Off-hour admission and outcomes for patients with acute myocardial infarction undergoing percutaneous coronary interventions

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Background Prior studies have suggested that patients with acute myocardial infarction (AMI) who are admitted during off-hours (weekends, nights and holidays) have higher mortality when compared with patients admitted during regular hours.

Methods We analyzed consecutive patients with AMI (ST-elevation myocardial infarction [STEMI] and non-STEMI) who were treated with percutaneous coronary interventions from January 1998 to June 2010 at an academic medical center. Multivariable logistic regression models were used to estimate the association between off-hour admission and clinical outcomes adjusted for demographic and clinical variables.

Results There were 3,422 and 2,664 patients with AMI admitted during off-hours and regular hours, respectively. Patients admitted during off-hours were more likely to have STEMI (56% vs 48%, $P < .001$), have cardiogenic shock at presentation (6% vs 4%, $P = .002$), and develop shock after presentation (6% vs 5%, $P = .004$). After multivariable analyses, off-hour admission was not significantly associated with in-hospital mortality (odds ratio [OR] 1.12, 95% CI 0.84-1.49), 30-day mortality (OR 1.12, 0.87-1.45), or 30-day readmissions (OR 1.01, 0.84-1.20) but was significantly associated with composite major complications and any of emergent coronary artery bypass graft surgery, ventricular arrhythmia, stroke/transient ischemic attack, and gastrointestinal/retroperitoneal/intracranial bleeding (OR 1.27, 1.05-1.55, $P = .015$). There was no significant time trend in the adjusted mortality difference between off-hours and regular hours. The results were not different between STEMI and non-STEMI.

Conclusions Patients who were admitted during off-hours did not have higher mortality or readmission rates as compared with ones admitted during regular hours at an academic medical center. (Am Heart J 2015;169:62-8.)

Acute myocardial infarction (AMI) remains a leading cause of death worldwide.[1] Every year, approximately 1 million people in the United States have AMI, and 400,000 die of coronary heart disease.[2] Prior studies have suggested that patients with AMI admitted to the hospital during off-hours (weekends and/or nights) may have higher mortality.[3] The proposed reasons for higher mortality during off-hours include lower likelihood of receiving evidence-based treatment or timely reperfusion therapies[4,5] and decreased number of hospital staff and their level of expertise.[6,7]

Using national registry, Magid et al[5] demonstrated that patients with ST-elevation myocardial infarction (STEMI) who presented during off-hours had higher in-hospital mortality compared with those admitted during regular hours. Kostis et al[8] examined an administrative database and found that weekend admissions for patients with AMI were associated with higher in-hospital, 30-day, and 1-year mortality. Although many studies reported an association of off-hour presentation with mortality in patients with STEMI using clinical database[9-11] or with AMI using administrative database (billing codes or claim data),[12-14] limited evidence exists for patients with AMI using a clinical database adjusted for clinical variables such as cardiogenic shock. Furthermore, it is not known if off-hour admissions are associated with complication rates or readmission rates after discharge.

The Mayo Clinic Percutaneous Coronary Intervention (PCI) registry prospectively collects demographic and clinical data for all patients undergoing PCIs at Mayo Clinic

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in Rochester, Minnesota. Based on existing literature, we hypothesized that admissions during off-hours are associated with worse clinical outcomes at our institution compared with those during regular hours.

Methods

Study design and setting

We analyzed prospectively collected cohort data at a single center in the United States. Mayo Clinic is an academic teaching hospital located in Rochester, Minnesota. Mayo Clinic performs ~1,200 PCIs annually and is staffed 24/7 by on-site cardiologists and catheterization laboratory nurses starting in 2008. The Mayo Clinic STEMI protocol was developed in 2004 to provide rapid and optimal reperfusion therapy at a PCI-capable hospital and within a regional network of 28 STEMI referral hospitals.[15] Patients with both STEMI and non–STEMI (NSTEMI) are treated according to the American College of Cardiologist/American Heart Association guidelines.[16,17] The study was approved by the Mayo Clinic Institutional Review Board.

