Prehospital delay and time to reperfusion therapy in ST elevation myocardial infarction

Linsha George, Lakshmi Ramamoorthy, Santhosh Satheesh¹, Rama Prakasha Saya², D. K. S. Subrahmanyam³

College of Nursing, Jawaharlal Institute of Postgraduate Medical Education and Research, Departments of 'Cardiology and 'General Medicine, Jawaharlal Institute of Postgraduate Medical Education and Research, Puducherry, 'Department of General Medicine, Kanachur Institute of Medical Sciences, Mangalore, Karnataka, India

ABSTRACT

Background: Despite efforts aimed at reducing the prehospital delay and treatment delay, a considerable proportion of patients with ST elevation myocardial infarction (STEMI) present late and receive the reperfusion therapy after unacceptably long time periods. This study aimed at finding out the patients’ decision delay, prehospital delay, door-to-electrocardiography (ECG), door-to-needle, and door-to-primary percutaneous coronary intervention (PCI) times and their determinants among STEMI patients. Materials and Methods: A cross-sectional study conducted among 96 patients with STEMI admitted in a tertiary care center in South India. The data were collected using interview of the patients and review of records. The distribution of the data was assessed using Kolmogorov–Smirnov test, and the comparisons of the patients’ decision delay, prehospital delay, and time to start reperfusion therapy with the different variables were done using Mann–Whitney U-test or Kruskal–Wallis test based on the number of groups. Results: The mean (standard deviation) and median (range) age of the participants were 55 (11) years and 57 (51) years, respectively. The median patients’ decision delay, prehospital delay, door-to-ECG, door-to-needle, and door-to-primary PCI times were 75, 290, 12, 75, 110 min, respectively. Significant factors associated (P < 0.05) with patients’ decision delay were alcoholism, symptom progression, and attempt at symptom relief measures at home. Prehospital delay was significantly associated (P < 0.05) with domicile, difficulty in arranging money, prior consultation at study center, place of symptom onset, symptom interpretation, and mode of transportation. Conclusions: The prehospital delay time among the South Indian population is still unacceptably high. Public education, improving the systems of prehospital care, and measures to improve the patient flow and management in the emergency department are essentially required. The time taken to take ECG and to initiate reperfusion therapy in this study points to scope for improvement to meet the American Heart Association recommended timings.

Key Words: Door-to-needle, door-to-primary percutaneous coronary intervention, myocardial infarction, prehospital delay, reperfusion therapy

INTRODUCTION

The Global Status Report on Noncommunicable Diseases has reported that in India, cardiovascular disease (CVD) caused more than 2.5 million deaths in 2008. As per 2014 statistics by the World Health Organization, 26% of total mortality in India is contributed by CVD. Mortality due to coronary artery disease (CAD) is higher in South India.

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How to cite this article: George L, Ramamoorthy L, Satheesh S, Saya RP, Subrahmanyam D. Prehospital delay and time to reperfusion therapy in ST elevation myocardial infarction. J Emerg Trauma Shock 2017;10:64-9.

Received: 07.08.15. Accepted: 27.01.17.
Treatment of patients with acute myocardial infarction (MI) is time related. Among patients with ST elevation MI (STEMI), there are chances of delay at various levels from the onset of the chest pain to the initiation of definitive therapy. Delay of every minute after STEMI is associated with increasing mortality and morbidity. The American Heart Association (AHA) guideline for the management of STEMI recommends performance of a 12-lead electrocardiography (ECG) at the site of first medical contact (FMC) within 10 min. FMC-to-primary percutaneous coronary intervention (PCI) time of ≤90 min is ideal. Fibrinolytic therapy when chosen as the primary reperfusion strategy should be administered within 30 min of hospital arrival. In spite of quality improvement efforts to decrease the system delay in starting reperfusion treatment, some percentages of patients receive therapy outside the recommended time interval even in developed countries.

Prehospital delay is a major contributor to the morbidity and mortality in MI. Several factors contribute to this delay such as age, gender, educational status, and clinical and psychological factors. Patients’ delays in seeking treatment as well as in-hospital delay for initiation of reperfusion therapy are the major limiting factors in the management of STEMI. While the extent and the determinants of this delay have been well researched in the developed countries, it remains yet to be systematically identified in various developing countries like India, and Indian studies are few in this regard. With this in the background, this study was conducted with the following objectives: (1) To assess the patients’ decision delay, prehospital delay, door-to-ECG, door-to-needle, and door-to-primary PCI times among patients with STEMI. (2) To identify the factors associated with patients’ decision delay, prehospital delay, and time taken to start reperfusion therapy in STEMI.

MATERIALS AND METHODS

This was a descriptive, cross-sectional study conducted in a tertiary care institution in South India with a daily average emergency department (ED) attendance of 300–350 and yearly admission through ED of more than 40,000. The Institutional Ethical Clearance was taken before the study. The study setting included ED, male and female ED short stay wards, coronary critical care unit, cardiology ward, and the various male and female medical wards.

