Cardiac Troponin I as a Predictor of Major Cardiac Events in Emergency Department Patients With Acute Chest Pain

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Objectives. We sought to evaluate the diagnostic and prognostic value of cardiac troponin I (cTnI) in emergency department (ED) patients with chest pain.

Background. Although cTnI has been shown to correlate with an increased risk for complications in patients with unstable angina, the prognostic significance of this assay in the heterogeneous population of patients who present to the ED with chest pain is unclear.

Methods. cTnI and creatine kinase-MB fraction (CK-MB) mass concentration were collected serially during the first 48 h from onset of symptoms in 1,047 patients ≥30 years old admitted for acute chest pain. Sensitivity, specificity and receiver operating characteristic curves were calculated for cTnI and CK-MB collected in the first 24 h.

Results. The sensitivity, specificity and positive predictive value of cTnI for major cardiac events were 47%, 80% and 19%, respectively. Among patients who were ruled out for myocardial infarction, cTnI was elevated in 26% who had major cardiac complications compared with 5% for CK-MB; the positive predictive value for an abnormal cTnI result was 8%. Elevated cTnI in the presence of ischemia on the electrocardiogram was associated with an adjusted odds ratio of 1.8 (95% confidence interval 1.1 to 2.9) for major cardiac events within 72 h. Among patients without a myocardial infarction or unstable angina, cTnI was not an independent correlate of complications.

Conclusions. In patients presenting to the ED with acute chest pain, cTnI was an independent predictor of major cardiac events. However, the positive predictive value of an abnormal assay result was not high in this heterogeneous cohort.

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and were admitted to the Brigham and Women’s Hospital between July 27, 1994 and June 30, 1995 with a chief complaint of anterior, precordial or left lateral chest pain that could not be explained by local trauma or abnormalities on the chest roentgenogram. Patients had serial blood sampling for CK and CK-MB according to a “rule-out myocardial infarction” protocol, and cTnI was measured in serum from these same samples. Ninety-two patients were excluded because of incomplete cTnI or CK-MB data during the first 24 h; therefore, 1,047 patients (92%) were considered the study cohort.

**Data collection.** Data from the history, physical examination and ECG were recorded by the evaluating physician in the ED or by a research nurse (G.P.-K., L.L.) according to the previously described protocol of the Multicenter Chest Pain Study (19,20). These data were recorded on a standardized form that was part of the permanent medical record. The person who completed the form had no knowledge of, and thus could not be influenced by, the patient’s course after treatment in the emergency room. Cardiac enzyme measurements were obtained according to a standard “rule-out myocardial infarction protocol” that specified CK and CK-MB sampling every 8 h for 24 h. The charts of all admitted patients were reviewed each day by a trained study nurse (G.P.-K., L.L.) who recorded dates and times of cardiovascular procedures and complications, cardiac enzyme levels and diagnoses.

The same samples obtained for CK-MB determination in the ED and after admission to the hospital were used for cTnI assays. These data were not available to physicians who managed the patients in the ED or after admission. The investigators (T.H.L., P.A.J.) who classified patients and their clinical outcomes or complications, or both, were blinded to the results of this cardiac enzyme.

Total CK was assayed throughout this study on an ACA discrete clinical analyzer (Du Pont). The upper reference values were 218 and 266 U/liter for women and men, respectively. A mass assay for CK-MB was performed, utilizing a monoclonal antibody, with the Stratus instrument (Baxter Diagnostic). The upper limit of reference was 5 ng/ml. Cardiac troponin I was measured by an immunoassay procedure that uses complementary monoclonal antibodies, as described by Bodor et al. (14) and Zaninotto et al. (21). All analyses were performed using the same Stratus instrument (DADE International Inc.); the signal detection limit (smallest concentration that can be distinguished from zero) was 0.4 ng/ml, and the upper reference limit for this assay was 1.5 ng/ml.

