Original Article

Evaluation of Door-To-Balloon Time for Performing Primary Percutaneous Coronary Intervention in ST-Segment Elevation Myocardial Infarction Patients Transferred by Pre-Hospital Emergency System in Tehran

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Abstract

Background: The suggested treatment for patients with ST-segment elevation is the Primary Percutaneous Coronary Intervention (PPCI) for coronary reperfusion. This study aimed to evaluate the contribution of pre-hospital and hospital emergency systems in the interval time for PPCI among patients with the ST-segment elevation myocardial infarction (STEMI) in selected hospitals of Tehran city. **Materials and Methods:** This cross-sectional study was carried out on patients with typical chest pain transferred to the emergency wards of three large general hospitals in Tehran city by Emergency Medical Services. They received the PPCI. The information about admission time to the triage, time of conducting electrocardiography (ECG), diagnosis time of STEMI, and time of the PPCI were recorded and analyzed using descriptive and inferential statistics. **Results:** In this study, 121 patients were evaluated, and of which 94 (77.68%) were men and 27 (22.32%) were women. The average time (SD) of patient admission in the triage until to receive the PPCI (door-to-balloon) was 104.60 (62.30) min. **Conclusions:** The door-to-balloon time was 104.60 min. If ECG is taken by pre-hospital emergency nursing staff and diagnosis of STEMI is performed by the pre-hospital emergency service, and the patient is delivered directly to the angiography department, the door-to-balloon time is significantly reduced.

Keywords: *Door-to-balloon, emergency care information systems, percutaneous coronary intervention, ST-segment elevation myocardial infarction*

Introduction

Myocardial infarction (MI) is responsible for 29.6% of the whole mortality rate across the world and corresponds to 16 million deaths. It accounted for 20% of death cases in Europe in 2014.[1] It led to >385,000 deaths (23%) in the USA in 2013.[2] Moreover, the Iran's Ministry of Health released statistics in recent years showed that the percentage of deaths due to cardiovascular diseases, especially MI increased significantly,[3] that is the reason for 46% of all mortalities in Iran.[4]

Myocardial infarction with ST-segment elevation (STEMI) is named as acute STEMI. It occurs due to the complete blockage of the coronary artery by a blood clot.[5] Remission depends on the time interval between the onset of symptoms and treatment.[3,6] Therefore, reduction of this time interval diminishes the mortality rate by 50%, and any delay in the treatment process significantly decreases its benefits.[3] The strategy of ischemia time reduction includes an attempt to decrease time delay from the patient's decision time to call for the pre-hospital emergency system for pre-hospital transmission and delivery of care at the hospital.[7] Any delay in pre-hospital emergency proceedings can increase cardiac complications and significantly decrease the patient's survival rate, and even worsen the disease prognosis. Reperfusion of blood to occluded vessels is an urgent intervention, by which angioplasty is taken for <120 min from the beginning symptoms for patients with acute MI.[6,8] Transmission and pre-hospital emergency care, in accordance with the guidance suggested by the American Heart Association (2015), is recommended for patients with acute MI.[9] The patient's waiting time to receive therapeutic services during admission to the emergency ward is an important index of care quality.[10]

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Long-term delays in the emergency department can hinder appropriate attention to patients' needs in the emergency department, lead to dissatisfaction with care, and an increase in the mortality rate.[11]

The major cause of the patients' delay in the hospital is associated with the patient's decision-making to call for help, the time from the patient's transmission to the hospital, and the time spent to diagnose the disease and start thrombolytic therapy.[12] Nurses at the emergency department and angiography ward play a key role in shortening the door-to-balloon time interval. Performance nurses' expertise and performance for making a decision and conducting interventions can shorten the time interval for invasive treatments and can improve the outcome of treatment of patients with STEMI. Also, the periodic evaluation of nurses' performance in the emergency department is helpful.[3,12]

In recent years, pharmaceutical methods for the treatment of acute MI have been replaced by invasive procedures, that can significantly decrease the mortality rate.[13] The recommended treatment for patients with acute STEMI is the primary percutaneous coronary intervention (PPCI) to re-establish blood flow in occluded vessels.[14] In comparison with thrombolytic therapy, the PPCI is associated with a lower mortality rate, re-infarction, stroke, and intracranial bleeding.[15] Although angioplasty could be more costly than thrombolytic therapy, it is more effective due to the number of patients that need medical intervention after thrombolytic therapy, long-time hospitalization in thrombolytic-therapy, and a high frequency of heart failure.[16] If the PPCI can be performed, there is no medical indication for thrombolytic therapy.[17] Given the importance of time for the treatment of acute MI, this study was conducted to evaluate the contribution of pre-hospital and hospital emergency systems in the interval time for PPCI among patients with STEMI in selected hospitals of Tehran city.

