Acute Noncardiac Conditions and In-Hospital Mortality in Patients With Acute Myocardial Infarction

Judith H. Lichtman, PhD, MPH; John A. Spertus, MD, MPH; Kimberly J. Reid, MS; Martha J. Radford, MD; John S. Rumsfeld, MD, PhD; Norrina B. Allen, MPH; Frederick A. Masoudi, MD, MSPH; William S. Weintraub, MD; Harlan M. Krumholz, MD, SM

Background—Acute myocardial infarction may be accompanied by acute, severe, concomitant, noncardiac conditions, but their prevalence and prognostic importance is not well defined. We sought to evaluate the prevalence of acute, severe, noncardiac conditions present at the time of hospital admission with acute myocardial infarction and to assess the association of these conditions with in-hospital mortality.

Methods and Results—A total of 3907 patients admitted with an acute myocardial infarction were prospectively enrolled in 19 US centers between January 2003 and June 2004. Acute noncardiac conditions present at admission with imminent threat to life were identified from medical record review within 24 hours of admission. Using multivariable analyses, we evaluated the relationship between these conditions and in-hospital mortality. We documented a concomitant acute, severe, noncardiac condition in 6.8% (n=267) of the study sample. The most common concomitant conditions were severe pneumonia (potentially requiring intubation; 18.4%), severe gastrointestinal bleeding/anemia (15.7%), stroke (9.7%), and sepsis (9.4%). These patients were less likely to be ideal for or to receive evidence-based therapies at the time of admission. The in-hospital mortality was 21.3% (57 of 267) for patients with concomitant conditions versus 2.7% (100 of 3640) for those without these conditions. The presence of an acute noncardiac condition was associated with an increased risk of in-hospital mortality after adjustment for demographic and clinical characteristics and disease severity (odds ratio, 5.0; 95% confidence interval, 3.3 to 7.7).

Conclusions—Concomitant, acute, noncardiac conditions are common and associated with a marked increase in the risk of in-hospital mortality. (Circulation. 2007;116:1925-1930.)

Key Words: comorbidity ■ mortality ■ myocardial infarction ■ prognosis

Many studies of patients with an acute myocardial infarction (AMI) have described the presence of chronic comorbid conditions, but little information is available about the coexistence of other acute potentially life-threatening conditions that would, in their own right, be an indication for admission. To extend these limited observations, we designed a prospective, multicenter, cohort study within the Prospective Registry Evaluating Myocardial Infarction: Event and Recovery, Quality Improvement (PREMIER-QI) study to specifically characterize the prevalence and prognostic importance of acute, severe, concomitant noncardiac conditions on the care and outcomes of patients with AMI. In
PREMIER-QI, the medical records of all patients at the participating sites who were admitted with an AMI were reviewed to determine the presence of an acute, severe, noncardiac condition that was life threatening even in the absence of the AMI and the association of these conditions with patient outcomes.

Methods

Study Sample

Between January 1, 2003, and June 28, 2004, we recruited 3953 AMI patients into the PREMIER-QI study from 19 US hospitals, including 6 academic centers, 4 inner-city hospitals, 3 single-payer systems, and 6 nonuniversity hospitals (see the Appendix for hospital details). The methods of the PREMIER study have previously been described. In brief, all patients with elevated cardiac markers during the initial 24 hours of admission were screened for possible inclusion in the study. Using standard criteria, we deemed patients eligible if they were ≥18 years of age and had other evidence supporting the diagnosis of AMI such as prolonged (>20 minutes) ischemic signs/symptoms or ECG ST changes. Patients not presenting initially to the enrolling institution were eligible only if they were transferred within the first 24 hours of initial presentation. Patients who were incarcerated and those having elevated cardiac markers as a complication of elective coronary revascularization were not eligible. Institutional Research Board approval was obtained at each participating institution, and patients signed informed consent for baseline and follow-up interviews.

Data Collection

We used 2 sources of baseline data in this study. First, trained data collectors performed an abstraction of data on patients’ presentation, clinical history, admission medications, presenting ECG, and treatments during the first 24 hours. Second, at discharge, patients’ diagnostic information, including the results of angiography and ECG, and information on in-hospital treatment, in-hospital complications, in-hospital mortality, and final diagnosis were collected. For practical reasons, the final chart abstractions were performed after discharge so that final discharge summaries and dictated discharge summaries and dictated discharges were completed.