**Diagnosis.** A diagnosis of myocardial infarction was made if any of the following criteria were present: 1) an absolute value of CK-MB >5 ng/ml using the mass assay; 2) an ECG showing development of pathologic Q waves (at least 0.04 s in duration) and at least 25% decrease in the amplitude of the following R wave compared with that of the ED ECG; 3) sudden cardiac arrest in patients who died before it was possible to obtain enzymatic confirmation of myocardial necrosis and if there were no other explanation for the arrest; and 4) administration of acute reperfusion therapy with intravenous thrombolytic agents or primary angioplasty, if the patient had new ST segment elevation that evolved over the next day, or if patients undergoing primary angioplasty also had known occlusion or subtotal occlusion of the artery presumed to be infarct related. Patients who showed evolution of cardiac enzymes after the performance of an invasive cardiac procedure were not considered to have had an acute myocardial infarction. All potential cases of acute myocardial infarction were reviewed by a cardiologist (C.A.P., P.A.J.) blinded to cTnI data. Unstable angina was diagnosed if the patient’s original chest pain syndrome was either new or worse in frequency, severity or duration than his or her chronic anginal syndrome and was made by the senior clinician responsible for the patient.

The present study examined the relation between cardiac markers obtained during the first 24 h and early cardiac events. Therefore, only major cardiac events within 72 h after presentation to the ED were included in the analyses. Major cardiac events included cardiogenic shock or cardiac arrest, ventricular tachycardia or ventricular fibrillation requiring defibrillation, Mobitz II second-degree atrioventricular block requiring temporary or permanent pacing, new complete heart block, use of an intraaortic balloon pump, intubation, coronary artery bypass graft surgery and percutaneous transluminal coronary angioplasty (PTCA). Analyses that included pulmonary edema or severe congestive failure (n = 16) among the major cardiac events yielded similar findings but are not presented because we considered the complications enumerated to be more reliable in their diagnosis and more directly linked to myocardial ischemia.

**Statistical analysis.** Sensitivity, specificity, PPV and negative predictive value (NPV) were calculated for 1) myocardial infarction and 2) major cardiac events within the first 72 h for the a) first sample and b) peak level of CK-MB and cTnI detected during the first 24 h after presentation to the ED. Only first samples that were collected <3 h after presentation to the ED were considered in the analyses of the diagnostic performance of initial samples. Although cTnI and CK-MB were serially collected, the peak measurements detected in the first 24 h were used to calculate the performance of the cardiac markers. Only CK-MB and cTnI samples that were obtained before the first major event were included in analyses. Hence, an abnormal test result obtained after an invasive cardiac procedure had occurred was not included. Analysis of the correlation of cTnI and major cardiac events was performed...
for the entire cohort and in the subset of patients who were ruled out for an acute myocardial infarction.

Sensitivity was defined as the number of patients with the outcome and an abnormal test result divided by the number of patients with the outcome. Specificity was defined as the number of patients without the outcome and with a normal result divided by the number of patients without the outcome. PPV was defined as the number of patients with the outcome and an abnormal test result divided by the number of patients with an abnormal test. NPV was defined as the number of patients without outcome and a normal test result divided by all those with a normal test result.

Receiver operating characteristic (ROC) curves were constructed to compare the discriminative power of cardiac enzyme tests. Areas under the ROC curve and differences between ROC curves were assessed as described by Hanley and McNeil (22) and Metz (23). Differences between the sensitivity and specificity of CK-MB and cTnI were calculated with the McNemar test for correlated proportions. Multivariate logistic regression analysis was used to assess the independent predictor ability of cTnI and CK-MB for major cardiac events after adjustment for clinical risk factors. A p value <0.05 was considered statistically significant.