Materials and Methods

This cross-sectional study was conducted in Tehran city. There were five hospitals with the emergency department systems to transfer patients with STEMI for emergency PPCI, and of which two hospitals were unwilling to participate in the research. Accordingly, patients with chest pain that transferred by the emergency medical system to three hospitals and received PPCI were selected. This study was conducted from October 2015 to July 2016, and all patients were recruited using the census sampling. In total, 775 patients were eligible to enter the study based on inclusion and exclusion criteria, and of which 121 patients were selected. Inclusion criteria were as follows: being transferred by the emergency service to the emergency department of the hospital and undergoing the PPCI. Exclusion criteria were as follows: patients with acute MI transferred by private ambulances, family, and taxi; patients hospitalized with noncardiac diagnosis, suffering from a heart attack in the hospital, and transfer from other cities or provinces of the country.

To record of time intervals, the researcher referred to the Central Emergency Pre-hospital services in Tehran city. The GPS system and Tehran Emergency Communication Center were used to collect data regarding the time intervals. To validate data collection, a pilot study was conducted with 25 patients and the correlation between recorded time intervals by emergency department nurses, angiography unit, and the researcher via digital and manual methods was measured.

For data collection, the demographic data form and time recording sheet were used. Their validity was assessed by a panel of experts on available recorded time intervals in the patients' medical records including from arrival to the emergency ward triage to assess vital signs, from arrival to the emergency ward triage to take electrocardiogram (ECG time), from taking the ECG to diagnose the STEMI, from diagnosis of acute STEMI elevation to enter the angiography unit, and from the time of entrance to the angiography unit until performing initial angioplasty.

After obtaining permissions to enter the hospitals, the researcher accessed the archive of medical records. Data of patients undergoing PPCI and were transferred by the Tehran pre-hospital emergency system were collected for data analysis. The time intervals to enter the triage ward, take ECG, arrive to admission and the angiography unit, and undergo the PPCI were simultaneously recorded by nurses' using digital and manual methods. Data were analyzed using the SPSS software version 21 (copyright IBM Corporation and its licensors 1989–2016). The analysis of variance (ANOVA) and independent *t*-tests were used to compare mean scores.

Ethical considerations

This study was approved in the Ethics Committee affiliated with Qazvin University of Medical Sciences, Qazvin, Iran (decree code: IR.QUMS.REC.1395.106). The permission to enter the research zone was obtained and the hospital authorities were informed of the study aim, and method. They were ensured of confidentiality of data in the study process.

Results

This study was carried out on 121 patients. Also, 94 patients were male (77.68%) and 27 patients were female (22.32%). The patients' age range was 31–100 years with a mean (SD) of 58.36 (12.09) years. The mean (SD) time interval to reach triage and assess vital signs was 5.10 (4.57) min. The mean (SD) time to reach triage and take the ECG was 16.33 (15.43) min. Moreover, the mean (SD) time to take the ECG until the diagnosis of the STEMI was 12.14 (17.27 min) [Table 1]. The mean (SD) time to enter the angiography ward was 48.37 (49.36)

min. The door-to-balloon time encompassed 72% of time interval to PPCI. The highest proportion of the total time to the initial angioplasty was the time interval between the STEMI diagnosis and arrival to the angiography ward. The time interval to take ECG to STEMI diagnosis encompassed 8% of interval time to primary angioplasty [Figure 1]. Additionally, the mean (SD) time required from arrival to perform PPCI was 27.98 (17.88) min. Finally, the mean (SD) time for patient admission to triage until perform the primacy PCI (door-to-balloon) was 104.6 (62.37) min [Figure 2]. According to the ANOVA test, no statistically significant difference was reported in the door-to-balloon time interval between the hospitals ($P > 0.05$).

Discussion

One of the main issues in the management of STEMI is the time delay for blood flow reperfusion. The benefit of blood flow reperfusion occurs within the first 2–3 h after the onset of symptoms.[15] This study showed that ECG should be taken in <10 min at the emergency department. It is performed along with general examinations, assessment of the patient's vital signs, and risk of the disease as the main standards for making decisions to start reperfusion, and is called "door-to-ECG time."[18] In this study, average time interval to reach triage until take ECG (ECG time) was 16.33 (15.44) min. Facilities such as an equipped laboratory, professional staff, and operators in the hospital are required for performing the PPCI in ≤90 min, which is called the "door-to-balloon" time interval.[15,18]

Joshua *et al*. (2014) in a study entitled "using of pre-hospital emergency system in accelerating STEMI patient's care undergoing primary angioplasty interventions' showed that the door-to-balloon interval was reduced in the patients transferred by the pre-hospital emergency system. The time interval of door to take ECG and the time interval of ECG to call the doctor were less in patients transferred by the pre-hospital emergency system,[19] which was consistent with the result of this study.