Acute Noncardiac Conditions

We abstracted acute noncardiac conditions at the patient’s time of arrival using a standardized method from each patient’s medical record during the first 24 hours. The specific question was, “Did the patient have any other acute noncardiac conditions at the time of arrival that were potentially life threatening?” If yes, we documented the condition and classified it by the following prespecified categories: severe pneumonia potentially requiring intubation, trauma, stroke, severe gastrointestinal bleeding/anemia, sepsis, hip fracture, or other conditions. We selected a subset of cases with potentially life-threatening conditions and asked the local principal investigators to conduct a second chart review to verify the presence and severity of these acute potentially life-threatening conditions at the time of admission.

Additional Variables

We collected medical record abstraction of patients’ presentation, clinical comorbidities, presenting ECG, diagnostic information (including the results of angiography), in-hospital treatment, complications (bleeding included cardiac catheterization site, coronary artery bypass graft surgery [CABG] surgical site, other instrumented site, gastrointestinal, or other), and final diagnoses (Tables 1 through 3). Eligibility for short-term therapies, including aspirin or β-blocker therapy within 24 hours, and reperfusion (fibrinolytic therapy within 30 minutes or primary percutaneous coronary intervention [PCI] within 2 hours) was determined on the basis of Centers for Medicare and Medicaid Services and the Joint Commission National Hospital Quality Measure definitions. Common exclusions included patients who were transferred from another acute-care hospital on the day of arrival, those who left against medical advice, and those on comfort measures only. Additional exclusions for aspirin included active bleeding, aspirin allergy, Coumadin or warfarin as prearrival medication, or other reasons documented by a care provider for not giving aspirin within 24 hours of arrival. Exclusions for β-blockers within 24 hours included β-blocker allergy, bradycardia, heart failure, second- or third-degree heart block, shock on arrival or within 24 hours of arrival, or other reasons documented by the care provider. Exclusions for primary PCI included patients administered fibrinolytic therapy. We defined left ventricular systolic dysfunction as a recorded left ventricular ejection fraction <40% or documented left ventricular systolic dysfunction graded as severe or moderate.

Outcome

The outcome of this study was in-hospital mortality. We obtained mortality data from chart review and by cross-referencing patients’ social security numbers with the Social Security Death Master File.

Statistical Analysis

We used bivariate analyses to examine the relationship between the acute noncardiac conditions and demographic factors, clinical presentation, patterns of care, and initial treatment. We analyzed categorical variables using Fisher’s exact or χ² test, and continuous variables using the t test or the Kruskal-Wallis test, depending on the distribution of the variable. A logistic regression model examined the relationship between acute noncardiac conditions and in-hospital mortality, with adjustment for site, patient demographic factors (age, gender, race), medical history (prior AMI, angina, heart failure, prior CABG or PCI, stroke, diabetes mellitus, hypertension, hypercholesterolemia, smoking status), and clinical characteristics (new chest pain, acute systolic blood pressure, acute heart rate, ST elevation, ST depression, Q wave, left bundle-branch block, right bundle-branch block, anterior AMI, left ventricular ejection fraction <40%). To minimize the concern that patients with heart failure could be misclassified as having pneumonia or sepsis, we repeated our analyses after excluding pneumonia and sepsis as acute noncardiac conditions. Age was modeled using restricted cubic splines to account for a possible nonlinear relationship. Information on ≥1 covariates was missing for 308 patients (8%); 77 patients (2%) were missing ≥4 covariates. Missing covariate data were assumed to be missing at random (ie, noninformatively missing given the available observed data) and were imputed using multiple imputation methods to allow incorporation of all patients and to correctly account for uncertainty resulting from absent data. The imputation model consisted of all variables used in the multivariable model plus additional