Results

Patients. The study cohort (n = 1,047) had a mean (±SD) age of 61 ± 14 years and included a large proportion of women and nonwhites (Table 1). Slightly more than half of the patients described the quality of their pain as “pressure,” and a minority had a previous history of myocardial infarction or angina. The median time interval between onset of chest pain and presentation to the ED was 8 h. The ED ECG was interpreted as having new ischemic changes (≥1-mm ST segment elevation or new Q waves in two or more continuous leads, ST segment depression or other new alterations believed to be ischemic) in 27% of the study cohort. There was no significant difference in clinical characteristics and outcomes between the study cohort (n = 1,047) and patients who were admitted but excluded from the study because of missing cTnI or CK-MB data (n = 92).

Myocardial infarction was diagnosed in 142 patients (14%), and 385 (37%) had a final diagnosis of unstable angina (Table 2). Ninety-four subjects (9%) experienced at least one major cardiac event during the first 72 h after admission. Major cardiac event rates were 26%, 15% and 0.2% among subsets of patients with a diagnosis of myocardial infarction, unstable angina or nonischemic chest pain, respectively. Only one major cardiac complication occurred among the 520 patients without a diagnosis of acute myocardial infarction or unstable angina.

cTnI and diagnosis of acute myocardial infarction (Table 3). Sensitivity, specificity, PPV and NPV for acute myocardial infarction for peak cTnI and CK-MB during the first 24 h are presented in Table 3. Elevated cTnI levels (≥0.4 ng/ml) were detected within 24 h of admission in 84% of the 142 patients with a myocardial infarction. Patients with a final diagnosis of myocardial infarction and a normal level of cTnI (n = 23) were predominantly patients with a small, non-Q wave myocardial infarction (n = 17). Among the patients with a myocardial infarction and normal cTnI levels, one underwent coronary artery bypass graft surgery, and four underwent PTCA during the first 24 h after presentation to the ED. In these patients, there may have been insufficient time for cTnI to increase to abnormal levels because cTnI considered for analysis included only those collected before the procedures. One patient with ECG abnormalities consistent with a large acute myocardial infarction had a cardiac arrest within the first hour after presentation to the ED but had a normal cTnI level before the acute episode.

The specificity of the cTnI assay using 0.4 ng/ml as the threshold value was 87%; hence, 13% of patients without a myocardial infarction in this cohort had increased levels of cTnI. When a higher cutoff value of 1.5 ng/ml was used, the specificity of this marker improved to 97% and was similar to CK-MB. The NPV of cTnI for acute myocardial infarction using thresholds of 0.4 and 1.5 ng/ml were 97% and 96%, respectively.

Because the diagnosis of acute myocardial infarction was
made by investigators who used CK-MB criteria, comparisons of CK-MB and cTnI are difficult to perform in this data set. When ROC analysis was used to compare the diagnostic performance of cTnI and CK-MB for the diagnosis of acute myocardial infarction, the area under the ROC curve for cTnI (0.92) was significantly smaller than the area under the ROC curve for CK-MB (0.97, p < 0.001).

**Initial cTnI (Table 4).** cTnI levels were obtained within 3 h of presentation to the ED for 808 patients. The median time interval between onset of chest pain and drawing of cTnI samples was 8.8 h and was not different among patients with distinct outcomes. For these initial determinations, the sensitivity and specificity of cTnI for acute myocardial infarction were 40% and 95%, respectively (Table 4). Seventy-nine patients (10%) with initial samples experienced at least one major cardiac event within 72 h, for which cTnI showed a sensitivity and specificity of 18% and 91%, respectively. Among 703 patients who were ruled out for myocardial infarction, 52 (7%) had a major cardiac event within 72 h of presentation to the ED. Of these 52 patients, 3 (6%) had abnormal initial troponin results (Table 4). There was no increase in relative risk for major cardiac complications associated with the initial cTnI among patients who did not have an acute myocardial infarction.

**cTnI and major cardiac events (Table 5).** The diagnostic performance of peak cTnI and CK-MB obtained during the first 24 h for major cardiac events within 72 h is shown in Table 5. Among 94 patients who had early major cardiac complications, elevated cTnI levels were detected in 44 patients (47%) during the first 24 h. Elevated cTnI levels were also detected among 20% of patients without major events.

