Regional Systems of Care for Patients With ST-Elevation Myocardial Infarction  
Being at the Right Place at the Right Time

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T-segment–elevation myocardial infarction (STEMI) presents a true medical emergency, where the relationship between treatment (reperfusion) and mortality is measured in minutes. Fortunately, when administered early in properly selected patients, both fibrinolytic therapy and primary percutaneous coronary intervention (PCI) have been associated with significant reductions in mortality.1,2 Unfortunately, it has become increasingly clear that only a minority of STEMI patients receive fibrinolytic therapy within 30 minutes from door-to-needle or receive primary PCI within 90 minutes from door-to-balloon as recommended by the guidelines from the American College of Cardiology/American Heart Association (AHA).3

Moreover, as enthusiasm for primary PCI as the preferred reperfusion modality has escalated, the importance of time to treatment has gained increased recognition. Door-to-balloon time is now included as 1 of the core quality measures collected and reported by the Centers for Medicare and Medicaid and The Joint Commission. Furthermore, although the performance of primary PCI has increased from 18% to 53% worldwide during the past 7 years (with an expected decrease in use of fibrinolytic therapy from 50% to 28%), nearly 30% of patients still do not receive either form of therapy even in the absence of contraindications.4

It is these realities of the current status of reperfusion therapy that have fostered the concept of systems and centers of care for STEMI patients and interest in the exploration of the feasibility of establishment of regional STEMI networks. It is not surprising that healthcare systems and hospitals across the country are examining their standards of care and organizing quality improvement initiatives to decrease time to treatment and increase adherence to evidence-based therapies for patients with STEMI.5,6 In this issue of Circulation, 2 pioneering model regional approaches that use integrated systems of care to increase the number of STEMI patients with timely access to a PCI facility are reported.

Based on the premise that primary PCI is superior to fibrinolysis even when transfer from a non–PCI-capable facility to a primary PCI center is necessary, Henry and colleagues7 developed a PCI-based treatment system with an integrated transfer program for STEMI patients at 30 hospitals within 210 miles from the Minneapolis Heart Institute at Abbott Northwestern Hospital. Participating hospitals were divided into zone 1 (<60 miles) and zone 2 (60 to ≤210 miles) from the Minneapolis Heart Institute. A standardized treatment protocol was developed on the basis of American College of Cardiology/AHA guidelines that was identical for the PCI center, zone 1, and zone 2 hospitals except that zone 2 patients received half-dose tenecteplase (in the absence of a contraindication to fibrinolytic therapy) in anticipation of a lengthy transfer time. At each hospital, training of all personnel (emergency medical services, emergency department, primary care physicians) was performed, tool kits (with checklists, transfer forms, clinical data forms, standing orders, adjunctive medications, and laboratory supplies) were used, and a comprehensive feedback and quality assurance plan was developed. The diagnosis of STEMI was made by the emergency department physician who activated the system with 1 phone call.

In the 1345 consecutive patients with STEMI, which included those at high risk and 1048 patients transferred from non–PCI-capable hospitals, the median first door-to-balloon time for zone 1 patients was 95 minutes (25th and 75th percentiles, 82 and 116 minutes) and for zone 2 was 120 minutes (25th and 75th percentiles, 100 and 145 minutes). Notably, median length of hospital stay was 3 days and in-hospital mortality was 4.2%.

Ting and colleagues8 at the Mayo Clinic report their implementation and evaluation of a protocol to coordinate systems of care for a PCI center (Saint Mary’s Hospital) and 28 regional hospitals within 150 miles across 3 states as part of a quality improvement effort to improve timeliness of reperfusion for STEMI patients who arrive at hospitals with or without PCI capability. The study cohort comprised 258 patients who presented to the PCI center and were treated with primary PCI, 105 patients who presented to a regional hospital with symptom onset >3 hours and then were transferred for primary PCI, and 131 patients who presented to a regional hospital with symptom onset <3 hours and were treated with full-dose fibrinolytic therapy. The PCI center’s STEMI protocol consisted of recommended strategies5,6 that included acquisition and interpretation of a 12-lead ECG within 10 minutes of hospital arrival, emergency department activation of the entire cardiac catheterization laboratory...
team with a single call, catheterization laboratory readiness within 30 minutes of activation, and prospective data collection and feedback. The regional STEMI protocol included standard order sets with adjunctive therapies for both primary PCI and fibrinolytic therapy, a single phone call system to activate the transfer and cardiac catheterization team, a centralized communication center to select the fastest mode of transport from 3 helicopters, a helicopter protocol to minimize ground time to ≤10 minutes, and the bypass of the PCI center emergency department evaluation. Of note, for those patients who received fibrinolytic therapy, the protocol mandated transfer to the PCI center for consideration of rescue PCI for suspected failure of reperfusion or routine elective catheterization 24 to 48 hours after suspected successful reperfusion.