<table>
<thead>
<tr>
<th>Acute Noncardiac Condition (n=267)</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severe pneumonia</td>
<td>49</td>
<td>18.4</td>
</tr>
<tr>
<td>Severe GI bleed/anemia</td>
<td>42</td>
<td>15.7</td>
</tr>
<tr>
<td>Stroke</td>
<td>26</td>
<td>9.7</td>
</tr>
<tr>
<td>Sepsis</td>
<td>25</td>
<td>9.4</td>
</tr>
<tr>
<td>Hypertension</td>
<td>17</td>
<td>6.4</td>
</tr>
<tr>
<td>Respiratory failure</td>
<td>16</td>
<td>6.0</td>
</tr>
<tr>
<td>Diabetes ketoacidosis</td>
<td>14</td>
<td>5.2</td>
</tr>
<tr>
<td>Acute renal failure</td>
<td>11</td>
<td>4.1</td>
</tr>
<tr>
<td>Trauma</td>
<td>7</td>
<td>2.6</td>
</tr>
<tr>
<td>Chronic obstructive pulmonary disease</td>
<td>7</td>
<td>2.6</td>
</tr>
<tr>
<td>End-stage renal disease</td>
<td>6</td>
<td>2.3</td>
</tr>
<tr>
<td>Hip fracture</td>
<td>4</td>
<td>1.5</td>
</tr>
<tr>
<td>Other</td>
<td>43</td>
<td>16.1</td>
</tr>
</tbody>
</table>

GI indicates gastrointestinal.
by guest on April 19, 2017 http://circ.ahajournals.org/ Downloaded from

the hospital with acute, severe, noncardiac conditions tended
to be older, female, and nonwhite (P <0.001; Table 2). A
greater percentage of these patients had a documented history
of preexisting comorbid conditions, including chronic lung
disease, chronic renal failure, heart failure, hypercholesterol-
emia, dementia, and diabetes mellitus (P<0.001), as well as
hypertension and stroke (P=0.006).

### Results

### Study Population

Among the 3953 AMI patients in the PREMIER-QI study, 3907 (98.8%) had complete medical record abstraction data and
were included in our study cohort. Of these patients, 7% (267 of 3907) presented to the hospital with an acute, severe, noncardiac condition that was potentially life threatening (Table 1). The most common conditions were severe pneumonia (18.4%), severe gastrointestinal bleed/anemia (15.7%), stroke (9.7%), and sepsis (9.4%). Patients who presented to the hospital with acute, severe, noncardiac conditions tended

### Table 2. Baseline Demographic and Clinical History by Presence of Acute Noncardiac Condition

<table>
<thead>
<tr>
<th>Condition</th>
<th>Yes (n=267)</th>
<th>No (n=3640)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (mean), y</td>
<td>66.8</td>
<td>62.1</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Female, %</td>
<td>47.6</td>
<td>33.8</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Nonwhite race, %</td>
<td>51.7</td>
<td>26.9</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>History, %</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Family history of CAD</td>
<td>16.1</td>
<td>32.2</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Angina</td>
<td>14.2</td>
<td>18.7</td>
<td>0.072</td>
</tr>
<tr>
<td>Myocardial infarction</td>
<td>25.1</td>
<td>23.2</td>
<td>0.490</td>
</tr>
<tr>
<td>Heart failure</td>
<td>26.2</td>
<td>12.9</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>PCI</td>
<td>15.0</td>
<td>18.0</td>
<td>0.218</td>
</tr>
<tr>
<td>CABG</td>
<td>12.0</td>
<td>13.5</td>
<td>0.494</td>
</tr>
<tr>
<td>Smoking history (past year)</td>
<td>48.3</td>
<td>60.6</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Chronic lung disease</td>
<td>26.2</td>
<td>12.1</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Chronic renal failure</td>
<td>23.6</td>
<td>10.4</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Dementia</td>
<td>8.6</td>
<td>2.3</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>39.7</td>
<td>29.1</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Hypercholesterolemia</td>
<td>32.6</td>
<td>49.1</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Hypertension</td>
<td>73.0</td>
<td>64.8</td>
<td>0.006</td>
</tr>
<tr>
<td>Peripheral arterial disease</td>
<td>11.2</td>
<td>9.0</td>
<td>0.211</td>
</tr>
<tr>
<td>Stroke</td>
<td>12.4</td>
<td>7.7</td>
<td>0.006</td>
</tr>
<tr>
<td>ischemic symptoms</td>
<td>49.2</td>
<td>94.5</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Clinical characteristics, %</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LVEF &lt;40%</td>
<td>35.3</td>
<td>26.0</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Heart rate &gt;100 bpm</td>
<td>35.4</td>
<td>14.9</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>SBP ≥100 mm Hg</td>
<td>21.4</td>
<td>8.6</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Creatinine ≥2.5 mg/dL</td>
<td>26.2</td>
<td>6.2</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>ECG findings, %</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ST elevation</td>
<td>29.2</td>
<td>45.3</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>ST depression</td>
<td>40.4</td>
<td>43.4</td>
<td>0.351</td>
</tr>
</tbody>
</table>