Among non-myocardial infarction patients, 385 (43%) had a final diagnosis of unstable angina and 520 (57%) other diagnosis. Seventy-four patients (32%) with unstable angina had abnormal levels of cTnI, and 40 (17%) with other diagnosis had elevated cTnI levels. No patient in the latter group experienced a major cardiac event within 72 h from presentation to the ED. The sensitivity and specificity of elevated troponin I levels in patients without a myocardial infarction for a major cardiac event were 26% and 88%, respectively. The PPV was 8% and the relative risk 2.6.

The sensitivity of peak CK-MB during the first 24 h for major events was slightly lower than that for cTnI (38% vs. 47%, p = 0.06). However, diagnostic test performance characteristics were otherwise similar (area under the ROC curve 0.66 ± 0.03 vs. 0.68 ± 0.03, p = 0.3). Among patients who were

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**Table 2.** Final Diagnosis and Major Cardiac Events* Within 72 h After Presentation to Emergency Department

<table>
<thead>
<tr>
<th>All Pts (n = 1,047)</th>
<th>Pts With MI (n = 142)</th>
<th>Pts With UA (n = 385)</th>
<th>Pts With No MI or UA (n = 520)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥1 major cardiac events in 1st 72 h after presentation to ED</td>
<td>94 (9%)</td>
<td>37 (26%)</td>
<td>56 (15%)</td>
</tr>
<tr>
<td>Cardiac arrest</td>
<td>7 (0.7%)</td>
<td>1 (0.7%)</td>
<td>5 (1.3%)</td>
</tr>
<tr>
<td>High degree AV block</td>
<td>1 (0.1%)</td>
<td>0</td>
<td>1 (0.3%)</td>
</tr>
<tr>
<td>Intubation</td>
<td>5 (0.5%)</td>
<td>2 (1.4%)</td>
<td>3 (0.8%)</td>
</tr>
<tr>
<td>Intracoronary balloon pump</td>
<td>26 (2%)</td>
<td>17 (12%)</td>
<td>9 (6%)</td>
</tr>
<tr>
<td>Coronary revasc</td>
<td>80 (8%)</td>
<td>32 (23%)</td>
<td>48 (13%)</td>
</tr>
</tbody>
</table>

*Cardiogenic shock or cardiac arrest, ventricular tachycardia or ventricular fibrillation requiring defibrillation, Mobitz II second-degree atrioventricular (AV) block requiring pacemaker, new complete heart block, use of intracoronary balloon pump, coronary artery bypass graft surgery and percutaneous transluminal coronary angioplasty. Data presented are number (%) of patients (Pts). ED = emergency department; MI = myocardial infarction; UA = unstable angina.

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**Table 3.** Diagnostic Performance of Cardiac Troponin I and Creatine Kinase-MB Fraction Assays for Acute Myocardial Infarction Relative to Peak Level in First 24 h After Presentation to Emergency Department (1,047 study patients)

<table>
<thead>
<tr>
<th>Assay</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>PPV</th>
<th>NPV</th>
<th>Area under the ROC curve</th>
</tr>
</thead>
<tbody>
<tr>
<td>cTnI ≥0.4 ng/ml</td>
<td>84% (119/142)*</td>
<td>75% (106/142)*</td>
<td>96% (137/142)</td>
<td>5% (4/91)</td>
<td>0.92 ± 0.02*</td>
</tr>
<tr>
<td>cTnI ≥1.5 ng/ml</td>
<td>87% (79/125)</td>
<td>97% (85/125)</td>
<td>97% (88/125)</td>
<td>96% (13/14)</td>
<td>0.82 ± 0.03*</td>
</tr>
<tr>
<td>·CK-MB ≥5.0 ng/ml</td>
<td>90% (137/152)</td>
<td>96% (132/152)</td>
<td>95% (127/152)</td>
<td>5% (5/104)</td>
<td>0.85 ± 0.02*</td>
</tr>
</tbody>
</table>

*p < 0.001 versus creatine kinase-MB fraction (CK-MB). Data presented are mean value ± SD or percent (number) of patients. cTnI = cardiac troponin I; NPV = negative predictive value; PPV = positive predictive value; ROC = receiver operating characteristic.

