Time to Treatment

Focus on Transfer in ST-Elevation Myocardial Infarction

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KEYWORD

• Time to treatment • Door-to-balloon time • ST-elevation myocardial infarction

KEY POINTS

- In the modern ST-elevation myocardial infarction (STEMI) system, the use of electrocardiogram by emergency medical services (EMS) personnel and the option to bypass emergency departments on route to a PCI-capable hospital is of particular importance.
- Through training and a standardized referral process, EMS personnel can now accurately diagnose and refer STEMI patients directly to the catheterization laboratory of a percutaneous coronary intervention–capable hospital.
- Regional STEMI models have been implemented successfully across North America, and this has resulted in palpable reductions in door-to-balloon time, morbidity, and mortality.

Time to reperfusion is a key modulator of morbidity and mortality in patients with ST-elevation myocardial infarction (STEMI).[1–3] During STEMI, acute thrombotic occlusion of a coronary artery initiates an ischemic cascade, culminating in myocardial injury and necrosis. If reperfusion in the infarct-related artery (IRA) is not promptly re-established, ischemic myocardium at risk becomes irreversibly damaged, leading to poor patient outcomes, including death. Timely reperfusion in the IRA by pharmacologic and/or mechanical means can stop myocardial ischemia, reducing infarct size, morbidity, and mortality. Fibrinolytic therapy and primary percutaneous coronary intervention (PCI) are the 2 strategies currently available to achieve reperfusion.

PRIMARY PERCUTANEOUS CORONARY INTERVENTION VERSUS FIBRINOLYTIC THERAPY

The efficacy of primary PCI lies in its ability to provide rapid, complete, and sustained reperfusion of the IRA by mechanical means. A systematic review of 23 randomized controlled trials demonstrated that compared with fibrinolytic therapy, primary PCI was superior in reducing death, reinfarction, and stroke in patients with STEMI.[4] Primary PCI is also less costly than fibrinolytic therapy.[5]

TIME-DEPENDENT EFFICACY OF PRIMARY PERCUTANEOUS CORONARY INTERVENTION

Observations from early randomized trials demonstrated that the efficacy of primary PCI is highly time-dependent. In the Global Use of Strategies to Open Occluded arteries (GUSTO)-IIb substudy,[6] a strong inverse relationship between time to angioplasty and mortality was noted with 1.0% and 6.4% mortality rates when time to angioplasty was equal to or less than 60 minutes and equal to or greater than 90 minutes, respectively (Fig. 1). The association between timely reperfusion therapy and mortality led to the notion of the "golden hour" of

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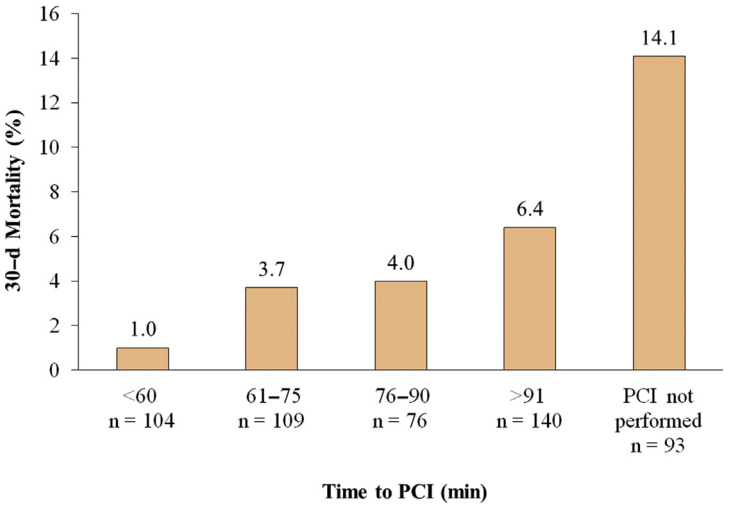

Fig. 1. Relationship between 30-day mortality and time from randomization to first balloon inflation in the GUSTO-IIb trial. Subjects assigned to PCI in whom PCI was not performed are also shown. (*Adapted from* Berger PB, Ellis SG, Holmes DR Jr, et al. Relationship between delay in performing direct coronary angioplasty and early clinical outcome in patients with acute myocardial infarction: results from the global use of strategies to open occluded arteries in Acute Coronary Syndromes (GUSTO-IIb) trial. Circulation 1999;100(1):17.)

primary PCI and an increased emphasis on its timely provision because "every minute of delay counts."[7] Thus, time to reperfusion emerged as a key indicator of the quality of care for STEMI patients managed with primary PCI. System delays, defined as the time from contact with the emergency medical services (EMS) to primary PCI and its components, prehospital delay, and door-to-balloon time (D2BT), all correlate with survival.[8] Accordingly, first medical contact has been recommended as a logical start time for measuring reperfusion therapy.[9–11] It has been defined as the time of EMS arrival on scene after the patient calls 9-1-1 or time of arrival at the emergency department when the patient arrives as a self-transport.[12] However, the time of arrival in the emergency department (door-time) has been generally adopted by most organizations as the standard start time for both scenarios because it is readily available in medical records and it facilitates performance measurement.[13] Hence, D2BT has become the most widely used metric for primary PCI.

Data from the National Registry of Myocardial Infarction has corroborated the inverse relationship between D2BT and survival in patients referred for primary PCI.[2,3] Cannon and colleagues[2] evaluated 27,080 consecutive STEMI patients managed with primary PCI between 1994 and 1998, and found significantly higher in-hospital mortality when D2BT was greater than 2 hours. Shortly thereafter, McNamara and colleagues[3] reported on 29,222 patients treated with primary PCI within 6 hours of presentation between 1999 and 2002, and found a strong linear correlation between D2BT and in-hospital mortality (Fig. 2). In addition, D2BT correlated with mortality regardless of (1) time of symptom onset to hospital presentation and (2) baseline mortality risk. In a separate analysis,

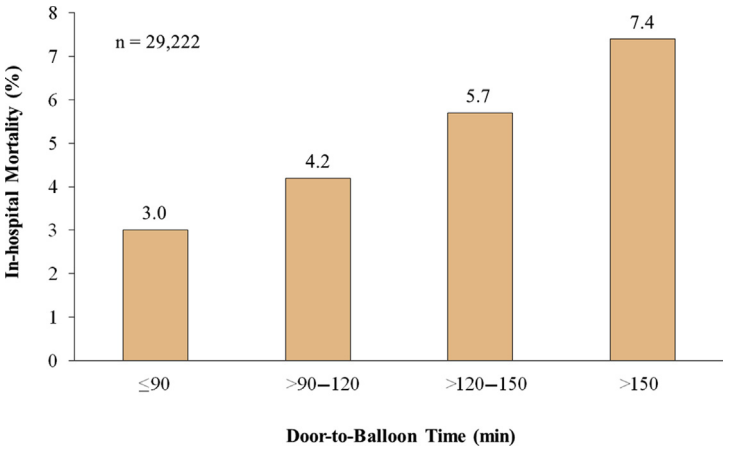

Fig. 2. In-hospital mortality and D2BT. In a cohort study of 29,222 STEMI subjects treated with PCI within 6 hours of presentation at 395 hospitals that participated in National Registry of Myocardial Infarction, longer D2BT was associated with increased in-hospital mortality. (*Data from* McNamara RL, Wang Y, Herrin J, et al. Effect of door-to-balloon time on mortality in patients with ST-segment elevation myocardial infarction. J Am Coll Cardiol 2006;47(11): 2180–6.)