Patients admitted with STEMI, who survived, and were able to give informed consents were included in the study. Those patients who received thrombolytic therapy before arrival to this hospital were excluded from the study. The data were collected by interview of patients using a structured questionnaire and review of patients’ records. The data collection required 30–40 min per patient. The sample size estimated was 96, with an expected percentage of patients delaying for more than 1 h of symptom onset as 50% (which gives the maximum sample size), at 20% relative precision, and 5% level of significance.

Operational definitions

Onset-to-decision time was defined as the time between the STEMI symptom onset and making the decision to visit a hospital. Symptom onset to FMC time is the interval between the onset of symptoms and the time of reaching the first hospital/clinic. Prehospital delay was defined as the time interval between the onset of symptoms and the first documented time in the ED of the study center. Time to initiate reperfusion therapy was defined as the interval between the first documented time in the ED and the time of initiating reperfusion therapy either thrombolysis or PCI. The door-to-needle time is the interval between the time of arrival at study center and the time of starting thrombolytic therapy. Door-to-balloon time is the interval between the time of reaching the hospital and the time of starting primary PCI.

Description of the tool

Demographic data consisted of ten questions to elicit information about patient’s age, sex, hospital number, marital status, religion, education status, domicile, employment status, and monthly household income. Social factors consisted of two questions about difficulty in arranging money and data about the patient being alone during the symptom onset. Clinical data included the history of alcoholism, smoking, CAD, prior consultation at the study center, and the ECG location of MI. Timings included patient’s self-reported time of onset of pain, and the timings were collected from patient’s records, triage register, and nurse’s record. It included prehospital timings and in-hospital timings. Symptom survey included 15 questions related to the patient’s symptom presentation.

Statistical analysis

Both descriptive and inferential statistics are used for analyzing the data. Baseline characteristics are presented as mean with standard deviation (SD) or frequencies and percentages whichever is appropriate. The distribution of the data was assessed using Kolmogorov–Smirnov test, and the comparisons of the patients’ decision delay, prehospital delay, and time to start reperfusion therapy with the different variables were done using Mann–Whitney U-test or Kruskal–Wallis test based on the number of groups.

RESULTS

Baseline characteristics are shown in Table 1. The mean ± SD and median (range) age were 55 ± 11 years and 57 (51) years, respectively. About 14% of the patients reported that they had difficulty in arranging money for treatment and transport. Around one fourth of the patients (26%) were alone during the symptom onset. Most of the patients (76%) had at least one hospital/clinic consultation before arriving at this hospital. Only 38% patients arrived by ambulance, among them 18% arrived by government/108 ambulance.

The median patients’ decision delay was 75 min. The factors associated with lesser patients’ decision delay were
alcoholism \(P = 0.025\), rapid symptom progression \(P = 0.005\), and not attempting symptom relief measures \(P = 0.002\). The median time interval between onset of symptoms and FMC (either outside or inside the study center) was 120 min, and the median prehospital delay was 290 min [Table 2]. The majority of the patients (59%) came within 6 h of symptom onset. The determinants of prehospital delay were rural residence \(P = 0.005\), not having prior consultations at study center \(P = 0.002\), difficulty in arranging money \(P = 0.04\), previous consultations before reaching study center \(P < 0.001\), use of public transportation \(P = 0.039\), symptom onset at home \(P = 0.019\), symptom misinterpretation \(P = 0.012\), gradual onset of symptoms \(P=0.001\), and perceiving symptoms to be not serious \(P \leq 0.001\) [Tables 3-5].

Patients who used public ambulance service had lower transportation time to the study center [Figure 1]. The median door-to-ECG time was 12 min. ECG was taken within 10 min for 45% of the patients. The median time taken to start thrombolytic therapy was around 75 min and to start primary PCI was 110 min [Table 2]. Thrombolytic therapy was started within the recommended 30 min for 13% of the patients [Figure 2]. Primary PCI was initiated within 90 min of arrival for two out of the eight patients.

## DISCUSSION

Majority of the subjects were male (81%), married (88%), belonged to Hindu religion (93%), and predominantly from rural areas (65%). About 14% of the patients reported that they had difficulty in arranging money for treatment and transport. The distribution of the background variables were comparable in an Indian study, in which around 66% of the participants were in age group of 46–65 years, majority were male (81%), 97% were married, and 21% reported shortage of money, and 15% of them reported nonavailability of a person to accompany to hospital as a cause for delay.[8]

The median prehospital delay time in this study was 4.8 h, and majority of the patients (59%) came within 6 h of symptom onset. Comparable median (3 h) prehospital delay times were reported by a previous Indian study from Chennai in 2001.[13] However, much lesser median delay times were reported from Korea (2.5 h), Beijing (2.3 h), and Iran (2.6 h).[14-16]