CAO indicates coronary artery disease; LVEF, left ventricular ejection fraction; and SBP, systolic blood pressure.

### Table 3. In-Hospital Treatment and Events

<table>
<thead>
<tr>
<th>Variable</th>
<th>Yes</th>
<th>No</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Therapy during first 24 h, %</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>7.9</td>
<td>0.2</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Ideal for aspirin at arrival</td>
<td>83.9</td>
<td>97.0</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Aspirin at arrival among ideal candidates*</td>
<td>87.5</td>
<td>96.3</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Antiplatelet agent within 24 h</td>
<td>19.1</td>
<td>54.9</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Ideal for β-blocker at arrival</td>
<td>74.9</td>
<td>89.8</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>β-Blocker at arrival among ideal candidates†</td>
<td>76.5</td>
<td>91.0</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Fibrinolytic therapy</td>
<td>1.5</td>
<td>11.7</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Antiinthrombin</td>
<td>51.7</td>
<td>86.0</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Glycoprotein IIb/IIIa blockade</td>
<td>14.2</td>
<td>56.5</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Ideal for acute reperfusion (fibrinolysis or primary PCI)</td>
<td>6.0</td>
<td>29.1</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Received acute reperfusion among ideal candidates‡</td>
<td>50.0</td>
<td>64.7</td>
<td>0.223</td>
</tr>
<tr>
<td>Time from onset to reperfusion &lt;4 h</td>
<td>4.8</td>
<td>17.9</td>
<td>0.002</td>
</tr>
<tr>
<td>Ideal for reperfusion</td>
<td>34.1</td>
<td>46.8</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Received reperfusion among ideal candidates§</td>
<td>17.6</td>
<td>67.4</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Procedures during index hospitalization, %</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coronary angiography</td>
<td>22.8</td>
<td>40.6</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>PCI (primary)</td>
<td>9.4</td>
<td>44.8</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>PCI (nonacute)</td>
<td>7.5</td>
<td>19.3</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>CABG</td>
<td>3.4</td>
<td>9.6</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>PCI or CABG</td>
<td>18.7</td>
<td>69.6</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Stress test</td>
<td>7.9</td>
<td>4.9</td>
<td>0.035</td>
</tr>
<tr>
<td>In-hospital events, %</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Atrial fibrillation/flutter</td>
<td>13.5</td>
<td>9.9</td>
<td>0.060</td>
</tr>
<tr>
<td>Bleeding</td>
<td>22.5</td>
<td>8.7</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Cardiac arrest</td>
<td>15.0</td>
<td>2.7</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Cardiogenic shock</td>
<td>8.6</td>
<td>4.0</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Heart failure</td>
<td>19.5</td>
<td>9.1</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Length of stay, median (IQR), d</td>
<td>7.5 (8)</td>
<td>4.0 (3)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>In-hospital mortality, %</td>
<td>21.3</td>
<td>2.7</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

IQR indicates interquartile range.

*Received aspirin at arrival among ideal candidates: 169 of 224 and 3403 of 3532.
†Received β-blocker at arrival among ideal candidates: 153 of 200 and 2974 of 3267.
‡Received acute reperfusion among ideal candidates: 8 of 16 and 685 of 1059.
§Received reperfusion among ideal candidates: 16 of 91 and 1147 of 1702.

The authors had full access to and take full responsibility for the integrity of the data. All authors have read and agree to the
manuscript as written.
Clinical Presentation
The clinical presentation of the AMI differed in patients admitted with an acute noncardiac condition compared with patients who did not present with one of these conditions (Table 2). A greater percentage of patients with acute noncardiac conditions had elevated heart rate, hypotension, and elevated serum creatinine on presentation (P<0.001). These patients also had a lower likelihood of ST-segment elevation on their ECG (P<0.001) and were less likely to have ischemic symptoms documented at the time of presentation (P<0.001).