Data source and study sample

All patients undergoing PCI at Mayo Clinic in Rochester are followed in a prospective registry. Data elements include demographic, clinical, angiographic, procedural, and follow-up variables. Postprocedural and in-hospital events are recorded, and each patient is contacted by telephone using a standardized questionnaire at 6 months, 1 year, and then annually by trained personnel to document long-term outcomes. During the 6-month follow-up contact, details of any readmission during that period are collected, including the date and name of hospital. All adverse events are confirmed by reviewing the medical records for patients followed at our institution and by contacting patients' physicians and requesting hospital records for patients treated elsewhere. Demographic variables, including age and sex, were collected from the Mayo Clinic PCI registry. Other demographic variables were collected from Mayo Clinic administrative databases and merged with the PCI registry. These variables included race, marital status, education level, and miles traveled to Mayo Clinic.

All patients undergoing PCI for AMI (both STEMI and NSTEMI, based on admission diagnosis) from January 1998 to June 2010 were included in this analysis. Myocardial infarction was defined by the presence of 2 of the following 3 criteria: (1) prolonged chest pain ≥20 minutes consistent with ischemia, (2) cardiac biomarker (creatine kinase-MB or troponin) elevation ≥2 time of the upper normal limit, or (3) electrocardiographic changes consistent with acute ischemia or infarction (ST-segment changes, T-wave or Q-wave abnormalities). *ST-elevation myocardial infarction* is defined as ST-segment elevation of >0.1 mV in at least 2 contiguous precordial or adjacent limb leads, a new left bundle-branch block, or a true posterior myocardial infarction (MI) confirmed by posterior leads. *Non–ST-elevation myocardial infarction* was defined as any MI that did not meet STEMI criteria.

There were 6,312 such admissions of 5,985 unique patients included in the database; 212 patients (3.5%) were excluded because they declined authorization to use their medical records for research. Therefore, 6,086 admissions from 5,773 unique patients were included in the main analyses. For the analysis of 30-day readmission rates, 268 patients (4.6%) who died before discharge, and 67 patients (1.2%) without 30-day follow-up were further excluded, resulting in a total of 5,751 admissions from 5,448 unique patients.

Outcome measures

The primary outcome was all-cause in-hospital mortality. Secondary outcomes were all-cause 30-day mortality (including in-hospital deaths), all-cause 30-day readmission to any hospital, and composite major complications. The composite major complications are defined by any of emergent coronary artery bypass graft surgery; ventricular arrhythmia (ventricular fibrillation as documented by electrocardiographic evidence or ventricular tachycardia requiring treatment); in-hospital stroke or transient ischemic attack; and gastrointestinal (manifested as hematemesis, melena, or hematochezia), retroperitoneal (postcatheterization bleeding on the side of the puncture site, documented radiographically), or intracranial bleeding.

The primary independent variable, patient admission time, was categorized into off-hour and regular hour. Off-hour was defined by time of admission from 5 PM to 8 AM or day of admission on weekends or hospital holidays (6 per year). Time and day of admission were retrieved from the administrative database, which was linked with the PCI registry.

Other variables included baseline sociodemographic factors, medical history, clinical characteristics, and procedural characteristics and complications. *Moderate to severe renal dysfunction* was defined as a creatinine level of >3.0 mg/dL (2,652 μmol/L) or a history of hemodialysis or renal transplant. *Cardiogenic shock* was defined as a sustained (>30 minutes) episode of systolic blood pressure <90 mm Hg, cardiac index <2.2 L/min per square meter determined to be secondary to cardiac dysfunction, and/or the requirement for parenteral inotropic or vasopressor agents or mechanical support to maintain blood pressure and cardiac index above those specified levels. Shock at presentation was defined by the development of shock before or within 30 minutes of patient presentation to our facility. *Shock after presentation* was defined as development of shock 30 minutes or later after patient presentation to our facility.

Statistical methods

Continuous data are summarized as mean (±SD) unless otherwise stated. Categorical data are summarized as frequency and group percentage. The primary analyses