For patients who presented to the PCI center, median door-to-balloon time was 71 minutes and was <90 minutes in 75% of patients. For patients who were transferred for primary PCI, median door-to-balloon time was 116 minutes and was <90 minutes in 12% of patients. Median door-to-needle time was 25 minutes for patients treated initially with fibrinolytic therapy and <30 minutes in 70% of patients.

From these 2 provocative and innovative studies of systems and centers of care for patients with STEMI emanate several consistent and important messages. First, the establishment of integrated systems that reduce barriers to collaborative care between different hospitals and different groups of healthcare professionals is feasible. Second, the transport of STEMI patients to another facility during the acute phase of care appears to be safe. In the 1048 patients transferred to the Minneapolis Heart Institute, endotracheal intubation was required during transport in 7 (0.7%) patients, and cardiopulmonary arrest occurred during transport in 21 (2.0%) patients, with all but 1 patient successfully resuscitated. Among transferred patients in the Mayo Clinic system, no patient died at the regional hospital prior to or during transfer to the PCI center.

Moreover, both studies underscore the importance of standardized protocols (that increase timely access to reperfusion as well as adherence to all evidence-based therapies), establishment of coordinated transport (and back-up) plans, and comprehensive real-time data feedback and quality assurance to all system participants. In addition, both studies serve to highlight the substantial number of patients for whom PCI may be the only reperfusion option (12.3% cardiogenic shock, 10.8% cardiac arrest, 14.6% ≥80 years old in the report by Henry et al,7 and nearly one third of patients presenting to regional hospitals within 3 hours of symptom onset with too high a clinical risk or contraindications to fibrinolysis in the report by Ting et al) and remind us that in these patients, rapid triage and access to primary PCI is essential. Finally, at a high-volume and experienced PCI center that provides continuous primary PCI and where the catheterization laboratory team was presumably at Abbott Northwestern Hospital awaiting the arrival of a transferred STEMI patient, (second) door-to-balloon time was a noteworthy median of 21 minutes (25th and 75th percentiles, 16 and 28 minutes) and 19 minutes (25th and 75th percentiles, 15 and 25 minutes) in zones 1 and 2, respectively.

However, despite the increased timelines and access to reperfusion that these model systems achieved, several concerns exist. Although both Minneapolis Heart Institute and Mayo Clinic investigators established integrated systems of standardized care and patient transfer that were fortified by the commitment and dedication of multidisciplinary physicians and staff, (first) door-to-balloon time within 90 minutes was only achieved in ≈40% of (transferred) patients within 60 miles, ≈15% of patients from 60 to 210 miles from the Minneapolis Heart Institute, and 12% of patients within 150 miles from Saint Mary’s Hospital. In addition, whereas mortality was not different among groups, neither study was powered to detect clinically relevant differences. Finally, although the concept of facilitated PCI with half-dose fibrinolytic therapy appears intuitive for patients in whom a relatively prolonged transfer time is anticipated, trials that tested this strategy have been disappointing to date and suggest the potential for harm.10 Furthermore, even though the pharmacoinvasive strategy (coronary angiography with potential PCI in all patients after successful reperfusion with full-dose fibrinolytic therapy)11 may serve to reduce the reinfarction rate that has accounted for part of the improved outcomes of primary PCI compared with fibrinolytic therapy,2 current evidence to support this strategy is limited.

Notwithstanding the above concerns, both the Minneapolis Heart Institute and the Mayo Clinic regional STEMI networks, in addition to other ongoing efforts in many states such as the Reperfusion of Acute Myocardial Infarction in Carolina Emergency Departments (RACE) program in North Carolina12 and the Emergency Medical Services Point of Entry program in Boston,13 have taught us that establishment of regional systems and centers of care for STEMI patients is possible. These efforts are energized by the knowledge that in many patients (those at high risk, those who present relatively late [≥3 hours] after symptom onset, and those in whom fibrinolysis is contraindicated), primary PCI is the only option. In addition, although a door-to-balloon time of <90 minutes from first medical contact is our system’s goal,14 in several subsets of patients the time interval when the advantage of primary PCI in comparison to fibrinolytic therapy is lost may be longer (or shorter).15 Furthermore, whereas the mortality benefit of primary PCI is reduced as the difference between door-to-balloon and door-to-needle time increases, the benefit of a reduction in stroke rate is maintained.