Treatment Patterns
Treatment patterns varied between groups. Patients with acute noncardiac conditions were less likely to be considered ideal for short-term (<24 hours) therapies such as aspirin, β-blockers, and timely reperfusion (P<0.001; Table 3). Even among ideal candidates, however, patients with acute noncardiac conditions were less likely to receive these therapies (P<0.001). Additional initial therapies such as antiplatelet agents (clopidogrel or ticlopidine), fibrinolytic therapy, anti-thrombin, or glycoprotein IIb/IIIa inhibitor (P<0.001) also were used less often among these patients. Patients with acute noncardiac conditions had lower rates of coronary angiography, primary PCI, nonacute PCI, or CABG (P<0.001).

Adverse Events
Adverse clinical events during the hospitalization occurred more frequently for patients who presented with concomitant acute noncardiac conditions at admission (Table 3). Rates of bleeding, cardiac arrest, cardiogenic shock, and heart failure (P<0.001) all were higher for patients with acute noncardiac conditions. The median length of stay was almost twice as long for patients who presented with an acute noncardiac condition (7.5 days [interquartile range, 4 to 12 days] versus 4.0 [interquartile range, 3 to 6 days]; Kruskal-Wallis P<0.001), and in-hospital mortality was markedly higher (21.3%) compared with that for patients without such conditions (2.7%; P<0.001).

Risk-Adjusted Analyses
A risk-adjusted model was developed to examine the independent association between acute noncardiac conditions at admission and in-hospital mortality, with adjustment for demographic, clinical, and treatment variables. In an unadjusted model, odds of in-hospital mortality were 9-fold higher for patients who presented with an acute noncardiac condition at admission compared with patients who did not have such conditions (odds ratio, 9.6; 95% confidence interval, 6.7 to 13.7). The association was attenuated but persisted after adjustment for site, demographic characteristics, medical history, and clinical characteristics (odds ratio, 5.0; 95% confidence interval, 3.3 to 7.7). The risk-adjusted association remained unchanged in the model that included imputed values for the missing data elements (odds ratio, 5.0; 95% confidence interval, 3.4 to 7.5). To minimize the concern that patients with heart failure could be misclassified as having pneumonia or sepsis, we repeated our analyses after excluding pneumonia and sepsis as acute noncardiac conditions and found no difference in the association between acute noncardiac conditions and outcome.

Discussion
In this prospective, multicenter study of patients with AMI, we found that concomitant acute, severe, noncardiac conditions were present for 1 of every 15 patients admitted with an AMI. Patients with these concomitant conditions have a substantially different clinical presentation, are less likely to be ideal for or to receive evidence-based therapies at the time of admission, and are more likely to have adverse outcomes. Although this group represented only 7% of the patients, it accounted for about a third of the in-hospital deaths. In risk-adjusted analyses, AMI patients with these complex presentations had nearly 5 times the odds of dying in the hospital compared with patients without these conditions.

In the present study, we have identified a subgroup of patients with AMI who require physicians to manage multiple acute conditions. Current clinical guidelines for AMI do not address the clinical management of these complex patients largely because the literature addressing this group is so limited. Much attention has been directed toward the prevalence and prognostic importance of chronic comorbid conditions, but acute severe conditions have been neglected. Moreover, these acute conditions have typically not been included in risk stratification and risk adjustment models, nor has their prognostic role on outcomes been assessed.

In our prior single-site, retrospective study, we found that 9% of patients with AMI presented with a concomitant, potentially life-threatening, noncardiac condition that was associated with double the odds of dying in the hospital. We further reported that patients who presented with serious, nonacute conditions (1 in 5 AMI patients) did not have this increased risk of dying. Using a prospective, multicenter design, the present study confirms that a substantial subset of AMI patients present with an acute concomitant condition that is associated with increased mortality in the hospital. The comparability of prevalence rates and marked increase in mortality after risk adjustment for other covariates show the prognostic importance of acute, severe, noncardiac conditions on patient outcomes.

