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EDITORIAL COMMENT

Changing Direction in ST-Segment Elevation Myocardial Infarction Care

Where Do We Go From Here?*

Alice K. Jacobs, MD, Claudia P. Hochberg, MD

Boston, Massachusetts

It is now widely accepted that for patients with ST-segment elevation myocardial infarction (STEMI), primary percutaneous coronary intervention (PCI) is the preferred reperfusion strategy if it can be delivered in a timely fashion. Based on robust evidence documenting a relationship between time-to-reperfusion (defined either by time between symptom onset or hospital arrival and reperfusion) and mortality (1,2), the American College of Cardiology/American Heart Association guidelines recommend that STEMI patients undergo primary PCI with a balloon inflation or device time within 90 min of first medical contact (3). Moreover, in the most recent focused update of the STEMI guidelines, it is recommended that each community develop a STEMI system of care that includes: 1) a process for pre-hospital identification of STEMI and catheterization laboratory activation; 2) destination protocols for STEMI-receiving centers; and 3) transfer protocols for patients who arrive at STEMI referral centers and are candidates for primary PCI, ineligible for fibrinolytic therapy, and/or in cardiogenic shock (4).

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The enthusiasm for developing centers and systems of care for STEMI patients is based on our inability to deliver life-saving, evidence-based, guideline-recommended, time-dependent therapies to all patients at all times in all locales. In fact, most STEMI patients present to hospitals without primary PCI capability and require transfer to PCI-capable hospitals. Timely transfer has been shown to occur in a minority of patients (5); in the voluntary ACTION (Acute Coronary Treatment and Intervention Outcomes Network)–GWTG (Get With The Guidelines) Registry, only 27% of STEMI patients transferred for primary PCI in the calendar year 2009 were treated within the recommended 90 min from arrival at the non–PCI-capable hospital to balloon inflation or device use in the PCI hospital (E. Peterson, June 2010).

To date, most efforts have centered on strategies to decrease door-to-balloon time at PCI centers, and these strategies have been successful. Both the American Heart Association GWTG-CAD (Coronary Artery Disease) (that addresses overall coronary artery disease care) and the American College of Cardiology Door-to-Balloon Alliance national quality improvement initiatives have resulted in a significant decrease in time to treatment. In hospitals participating in these programs, the percentage of patients treated with a door-to-balloon time of within 90 min increased from 54.1% in 2006 to over 70% in 2008 (6). However, less attention has been directed at the pre-hospital phase of STEMI care, where less progress has been made. To achieve a substantial reduction in mortality associated with STEMI, it will be necessary to focus on the continuum of care for patients, beginning with symptom onset and entry in to the health care system.

In this issue of *JACC: Cardiovascular Interventions*, Dieker et al. (7) directly address this issue by evaluating the impact of direct transport to a PCI center following pre-hospital diagnosis of STEMI on time to treatment and outcomes. Accordingly, 581 consecutive patients with pre-hospital diagnosis of STEMI referred for primary PCI to a single center in the Netherlands between 2005 and 2007 were evaluated, of whom 454 (78%) were transported directly to the PCI center and 127 (22%) were initially referred to a non-PCI capable (referral) center. The catheterization laboratory was activated before patient transport. Patients brought directly to the PCI center were younger, with a lower prevalence of anterior infarcts, and were transported a shorter distance than patients brought to a referral center. Direct ambulance transport compared with interhospital transfer to the PCI center was associated with a higher proportion of patients with first medical contact-to-balloon inflation of within 90 min (82% vs. 23%, $p < 0.01$) and a shorter median symptom onset-to-balloon time (149 [interquartile range 118 to 197] min vs. 219 [interquartile range 178 to 315] min, $p < 0.01$), a higher Thrombolysis In Myocardial Infarction (TIMI) flow grade 3 post-procedure, and a lower mortality at 1-year (7% vs. 13%, $p = 0.03$). Multivariate analyses revealed direct ambulance transport to the PCI center to be independently associated with the symptom-to-balloon time, and the symptom-to-balloon time was independently associated with post-procedure TIMI flow grade 3. The investigators concluded that pre-hospital diagnosis of STEMI and direct transport to a PCI center results in more than a 3-fold increase in the proportion of patients treated within the guideline-recommended 90 min and that the relationship

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From the Department of Medicine, Section of Cardiology, Boston Medical Center, Boston, Massachusetts. Dr. Jacobs serves as Chair of the Advisory Working Group for Mission: Lifeline.

between symptom-to-balloon time and post-procedural TIMI flow grade 3 underscores the importance of reducing delays in treatment.