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**Table 4.** Diagnostic Performance of First Sample of Cardiac Troponin I ≥0.4 ng/ml for Acute Myocardial Infarction and Major Cardiac Events Within 72 h in 808 Study Patients

<table>
<thead>
<tr>
<th>Assay</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>PPV</th>
<th>NPV</th>
<th>RR</th>
</tr>
</thead>
<tbody>
<tr>
<td>MI</td>
<td>40% (42/105)</td>
<td>18% (14/79)</td>
<td>6% (3/52)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Specifity</td>
<td>95% (664/703)</td>
<td>91% (663/731)</td>
<td>95% (615/651)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PPV</td>
<td>52% (42/81)</td>
<td>17% (14/81)</td>
<td>8% (3/36)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NPV</td>
<td>91% (664/727)</td>
<td>91% (663/727)</td>
<td>93% (615/664)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RR</td>
<td>5.9*</td>
<td>1.9*</td>
<td>1.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p < 0.05. Data presented are percent (number) of patients or relative risk (RR). Other abbreviations as in Tables 2 and 3.
ruled out for myocardial infarction, the sensitivity of peak CK-MB was significantly lower than that for cTnI (5% vs. 26%, p = 0.001), but the overall performance was not different.

**Multivariate analyses.** By multivariate analyses, four clinical variables were correlated with experiencing a major cardiac event within 72 h: ECG ischemia, chest pain worse than previous angina, history of PTCA and male gender. After adjustment for these patient characteristics at presentation, an elevated cTnI level during the first 24 h was significantly associated with major cardiac events. Subjects were stratified according to the presence of these independent predictors of major complications (Table 6). Among patients with none of these predictors present, an abnormal cTnI was not associated with an increased risk for cardiac events. However, in the presence of one or more predictors and no ECG ischemia, patients with elevated cTnI levels had a twofold higher risk of having an event than patients with normal cTnI levels. The same findings were observed for patients with ECG ischemia.

Among patients who were ruled out for myocardial infarction, ECG ischemia at admission was the strongest predictor for major event and an important effect modifier in the association between cTnI and major events. When the other variables were controlled, cTnI was not a significant predictor in patients with a no ECG ischemia (odds ratio [OR] 0.7, 95% confidence interval [CI] 0.2 to 2.7). Subjects with ECG ischemia and cTnI levels >0.4 ng/ml detected within 24 h had a 4.4-fold (95% CI 1.7 to 11.6) increase in the odds of an event compared with subjects with normal cTnI levels. CK-MB levels were also associated with major cardiac events (OR 1.1, 95% CI 1.0 to 1.2, per unit increase); however, after adjustment for clinical variables and cTnI, CK-MB was no longer correlated with major cardiac events among patients without a myocardial infarction.

**Discussion**

In the present study, we describe the diagnostic performance characteristics of cTnI for myocardial infarction and major cardiac events in a lower risk, heterogeneous cohort of patients presenting with acute chest pain to the ED. In this cohort, increased initial or peak cTnI levels during the first 24 h were associated with an increased risk for acute myocardial infarction and major cardiac events. Nevertheless, the PPV of an abnormal test result was lower than has been described (17) in higher risk patient groups. Furthermore, a negative test result was not a guarantee of a good prognosis: Among 57 patients without acute myocardial infarction who had major complications during the first 72 h, only 26% had abnormal peak cTnI levels during the first day of observation.