Yet, several other barriers will likely be encountered before widespread adoption of regional STEMI networks will occur. Perhaps most critical is the lack of public awareness about the importance of early access to the medical system and of activation of emergency medical services. Currently, the majority of patients transport themselves to the hospital or they are transported by family or friends. Many patients do not understand the community hospital’s role in STEMI care nor the implications of rapid interhospital transfer for PCI. EMS regions are governed separately by state. Emergency vehicles are staffed by different personnel and provide different levels of care and services in rural and urban areas and only a minority are equipped with 12-lead ECGs. In some states there is the mandate to deliver the patient with chest pain to the nearest hospital, even if that hospital does not
provide primary PCI. Often, when interhospital transfer for primary PCI is required, the service is the next available ambulance rather than a 9-1-1 system of activation. As a result of decreasing length of stay and a reduction of hospital beds, emergency departments are often overcrowded with acutely ill and complex patients awaiting placement. This leads to emergency department diversion, or rerouting emergency vehicles to other facilities. Financial disincentives associated with the loss of cardiac patients from the non–PCI-capable hospital exist. The PCI center must manage the reallocation of resources necessary to accommodate the increase in STEMI patients brought directly to their facility or via interhospital transfer. Finally, an increase in the number of patients with access to primary PCI will likely require payers to restructure how services are purchased and how payments are made.16

Clearly, overcoming the barriers to the establishment of national STEMI networks will take a broad-based approach. The AHA has embarked on a bold initiative to improve the quality of care and outcomes for all patients with STEMI, with a focus on increasing the number of patients with timely access to primary PCI. To accomplish this, the AHA held a stakeholder summit entitled “Development of Systems of Care for ST-Elevation Myocardial Infarction Patients” last March in Boston that brought together all constituents involved in the care of patients with STEMI (patients, physicians, nurses, EMS and ED personnel, hospital administrators, payers, and outcomes experts) who were charged to design the ideal system of care from the perspective of each stakeholder. On the basis of the recommendations for research, programs, and policy that emanated from the conference proceedings,16 the AHA launched “Mission: Lifeline,” a community-based initiative to improve the systems of care for STEMI patients. The initiative is unique in its approach to deal with STEMI patients across the continuum of care, from patient entry into the system, throughout the system, to return to the local community and caregivers and in specifically defining a role for the non–PCI-capable hospital, known as the STEMI referral hospital. “Mission: Lifeline” also addresses each of the barriers noted above, from patient (and family) education, to aligning financial incentives across emergency medical services, STEMI referral hospitals and STEMI receiving hospitals, to evaluation mechanisms and measurement of outcomes. The initial implementation plan will consist of Emergency Medical Services System Assessment and Improvement that will involve a needs assessment in collaboration with EMS organizations; Establishing Local Initiatives by convening local stakeholders to identify ways to establish national recommendations for STEMI systems on a local level in view of geography, resources and existing programs; Evaluating Existing Models for financial impact on STEMI referral and receiving hospitals, rural implications, resource allocation, and disparities in care; and Exploring the Development of National STEMI Center/Systems Certification in collaboration with other patient-focused organizations.

It is also important to note that the national focus on emergency care may ultimately benefit our patients with STEMI. The Office of Preparedness and Emergency Operations within the Department of Health and Human Services established an internal working group to study 3 Institute of Medicine Reports released June 2006 on emergency care in the United States. The working group concluded that there were 3 common themes in the Institute of Medicine recommendations: the establishment of an agency for emergency care; the establishment of regional trauma care systems; and additional funds for research on emergency care as well as greater coordination of federal agency efforts to promote clinical and system-based research.17

In addition, several congressional committees are examining problems with emergency care. The House Oversight and Government Reform Committee held a hearing June 2007 on “The Response of the Department of HHS to the Nation’s Emergency Room Crisis,” and both the House Homeland Security Committee and the House Ways and Means Committee plan to hold similar hearings. In fact, the Institute of Medicine Report made numerous observations and recommendations concerning the “boarding” of patients in the emergency department when beds are not available and hospital “diversion” that reroutes ambulances when the emergency department reaches capacity.

These federal initiatives, the AHA’s “Mission: Lifeline,” successful model systems of regional care described herein, and similar efforts in many states such as California, Florida, Texas, and Michigan, will contribute to the current momentum to improve the emergency care and outcomes for patients with STEMI. It is critical that we educate all constituents involved in the care of STEMI patients, but particularly patients, the public, and policy makers, about the importance of being at the right place at the right time because mortality is directly related to the time to treatment. Our goal should be nothing less than implementation of urban, suburban, and rural ideal systems of care for patients with STEMI that allow the timely delivery of the appropriate life-saving therapies to all patients in all places. Only then will we be successful in moving our evidence-based and guideline-recommended treatments from their discovery to the bedside and broadly into the community.

Disclosures

None.

References


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