This study highlights the complexity of many patients with AMI. The patients with acute, severe, concomitant conditions are unlikely to meet eligibility for a randomized trial, and even if they meet criteria, it is unlikely that they will be enrolled. Similarly, nonclinical trial studies, including cohort studies, registries, or administrative data sets, have not described these conditions in terms of their acute presentation or severity at the time of the AMI. Thus, little evidence exists to guide the treatment of these patients. The findings from this study indicate the importance of acknowledging the presence of these patients and developing evidence to help clinicians care for them. As we have shown, the presence of these conditions influences the initial presentation, use of appropriate short-term therapies, and outcomes of AMI patients. Our study demonstrates the feasibility of capturing clinical information on acute potentially life-threatening conditions that are present within the context of an AMI admission. Data elements that capture acute severe
conditions could be incorporated into other prospective AMI surveillance studies. The development of measures and data collection strategies that include the severity of acute conditions will improve our ability to test how these concurrent conditions influence the care and outcomes of patients and, importantly, will expand our knowledge base to develop more appropriate clinical guidelines for these complex patients.

Several issues must be considered in the interpretation of this study. We used information abstracted from medical records to identify our subgroup of AMI patients with active concomitant conditions at admission. It is possible that some important clinical events were not recorded in the medical chart; however, misclassification of patients should bias our findings to the null hypothesis, and our data collection clearly identified a cohort with adverse outcomes. Our ability to discriminate between acute conditions and chronic conditions was increased by a 2-stage record abstraction process for the PREMIER-QI project. Acute noncardiac events at admission were captured by record abstraction within the first 24 hours of the admission. This strategy guaranteed that complications that occurred during the hospitalization would not be identified as acute conditions present on admission. The length of stay was greater for patients with acute noncardiac conditions, thus introducing more opportunity to detect mortality; however, the mean and median days from admission to death were relatively similar for patients with and without these conditions (11 and 9 mean days, 7 and 6 median days, respectively). Finally, although the 19 PREMIER sites were selected to represent a spectrum of healthcare settings, including not-for-profit, government, academic, and nonacademic institutions, we did not include smaller, rural hospitals, and the prevalence of these factors may vary across diverse clinical settings.

Results from this multicenter study confirm that a considerable proportion of AMI patients present to the hospital with an additional acute noncardiac condition. The associated risk of mortality is exceptionally high for these patients, yet current clinical guidelines provide limited insight into the characteristics, care, and outcomes of these high-risk AMI patients limit our ability to identify opportunities to improve their clinical management.

Appendix

Participating Sites
Academic Centers: Harvard-Beth Israel: David Cohen, MD, SM; Yale-New Haven Hospital: Harlan Krumholz, MD, SM; Duke University: Eric Peterson, MD, MSc; Washington University: Richard Bach, MD; University of Alabama: John Canto, MD; University of Colorado: John Rumsfeld, MD, PhD, John Messenger, MD. Inner-city hospitals: Truman Medical Center: John Spertus, MD, MPH; Grady Health System: Viola Vaccarino, MD, PhD, William Weintraub, MD, Susmita Parashar, MD; Henry Ford Hospital: Jane Jie Cao, MD, MPH; Denver General Hospital: Edward Havranek, MD, Frederick Masoudi, MD, MSPH. Single-payer systems: Palo Alto Veterans Affairs Hospital: Paul Heidenreich, MD, MPH; Denver Veterans Affairs Hospital: John Rumsfeld, MD, PhD; Colorado Kaiser-Permanente: David Magid, MD. Nonuniversity hospitals: Sentara Health System (both Sentara and Sentara Lee Hospitals): John Brush, MD, MD; MericCare: Walter Radtke, MD; Baptist Healthcare: Gary Collins, MD; Swedish Medical Center: Tim Dewhurst, MD; Mid America Heart Institute: John Spertus, MD, MPH. (Drs Collins and Dewhurst terminated the study early because of administrative changes in their organizations that prevented sustainable data collection.)

Sources of Funding
Dr Lichtman is supported by grant K01 DP000085–03 from the Centers for Disease Control and Prevention, Atlanta, Ga. This work was funded by grants from Cardiovascular Therapeutics, Cardiovascular outcomes, and the National Heart, Lung, and Blood Institute. The sponsors did not play a role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; or preparation, review, and approval of the manuscript.