This study is of interest as systems of care for STEMI patients that include point-of-entry destination protocols are being developed to increase the number of patients with timely access to primary PCI. The results are consistent with previous studies evaluating pre-hospital identification of STEMI and activation of the catheterization laboratory. In Ottawa, Canada, guideline-recommended door-to-balloon times were achieved more often when trained paramedics independently triaged and transported STEMI patients directly to a PCI center than when patients were referred from emergency departments, with 70.7% compared with 11.9% of patients achieving a door-to-balloon time of within 90 min (8). Within the U.S., a pooled analysis of 10 registries, involving 72 STEMI receiving centers that coordinated universal access to 9-1-1 with the pre-hospital electrocardiogram diagnosis of STEMI revealed a door-to-balloon time of within 90 min in 86% of patients and within 60 min in 50% of patients (9).

The present study extends these observations by demonstrating a mortality benefit at 1-year in patients directly transferred to the PCI center. However, lack of randomization or propensity score matching and the important differences in the treatment groups suggest that residual bias and confounding may exist. In addition, it is unclear why the symptom onset to 9-1-1 call and the 9-1-1 call to diagnosis were longer in the referral center group, whether the pre-hospital and referral center treatment protocols were similar, and whether the findings would be similar in lower risk (smaller infarct) patients. Moreover, several predictors of mortality such as eligibility for fibrinolytic therapy and left ventricular function are not provided.

Notwithstanding the preceding limitations, this study suggests that development of systems that allow pre-hospital identification and triage of STEMI directly to PCI centers improves both process measures and outcomes and provides an opportunity to emphasize the importance of pre-hospital initiatives in the delivery of timely reperfusion therapy. Carefully crafted point-of-entry destination protocols using evidence-based strategies including fibrinolytic therapy eligibility checklists will limit the number of patients transported to the closest hospital where primary PCI may not be available. To be most effective, pre-hospital electrocardiograms must be effectively translated into action and coordinated with hospital processes to maximize the decrease in time to reperfusion (10). Moreover, the critical importance of data collection and participation in local and national registries, such as ACTION–GWTG Registry, with inherent quality improvement cannot be overstated. Currently, the majority of pre-hospital data collection is paper-based and little integration with hospital data exists. Finally, it will be important to focus on unaddressed treatment delays before emergency medical services (EMS) arrival including earlier symptom recognition by patients and immediate EMS notification, where efforts to date have been largely unsuccessful (11).

The barriers to widespread implementation of pre-hospital care that decreases time-to-treatment delays for STEMI patients are being addressed by Mission: Lifeline, the American Heart Association initiative introduced in 2007 to develop systems of care for STEMI patients (12). Mission: Lifeline is collaborating with multiple EMS organizations to build and evaluate the appropriate EMS infrastructure at the local, regional, and state level. Issues being addressed include funding, training, regulation, legislation, geography, local resources, and mitigation of potential disparities in access to care.

Fortified by the momentum and success of door-to-balloon initiatives and as EMS changes direction to transport STEMI patients directly to PCI centers, we too must now change direction and reach beyond the primary emphasis on door-to-balloon time. Expanding our efforts to target patient and pre-hospital programs, in addition to interhospital and post-STEMI secondary prevention strategies, will improve the comprehensive care and outcomes for all STEMI patients wherever they may reside.

Reprint requests and correspondence: Dr. Alice K. Jacobs, Section of Cardiology, Boston Medical Center, 88 East Newton Street, Boston, Massachusetts 02118. E-mail: alice.jacobs@bmc.org.

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