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Original Article

Door-to-Needle Time in Myocardial Infarction: Small Steps, Huge Dividends

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ABSTRACT

The Himachal Pradesh acute coronary syndrome registry highlighted a prehospital delay of 780 min. Additional door-to-needle time delay by 1 h increases the hazard ratio of death by 20%. We conducted a retrospective (group 1) and a prospective (group 2) analysis of 63 patients each to measure the impact of a fast-track protocol in the emergency department (ED) on the door-to-needle time in ST-elevation myocardial infarction (STEMI). The fast-track protocol involved zero cost to the hospital and saved 63 precious door-to-needle minutes for patients with STEMI. Thrombolysis in ED can save 33 precious minutes wasted in shifting patients to the coronary care unit.

1. Introduction

The Himachal Pradesh (HP) acute coronary syndrome (ACS) registry revealed an unacceptably high prehospital delay of 780 min.[1] The thrombolysis rate was 35.6%, and percutaneous intervention (PCI) was just 0.6%.[1] When we analyzed the factors responsible for poor thrombolysis rate, we found that prehospital delay in ST-elevation myocardial infarction (STEMI) was unacceptably high and was a contributor. This study was aimed at achieving a standardized effect size of 30 min through our intervention to reduce the door-to-needle time for STEMI.

2. Materials and methods

The project was conducted in Dr. Rajendra Prasad Government Medical College in the Kangra district of HP from May 2017 to April 2018.

2.1. Study Design

This was a nonrandomized controlled intervention trial.

2.2. Objectives

The objective of this study was to evaluate the impact of fast-track protocol for STEMI on the door-to-needle time in our hospital.

2.3. Intervention fast-track protocol

We adopted a three-step process to reduce the door-to-needle time in STEMI.

a. Step 1 – Early decision: Because our hospital did not have PCI facilities, all patients with STEMI were to be thrombolyzed. Electrocardiography (ECG) was performed soon after emergency department (ED) arrival, and the results were read within minutes; if findings were suggestive of STEMI, it was discussed with the senior resident to finalize the decision to thrombolyze. Patients were given loading doses of aspirin and clopidogrel as soon as diagnosis was made.
b. Step 2 – Fast transfer to the coronary care unit (CCU): Owing to lack of thrombolysis setup in the ED, patients need to be shifted to the CCU for thrombolysis. We ensured ready availability of stretchers and wheel chairs for patients with STEMI and an intern to accompany the patient to the CCU.
c. Step 3 – Advance communication to CCU to prepare for thrombolysis: The drug was kept ready for injection upon arrival of the patient. This step included ready stock of thrombolytics in the CCU. This was performed to reduce the time wasted in procurement of thrombolytic agents from the pharmacy shops.

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2.4. Sample size

With an α of 0.05, β of 0.2, equal proportion of subjects in 2 groups, effect size of 30 min, and standard deviation of 46 min, a total sample size of 126 was obtained.

2.5. Control (Group 1)

We analyzed records of the 63 consecutive patients with STEMI thrombolyzed in our hospital before the initiation of the study as the controls.

2.6. Intervention (Group 2)

These were the 63 patients with STEMI who were enrolled prospectively after the implementation of the fast-track protocol in the ED. Data were collected for the time of onset of chest pain, time of presentation at the hospital, time of ECG, time of aspirin administration, time of CCU admission, and time of thrombolysis. The data for patients were collected only after obtaining informed consent from the patients.

2.6. Primary outcome

Door-to-needle time was the primary outcome.

2.7. Secondary outcomes

Door-to-ECG time, door-to-aspirin time, and door-to-CCU time were the secondary outcomes.

2.8. Definitions

STEMI: Universal definition of myocardial infarction (MI) as new ST elevation at the J point in at least 2 contiguous leads of ≥2 mm (0.2 mV) in men or ≥ 1.5 mm (0.15 mV) in women in leads V2–V3 and/or of ≥1 mm (0.1 mV) in other contiguous chest leads or the limb leads.[2]

2.9. Ethics approval

The study was approved by the institutional ethics committee.

2.10. Data analysis

The data were entered into Microsoft Excel (2007) software and analyzed using OpenEpi software, version 3.01.[3] The continuous data were expressed as mean ± standard deviation for parametric data. The categorical variables were expressed as number (proportion). The comparison of distribution of variables among control and intervention groups was carried out using Fisher's exact test for categorical variables t-test for continuous variables. The results were considered significant at a p value of <0.05.

3. Results

Sociodemographic data for 126 patients were analyzed, 63 each in the control and intervention group. A total of 94 (75%) males and 32 (25%) females participated in the study, and the mean age of the patients was 58 ± 12 years. The presenting symptoms of patients with STEMI were chest pain (93.7%), perspiration (74.6%), fainting sensation (29.4%), and breathlessness (18.3%). Twenty-eight patients (22%) had oxygen saturation < 94% at presentation. The baseline variables have been compared between the two groups (Table 1). The distribution of STEMI was anterior wall MI in 52.4%, inferior wall MI in 46%, and posterior wall MI in 1.6%. Atrial fibrillation was present in 3 patients (2%); 5 (4%) had bradycardia (heart rate < 60), and 34 (27%) had tachycardia (heart rate ≥ 100). The median pain-to-hospital time for our patients was 253 min, and the mean was 270 ± 171 min.

Table 1
General characteristics of group 1 and 2.

Variable	Group 1 Retrospective, $n = 63$	Group 2 Prospective, $n = 63$
Age (in years), mean (SD)	55.9 (12.6)	61.8 (12.0)
Female gender (%)	26.9	23.8
Chest pain (%)	93	93.6
Anterior wall MI (%)	61	45
Inferior/posterior wall MI (%)	39	55
Streptokinase (%)	66.8	74.5
Reteplase (%)	31.7	24
Tenecteplase (%)	1.5	1.5

MI, myocardial infarction; SD, standard deviation.