Disclosures
None.

References
Many studies of patients with an acute myocardial infarction have described the presence of chronic comorbid conditions, but little information is available about the coexistence of other acute potentially life-threatening conditions that would, in their own right, be an indication for admission. Little is known about these patients because they often are excluded from clinical trials and are not described in cohort studies or registries. In this prospective, multicenter study of patients with acute myocardial infarction, acute noncardiac conditions present at admission that were considered potentially life threatening were identified from medical record review within 24 hours of admission. We found that concomitant acute, severe, noncardiac conditions were present in 1 of every 15 patients admitted with an acute myocardial infarction. Patients with these concomitant conditions have a substantially different clinical presentation, are less likely to be eligible for or to receive evidence-based therapies at the time of admission, and are more likely to have adverse outcomes. The most common concomitant conditions were severe pneumonia (potentially requiring intubation; 18.4%), severe gastrointestinal bleeding/anemia (15.7%), stroke (9.7%), and sepsis (9.4%). The in-hospital mortality was 21.3% (57 of 267) for patients with concomitant conditions versus 2.7% (100 of 3640) for those without these conditions. The presence of an acute noncardiac condition was associated with an increased risk of in-hospital mortality after adjustment for demographic and clinical characteristics and disease severity (odds ratio, 5.0; 95% confidence interval, 3.3 to 7.7). Our study demonstrates the prognostic importance of acute, concomitant, potentially life-threatening conditions present at the time of an admission for acute myocardial infarction.

CLINICAL PERSPECTIVE

Many studies of patients with an acute myocardial infarction have described the presence of chronic comorbid conditions, but little information is available about the coexistence of other acute potentially life-threatening conditions that would, in their own right, be an indication for admission. Little is known about these patients because they often are excluded from clinical trials and are not described in cohort studies or registries. In this prospective, multicenter study of patients with acute myocardial infarction, acute noncardiac conditions present at admission that were considered potentially life threatening were identified from medical record review within 24 hours of admission. We found that concomitant acute, severe, noncardiac conditions were present in 1 of every 15 patients admitted with an acute myocardial infarction. Patients with these concomitant conditions have a substantially different clinical presentation, are less likely to be eligible for or to receive evidence-based therapies at the time of admission, and are more likely to have adverse outcomes. The most common concomitant conditions were severe pneumonia (potentially requiring intubation; 18.4%), severe gastrointestinal bleeding/anemia (15.7%), stroke (9.7%), and sepsis (9.4%). The in-hospital mortality was 21.3% (57 of 267) for patients with concomitant conditions versus 2.7% (100 of 3640) for those without these conditions. The presence of an acute noncardiac condition was associated with an increased risk of in-hospital mortality after adjustment for demographic and clinical characteristics and disease severity (odds ratio, 5.0; 95% confidence interval, 3.3 to 7.7). Our study demonstrates the prognostic importance of acute, concomitant, potentially life-threatening conditions present at the time of an admission for acute myocardial infarction.
Acute Noncardiac Conditions and In-Hospital Mortality in Patients With Acute Myocardial Infarction


*Circulation.* 2007;116:1925-1930; originally published online October 8, 2007; doi: 10.1161/CIRCULATIONAHA.107.722090

*Circulation* is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231

Copyright © 2007 American Heart Association, Inc. All rights reserved.

Print ISSN: 0009-7322. Online ISSN: 1524-4539

The online version of this article, along with updated information and services, is located on the World Wide Web at:
http://circ.ahajournals.org/content/116/17/1925

Permissions: Requests for permissions to reproduce figures, tables, or portions of articles originally published in *Circulation* can be obtained via RightsLink, a service of the Copyright Clearance Center, not the Editorial Office. Once the online version of the published article for which permission is being requested is located, click Request Permissions in the middle column of the Web page under Services. Further information about this process is available in the Permissions and Rights Question and Answer document.

Reprints: Information about reprints can be found online at:
http://www.lww.com/reprints

Subscriptions: Information about subscribing to *Circulation* is online at:
http://circ.ahajournals.org//subscriptions/