**Sensitivity of cTnI for myocardial infarction and major cardiac events.** These data are consistent with and extend findings from previous research (10,17,24) that has identified cTnI as a marker for myocardial injury potentially superior to CK-MB. Although this test has been extensively evaluated in patients with unstable angina and acute myocardial infarction, there are few data on the performance of this assay in lower risk, heterogeneous patients with acute chest pain. In patients admitted to the coronary care unit, the sensitivity of this assay for acute myocardial infarction has been nearly perfect (16).

In the present study, we also found excellent if a slightly lower sensitivity (84%) for diagnosing myocardial infarction. Whether these data reflect an inaccurate clinical diagnosis of myocardial infarction or failure of cTnI to detect myocardial injury is uncertain. cTnI assays with lower detection limits of 0.1 ng/ml have the theoretical potential to be more sensitive for detecting myocardial injury. However, in studies conducted in selected patients with myocardial infarction, results have been similar to those that used assays with a higher detection limit (16,25). The scarce data available do not allow conclusions on whether differences in previous published results could be attributed to differences in the assays currently used. Technology continues to evolve, and improvements in the assay used to measure cTnI may improve its sensitivity.

**Value of early cTnI in the ED.** cTnI is used in the ED by some clinicians to guide triage decisions. However, in our study, cTnI levels collected within the first 3 h of admission had

### Table 5. Diagnostic Performance of Peak Cardiac Troponin I \( \geq 0.4 \) ng/ml and Creatine Kinase-MB Fraction Mass \( \geq 5.0 \) ng/ml for Major Cardiac Events Within 72 h in Entire Cohort and in Patients Ruled Out for Myocardial Infarction

<table>
<thead>
<tr>
<th></th>
<th>All Pts</th>
<th>CK-MB</th>
<th>Pts With No MI</th>
<th>CK-MB</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>cTnI</strong></td>
<td>Sensitivity</td>
<td>47% (44/94)</td>
<td>38% (36/94)</td>
<td>26% (15/57)</td>
</tr>
<tr>
<td></td>
<td>Specificity</td>
<td>80% (763/953)</td>
<td>87% (827/953)</td>
<td>88% (749/848)</td>
</tr>
<tr>
<td></td>
<td>PPV</td>
<td>19% (44/234)</td>
<td>22% (36/162)</td>
<td>8% (3/38)</td>
</tr>
<tr>
<td></td>
<td>NPV</td>
<td>94% (763/813)</td>
<td>93% (827/885)</td>
<td>95% (749/791)</td>
</tr>
<tr>
<td><strong>RR</strong></td>
<td>3.1*</td>
<td>3.4*</td>
<td>2.6*</td>
<td>2.1*</td>
</tr>
</tbody>
</table>

*p < 0.05. Data presented are percent (number) of patients or relative risk (RR). Other abbreviations as in Tables 2 and 3.

### Table 6. Probability of Major Cardiac Events Within 72 h by Presence of Independent Predictors* or ECG on Admission Electrocardiogram and Peak Cardiac Troponin I Level in First 24 h After Presentation to Emergency Department for All Patients

<table>
<thead>
<tr>
<th></th>
<th>Major Cardiac Event</th>
<th>RR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No predictors</td>
<td>cTnI (&lt; 0.4 ) ng/ml</td>
<td>0.5% (1/217)</td>
</tr>
<tr>
<td></td>
<td>cTnI ( \geq 0.4 ) ng/ml</td>
<td>6% (24/429)</td>
</tr>
<tr>
<td>≥1 predictor and no ECG ischemia</td>
<td>cTnI (&lt; 0.4 ) ng/ml</td>
<td>15% (25/167)</td>
</tr>
<tr>
<td></td>
<td>cTnI ( \geq 0.4 ) ng/ml</td>
<td>12% (27/225)</td>
</tr>
</tbody>
</table>

