>
<thead>
<tr>
<th>Risk Group</th>
<th>CMNW score</th>
<th>TIMI score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>0–2.5</td>
<td>0–2</td>
</tr>
<tr>
<td>Intermediate</td>
<td>3–6</td>
<td>3–4</td>
</tr>
<tr>
<td>High</td>
<td>&gt;6</td>
<td>5–7</td>
</tr>
</tbody>
</table>

Table 2 Overall outcomes at 30 days

systems were reliably able to risk stratify NSTEACS patients and subsequently predict adverse outcomes at 30 days. Furthermore, several limitations of the study must be acknowledged. Due to the small sample size and therefore inadequate power of the study, firm conclusions cannot be drawn from the study findings. The TIMI risk score was validated as predictive for 14-day outcomes; however, this study compares outcomes at 30 days. There was also the possibility of work-up bias in the study, regarding diagnosis. This is due to certain components of the risk scores that do not function independently of decision-making, for example, a positive troponin or ECG.

An important clinical consequence of the study is that, depending on the scoring system utilized, an individual presenting with an ACS may well be managed differently based on a centre’s preferred system. Of course, a centre’s choice of system may be dictated by the available resources, particularly onsite access to angiography and the number of cardiology and coronary care beds. This variation emphasizes the importance of clinical judgement and inclusion of other relevant criteria (e.g., comorbidities, patient preference etc.) and not considering scoring systems in isolation.

CONCLUSIONS
This study found that the CMNW risk score identified more patients who had the primary adverse outcome of death than the TIMI risk score, at 30 days post initial presentation to the ED with NSTEACS. However, due to a small sample size and therefore inadequate power, this study has a limited internal validity.

Competing interests None.

Provenance and peer review Not commissioned; externally peer reviewed.

REFERENCES

APPENDIX 1
TIMI score calculation:
Each of the following criteria contributed 1 point towards the total TIMI score with a maximum score of 7 attainable (points in parentheses):

- Age greater than 65 on day of admission (1)
- Three or more known risk factors for coronary artery disease (CAD) including (1):
  - Documented family history of CAD with a male relative’s first CAD event occurring before the age of 55 or a female relative’s first CAD event occurring before 65
  - Hypertension

Figure 1 Receiver operating characteristic (ROC) curve for death at 30 days. Non-ST elevation acute coronary syndrome (NSTEACS) at 30 days (including non-ST elevation myocardial infarction (NSTEMI) and unstable angina (UA)): Cheshire, Merseyside and North Wales Cardiac Network (CMNW) risk c-statistic is 0.486 (95% CI 0.345 to 0.556, asymptotic significance 0.386), Thrombolysis in Myocardial Infarction (TIMI) 0.418 (CI 0.281 to 0.555, asymptotic significance 0.231).

Table 3 Number of patients who had adverse outcome at 30 days in each risk category

<table>
<thead>
<tr>
<th>Patient number:</th>
<th>CMNW</th>
<th>Adverse outcome</th>
<th>TIMI</th>
<th>Adverse outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low risk</td>
<td>11 (11%)</td>
<td>4</td>
<td>26 (25%)</td>
<td>11</td>
</tr>
<tr>
<td>Intermediate risk</td>
<td>31 (30%)</td>
<td>6</td>
<td>67 (64%)</td>
<td>24</td>
</tr>
<tr>
<td>High risk</td>
<td>62 (60%)</td>
<td>29</td>
<td>11 (11%)</td>
<td>4</td>
</tr>
</tbody>
</table>

Average Cheshire, Merseyside and North Wales Cardiac Network (CMNW) score 7.09, Thrombolysis in Myocardial Infarction (TIMI) 3.24. Median CMNW score 7, TIMI 3.
—Hypercholesterolaemia
—Diabetes
—Current smoker

► Two or more severe, discreet anginal episodes in the preceding 24 h (1)
► ST-segment deviation on the qualifying ECG—either transient ST elevation or persistent ST depression of 0.05 mm within 24 h of an episode of NSTEACS at rest (1)
► Raised cardiac plasma marker—troponin I ≥0.07 mg/l (1)
► Known coronary artery stenosis of 50% or more from previous cardiac catheterisation (1)
► Aspirin use in the preceding 7 days (1)

CMNW score calculation:
Each of the following criteria contributed points towards the total CMNW score with a maximum score of 19.5 attainable (points in parentheses);
► Age greater than 65 on day of admission (0.5)
► Two or more known CAD risk factors including (0.5):
—Documented family history of CAD with a male relative’s first CAD event occurring before the age of 55 or a female relative’s first CAD event occurring before 65
—Hypertension
—Hypercholesterolaemia
—Current smoker
—ST elevation myocardial infarction within previous 3 months documented in the patient’s notes
—Radiologically proven peripheral vascular disease
—Chronic renal impairment with a creatinine >200 μmol/l
► Type I or type II diabetes mellitus (1)

► Ischaemic-sounding chest pain present on initial assessment (3)
► Ischaemic-sounding chest pain, which is ongoing or recurrent despite conventional medical management, for example, glyceryl trinitrate, morphine, antplatelets (3)
► Haemodynamic instability documented or observed, identified by the following (1) for each, maximum of 3:
—Systolic blood pressure <90 mm Hg, not associated with bradycardia or hypovolaemia
—Persistent sinus tachycardia (heart rate ≥100 bpm)
—Acute pulmonary oedema on chest radiograph
—Sustained ventricular tachycardia or recurrent ventricular fibrillation
► 12-lead ECG changes (3):
—Unequivocal, ST segment depression ≥1 mm in two or more contiguous leads, which is new and either persistent or transient
—Or transient ST segment elevation ≥1 mm in two or more contiguous leads
—Or deep symmetrical T wave inversion ≥3 mm in anterior leads, which is new and persistent
► Troponin I assay (in mg/l) taken 12 h after acute symptom onset (4 maximum):
≥0.20 (4)
≥0.10 but <0.20 (3)
≥0.07 but <0.10 (2)
≥0.03 but <0.07 (1)
► A minimum of one of the following documented in the patient’s notes (1):
—Previous CABG
—PCI within the last 7 days
—Documented NSTEACS within previous 3 months
► Pre-existing left ventricular dysfunction on echocardiogram, previously documented S3 heart sound or episode of pulmonary oedema (0.5)