Albert *et al*. (2012), in an analytical study investigated patients with acute STEMI. Accordingly, those patients who were transferred by the pre-hospital emergency system received angioplasty in <120 min,[20] which was consistent with the findings of the present study in terms of door-to-balloon time. Hosseinian *et al*. (2012) in Tehran city investigated the workflow of patients in the emergency department and reported that the time interval to enter emergency services was desirable in comparison with universal standards.[12] The average time interval between the triage to visit the doctor was reported as 22 min. In the study of Kassaian *et al*. (2015), in Tehran city, it was reported as 30 min.[21] Moreover, the time interval between

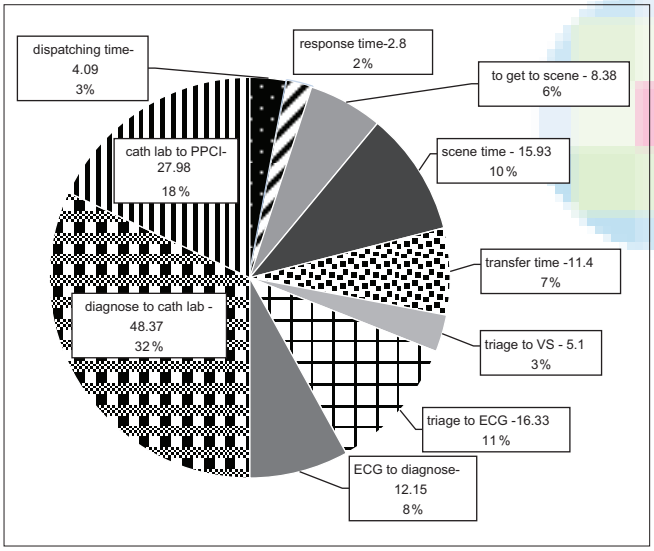

Figure 1: Share of the various time intervals in the primary percutaneous coronary intervention (PPCI)

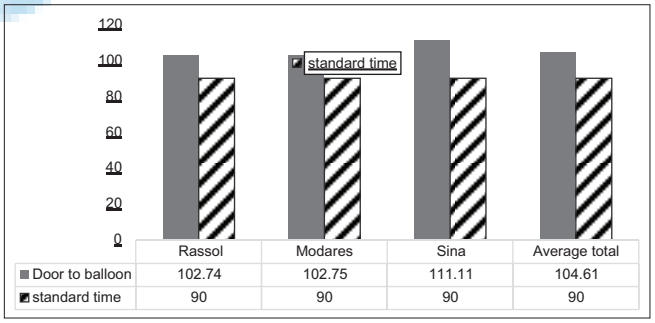

Figure 2: Comparison of the door-to-balloon time with the standard time 90 min in the three hospitals

Table 1: Comparison of the means of time intervals and door-to-balloon time in the three hospitals

Hospitals	Hazrat Rassol	Modares	Sina	Total	*p* (ANOVA)
Time intervals	Mean (SD)				
Triage to vital sign	4.73 (3.88)	4.31 (4.23)	6.62 (5.73)	5.09 (4.44)	0.12
Triage to ECG	14.64 (14.88)	16.81 (20.44)	20.92 (13.13)	16.33 (15.43)	0.18
ECG to diagnosis STEMI	10.87 (12.70)	14.25 (27.36)	14.59 (21.30)	14.12 (17.27)	0.55
From diagnosis to laboratory	47.32 (54.26)	47.25 (48.99)	52.07 (33.57)	48.37 (49.36)	0.90
From laboratory until PPCI	30.42 (17.06)	22.43 (22.85)	23.03 (16.17)	27.98 (17.88)	0.12
Door-to-balloon time	102.74 (65.11)	102.75 (66.18)	111.11 (53.09)	104.61 (62.37)	0.83

SD: standard deviation; ANOVA: analysis of variance; ECG: electrocardiography; STEMI: ST-segment elevation myocardial infarction; PPCI: primary percutaneous coronary intervention

visit by the doctor to leave the emergency ward was reported as 51 min.[22] These results were not consistent with those of the present study as the time interval for leaving the emergency ward was 76 min. A failure to record various time intervals for some patients could be a limitation of this study.

Conclusion

In this study, patients received PPCI in 147.07 min from the onset of symptoms. Designing the STEMI code and calling the central operator at hospitals to activate the STEMI code are suggested. Also, accelerating the provision of primary care by the pre-hospital emergency service and equipping them by ECG devices, monitors, and defibrillators can reduce the overall ischemic time and mortality rate. If the STEMI is detected on the scene using ECG taken on the patient's bedside, the pre-hospital emergency nursing team can provide appropriate care and take the patient straight to the angiography unit. Therefore, the whole time process of performing the initial angioplasty is saved. Hospitals' managers and healthcare centers should consider strategies for reducing the waiting time for patients with the consideration of staff, equipment, space, geographical location, and service delivery processes. Also, given the importance of time for performing primary angioplasty, the speed of nurses' performance for making a decision and diagnosis should be improved. More studies are needed to improve the quality of healthcare services delivered at the emergency situations to patients with STMI.

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Conflicts of interest

Nothing to declare.

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