*Male gender, chest pain worse than previous pain, previous coronary angioplasty and electrocardiographic (ECG) ischemia (≥1-mm ST segment elevation, ST segment depression or new Q waves in two or more contiguous leads or other new alterations believed to be ischemic). CI = confidence interval; other abbreviations as in Tables 2 and 3.
a poor sensitivity for detecting myocardial infarction and predicting major cardiac events. Single plasma levels of cTnI at admission did not offer any additional information to clinical and ECG data. These findings are consistent with those of Mair et al. (17) who described a low (23%) early sensitivity of cTnI for acute myocardial infarction in patients with chest pain on admission to the emergency room. These data emphasize that cTnI should not be relied on as the sole factor in deciding whether to discharge patients home from the ED.

Specificity and false positive results of cTnI. The specificity of cTnI for myocardial damage has been emphasized as one of the advantages of this marker (26). In the present report, the specificity of cTnI assay using a threshold value of 0.4 ng/ml was 87% for myocardial infarction but improved to 97% using the higher cutoff of 1.5 ng/ml. These findings are consistent with previous studies of markers of myocardial injury. Such false positive results have been interpreted as potential evidence that patients, especially patients with unstable angina, with elevated cTnI levels but without CK-MB elevations may have a mild degree of myocardial injury. In our study, 60% of false positive results were observed in patients with a clinical diagnosis of unstable angina.

When considering false positive results in a heterogeneous cohort of ED patients with acute chest pain, some of the findings may reflect possible noncardiac causes of elevated cTnI levels. This possibility is suggested by recent reports of patients with cancer and severe rhabdomyolysis but without evidence of cardiac disease in whom abnormal levels of cTnI were described (27,28). In addition, there have been reports of elevated cTnI levels in other cardiac syndromes, such as in heart transplant recipients or patients with congestive heart failure (29).

Clinical implications. The present data are consistent with other studies (11,12) that have shown that cTnI can improve risk stratification of patients with acute coronary syndromes. Antman et al. (11) reported that cTnI provides useful prognostic information and improves prediction of risk of death in patients with unstable angina or non-Q wave myocardial infarction. In lower risk group of patients with acute chest pain, our data suggest that cTnI may be most useful in the subgroup with ECG abnormalities consistent with ischemia, but its benefit in patients with benign ECG findings remains uncertain. Previous reports (30–32) have evaluated early or immediate noninvasive tests, such as imaging studies or exercise tests, to further stratify this low risk subgroup, and the results have suggested that such tests may be helpful in risk stratification of these patients.

Study limitations. The present data were obtained from a large cohort of heterogeneous patients at a single urban teaching hospital. In our study, the diagnosis of myocardial infarction was made by reviewers who used CK-MB; hence, cTnI was at a “disadvantage” in comparisons of diagnostic performance with CK-MB for this end point. It is also possible that false positive cTnI results were a reflection of myocardial injury too subtle to be detected by the methods available to the investigators or clinicians. Long-term follow-up will be required to understand the true meaning of a false positive cTnI result. Nevertheless, the finding that major clinical complications occurred in some patients with normal cTnI levels during the first 24 h emphasizes that clinicians cannot rely on any single laboratory test, including cTnI.

Conclusions. These data expand our understanding of the role of cTnI as a marker for myocardial ischemic syndromes. Although the present study does not support the routine use of cTnI as a diagnostic tool in the ED, the test showed a significantly better performance than CK-MB mass assay for predicting major cardiac events among patients who were ruled out for myocardial infarction. In patients with a previous PTCA, chest pain worse than previously diagnosed angina or myocardial infarction and male gender and in those who have ECG ischemia, the presence of abnormal cTnI levels supports the need for intensive patient evaluation and monitoring. Normal cTnI values do not necessarily guarantee a benign course; patients with such values may be appropriate for exercise testing before discharge. Future studies are needed to determine the best strategy to approach patients presenting to the ED with chest pain because only a minority of low risk patients who develop major cardiac events will be identified by cTnI assay.

References