The primary and secondary outcomes were compared between the two groups. Mean ± standard deviation for various time parameters was calculated and is shown in Table 2.

All time parameters showed significant improvement after the implementation of the fast-track protocol in the ED.

4. Discussion

The pain-to-hospital time was similar in both groups, averaging 270 min. This time was much shorter than 780 min reported for the patients with ACS by the HP ACS registry.[1] Because our study included only patients with STEMI and the HP ACS registry had 54.5% patients with non-STEMI, it is possible that patients with STEMI have more severe symptoms and thus present to the hospital early compared with the patients with unstable angina and non-STEMI. This can explain the huge difference of 510 min in the pain-to-hospital time between patients with and without STEMI.

The retrospective analysis of data for group 1 patients showed significant in-hospital delays in getting ECG, treatment decision, aspirin administration, shifting to CCU, and finally thrombolysis (Table 2). Delays added up to a mean door-to-needle time of 118 ± 71 min and median ± interquartile range (IQR) door-to-needle time of 91 ± 66 min. The internationally recommended door-to-needle time is now <20 min as per the European Society of Cardiology that includes 10 min for door-to-ECG time and 10 min for diagnosis-to-thrombolysis time.[4] In our study, not even a single patient achieved door-to-needle time of 20 min.

The door-to-ECG time was 13.8 min in the intervention group which was 5.7 min shorter than that in the control group. Quick treatment decision was made, and door-to-aspirin time was 21 min compared with 64 min in the control group. However, we achieved the international standards for the treatment decision, yet the door-to-needle time was 55 min in group 2 and 118 min in group 1.

Table 2
Various time parameters (in minutes) in group 1 and 2.

Time parameters	Study group	n	Mean	Std. deviation	P value (t test)
Pain-to-hospital	1	63	268.83	176.653	0.906
	2	63	272.44	167.807	
Door-to-ECG	1	63	19.52	17.049	0.015
	2	63	13.83	6.862	
Door-to-aspirin	1	43	64.16	41.046	0.000
	2	53	21.08	11.871	
Door-to-needle	1	63	118.32	71.578	0.000
	2	63	55.65	11.785	

ECG, electrocardiography.

Similar delays have been reported by a hospital in Cape Town, where door-to-ECG time was 13 min and door-to-needle time was 54 min.[6] Another Indian study showed a prehospital delay of 290 min, door-to-ECG time of 12 min, and door-to-needle time of 72 min[7]

The most important factor for delay was the time taken to shift the patient to the CCU for thrombolysis which was 46 and 30 min for group 1 and 2, respectively. The lack of facilities to thrombolyze patients in the ED is a universal issue in hospitals in this region. In absence of the academic departments of emergency medicine, the EDs are being run by MBBS doctors who are not confident in thrombolysis. The patients are shifted to the CCU for thrombolysis, which increases the door-to-needle time in our patients.

Group 1 wasted significant time in the CCU for thrombolysis because there was no advance communication from the ED and thrombolytics were not stocked in the CCU. Drugs had to be purchased by the patients from pharmacy. Our major achievement was the reduction in the CCU-to-thrombolysis time by 43 min by simply providing advance information to CCU nurses and ensuring ready stock of thrombolytics in the CCU. In group 2, the nurses had advance information and thus gave preference to start thrombolysis over the paper-based registration process. This is why the mean door-to-needle time was 1 min shorter than door-to-CCU time in group 2.

Still, there are major challenges to bring down the door-to-needle time to 20 min in Indian hospitals. Hospitals need to have facilities for thrombolysis in the ED itself. The choice of the thrombolytic agent is also an important consideration because still more than two-thirds of our patients received streptokinase (Table 1). Streptokinase infusion takes 30 min with constant supervision and monitoring of the blood pressure. Cost of thrombolytics is a major factor in India. Streptokinase is not a preferred agent for thrombolysis, but it is cheap and affordable for most poor patients. Tenecteplase can be safely used even in prehospital settings, but it is out of reach for most patients, and just 1 patient in each group received it. Reteplase is equally good as tenecteplase and much cheaper and was received by one-third of our study population. Now, there is even a provision of Rs. 8000 to the hospitals under Ayushman Bharat scheme for thrombolysis of below-poverty-line patients with STEMI. All hospitals therefore can achieve the door-to-needle times of 20 min if they adopt our fast-track protocol and ensure availability of reteplase in their EDs.

Some EDs have a chest pain unit (CPU) to take care of all patients with chest pain. A CPU can be physically placed in the ED with dedicated staff, equipment, and beds, or it can be a virtual CPU that comes into action when a patient with chest pain arrives and allocates resources in preference over other emergencies. A CPU is a good concept to institute the protocols for diagnosis and management of chest pain and MI.

Because STEMI has a high morbidity and mortality, it should be given utmost importance by the hospital administrators while allocating resources for CPUs. Delaying door-to-needle time by 1 h increases the hazard ratio of death by 20%, and a delay of 30 min can reduce the life expectancy by 1 year.[5] In our study, simple measures such as keeping a ready stock of thrombolytics and advance direction to CCU nurses reduced the door-to-needle time by almost an hour for our patients.

5. Conclusion

Long in-hospital delays show quality of service of a hospital. The hospital administrators need to look into this critical area where simple changes in the processes and establishment of a CPU can give huge dividends for the patient health. We have shown through a quality improvement process that up to 1 h of in-hospital delay in STEMI treatment is reduced with no additional cost to the hospital.

Source of support

None.

Conflict of Interest

All authors have none to declare.

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