Age has been shown to be a determinant of increased prehospital delay in many studies,[9,17] however, the present study did not show any significant correlation between age and delay. There was no significant difference in prehospital delay between

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### Table 1: Baseline characteristics (n=96)

| Baseline characteristics | n (%)
|--------------------------|------|
| Age (years)              |      |
| <36                      | 3 (3)|
| 36-45                    | 18 (19)|
| 46-55                    | 25 (26)|
| 56-65                    | 36 (37)|
| >65                      | 14 (15)|
| Men                      | 78 (81)|
| Married                  | 84 (88)|
| Education                |      |
| No formal education      | 21 (22)|
| Primary                  | 17 (18)|
| Secondary                | 49 (51)|
| Intermediate/graduate or above | 9 (9)|
| Urban                    | 34 (35)|
| Employed/pensioner       | 83 (87)|
| Diabetes                 | 32 (33)|
| HTN                      | 34 (35)|
| Alcoholism               | 35 (37)|
| Smoking                  | 41 (43)|
| Past history of CAD      | 16 (17)|
| Prior consultation at study center |      |
| No                       | 65 (68)|
| Cardiology department    | 11 (11)|
| Other departments        | 20 (21)|
| ECG location of MI       |      |
| AWMI/AAMI/ASMI           | 47 (49)|
| IWMI/ILMI/IPMI/PWMI      | 49 (52)|

AWMI: Anterior Wall Myocardial Infarction, AAMI: Antero-Lateral Myocardial Infarction, ASMI: Antero-Septal Myocardial Infarction, IWMI: Inferior Wall Myocardial Infarction, ILMI: Inferolateral Myocardial Infarction, IPMI: Inferoposterior Myocardial Infarction, PWMI: Posterior Wall Myocardial Infarction, ECG: Electrocardiography, CAD: Coronary Artery Disease, MI: Myocardial Infarction, HTN: Hypertension.

### Table 2: Description of the time delays

| Variable                        | n  | Median (min) |
|---------------------------------|----|--------------|
| Patients’ decision delay        | 96 | 75           |
| Symptom onset to FMC time       | 96 | 120          |
| Symptom onset to time of arrival at study center (prehospital delay) | 96 | 290          |
| Transportation time to study center | 96 | 60           |
| Door-to-ECG time                | 96 | 12           |
| Door-to-needle time             | 61 | 75           |
| Door-to-primary PCI time        | 8  | 110          |

PCI: Percutaneous Coronary Intervention, ECG: Electrocardiography, FMC: First Medical Contact.
different categories of gender, marital status, educational status, employment status, and education status of accompanying person in this study. Similar results were reported from a study, in which age, gender, and marital status were not found to be related with the prehospital delay time. In contrast to this finding, some other studies have reported that female gender is a determinant of prolonged prehospital delay. In contrast to this, the previous studies have reported that the presence of diabetes was associated with increased delay. There was no significant difference in delay times with respect to the history of hypertension, history of smoking/alcoholism, or history of CAD. However, another study reported that history of MI/CAD was associated with reduced delay. However, the Worcester study has reported that history of MI was associated with prolonged delay.

The correct interpretation of symptoms as heart attack (P = 0.012) and rapid progression of symptoms (P = 0.001) led to a significantly lower prehospital delay. In consistence with this, the previous studies have reported that interpretation of symptoms as cardiac led to a reduced prehospital time.

The median time taken to start thrombolytic therapy was 75 min in this study. Thrombolytic therapy was started within the recommended 30 min for only 13% of the patients. However, an
ACS registry from Kerala reported that about 68% of the patients received thrombolysis within 30 min [Figure 3].[25]

The median time taken to start primary PCI was 110 min. Many studies have reported lower door-to-PCI time.[5,26] An US study has shown improving trends in the door-to-PCI time from 96 min in 2005 to 64 min in 2010.[27] The previous studies have found out several factors associated with delay to start reperfusion therapy, the most prominent of them were higher age, female gender, presence of diabetes, history of CAD, or hypertension.[16,26] However, the present study failed to find out any significant relationship between time to initiate reperfusion therapy and various sociodemographic or clinical variables.

The present study had several limitations. This study sample does not represent the STEMI patients who died before or soon after reaching the study center. Patients who received thrombolysis outside the study center were excluded from the study. Patients who were hemodynamically unstable during the data collection period were also excluded from the study, which might have altered the results. An in-depth interview of the patients regarding the symptom interpretation was not done and thereby missing several cognitive and psychological factors determining the decision delay. Being a single-center study, the results cannot be generalized to the whole population and needs replications by large multicenter MI registries.

CONCLUSIONS

The prehospital delay time among South Indian population is still unacceptably high. Public education, improving the systems of prehospital care, and measures to improve the patient flow and management in ED are essentially required. The time taken to take ECG and to initiate reperfusion therapy in this study points to scope for improvement to meet the AHA recommended timings.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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