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Evaluation of Barriers of Achieving Timely Primary Percutaneous Coronary Intervention in Patients with ST-elevation Myocardial Infarction in Sulaimani Cardiac Hospital

Hawkar Rashid Taha* Hussein Murad Muhamad Amar Talib Al-Hamdi*****

Abstract

Background and objectives: An estimated increase in risk of death exists for patients with ST-elevation myocardial infarction. Primary percutaneous coronary intervention may lower this risk if only performed on time. The aim of this study is to evaluate the barriers to achieving timely primary percutaneous coronary intervention.

Methods: This is an observational/cross-sectional study conducted in Sulaimani city, Kurdistan Region of Iraq, from February 1, 2024, to January 31, 2025, on 200 patients with ST elevation myocardial infarction, assessment of time intervals from symptom onset to balloon, and the factors contributing to delay of primary percutaneous coronary intervention included in the questionnaire.

Results: Most of the patients (80.1%) were male; the mean age was 60.69 ± 12.16 years. 132 patients, 69.1%, had a timely door to balloon time (≤ 60 minutes). The median door-to-balloon time was 50 minutes (IQR 25-75: 10-10200 minutes). Median total ischemic time was 380 minutes (IQR 25-75: 60-2950 minutes). 19 (10%) had timely total ischemic time (≤ 120 minutes). statistically significant correlation with gender, door in to door out time, symptom to door time, and door to balloon time (P = 0.016, <0.001). Barriers that significantly prolong total ischemic time were patient delay, non-percutaneous coronary intervention-capable center delay, delay during transfer to the PCI center (P <0.001), and delay team activation.

Conclusion: Timely reperfusion is the mainstay of acute STEMI management. This study discovered that the main barriers of timely primary percutaneous coronary intervention are a patient's delay to present to the hospital, longer duration of remaining in non-PCI facility hospital, and delaying during transferring to PCI-capable center. Focusing on patients' education and alertness programs for acute chest pain are essential for enhancing total ischemic time.

Keywords: Primary percutaneous coronary intervention, ST elevation myocardial infarction, Total ischemic time

*MBChB, FIBMS, KHCMS- Department of Cardiology, Sulaimani Cardiac Hospital, Sulaimani, Kurdistan Region, Iraq. Corresponding author. Email: hawkarmed@gmail.com
**MBChB, FIBMS, Interventional Cardiologist, Sulaimani, Cardiac Hospital, Sulaimani, Kurdistan Region, Iraq. Email: HusseinM@yahoo.com
***MBChB, MRCP (UK), Professor of Medicine/Cardiology, Senior Consultant Cardiolo-gist/Electrophysiologist, College of Medicine, University of Sulaimani, Kurdistan Region, Iraq.Email: amaralhamdi@yahoo.com

Introduction

In developed countries, ST-segment elevation myocardial infarction (STEMI) is still a serious public health concern despite advances in diagnosis and treatment; there are racial inequities, and the prevalence increase dramatically with age in both men and women. It is also growing more common in developing countries.[1] Patients should start reperfusion therapy as soon as feasible if they have an ST-segment elevation and a clinical suspicion of myocardial ischemia.[2] The main objectives of treatment for acute myocardial infarction are to minimize remodeling that may occur and limit myocardial damage by restoring myocardial blood flow as soon as possible. This remodeling may have negative effects on ventricular function and prognosis.[3] Activating the catheterization laboratory as soon as a STEMI diagnosis is made in the prehospital scenario can reduce patient mortality and treatment delays.[4-7] Primary percutaneous coronary intervention (PCI) is also preferable to fibrinolysis since it has been shown to reduce mortality, stroke, and reinfarction rates in locations where PCI procedures are often performed.[8] Cardiologists now see the door to balloon time-the ER's arrival time to the ballooning time-as the most crucial quality metric for initial PCI.[9] The management recommendation of STEMI include a requirement for reducing the duration of door to balloon (DTB), with an ideal of no more than sixty minutes.[10] That being said, other delays in the timing of STEMI, like the interval between the start of chest discomfort and hospital arrival capable of performing PCI, received less attention.[11] Given that an increase in the area of microvascular blockage is connected with longer ischemia, the total ischemic time (TIT), which measures the duration from the onset of chest pain to ballooning or device activation, may be a more potent prognostic indicator than the DTB time.[12] In individuals with STEMI, TIT was found to be an independent predictor of infarct size and both short-and long-term mortality.[13] The patients (patient-correlated delays) interpret the time from symptoms to first medical contact (FMC), whereas the system (system-correlated delays) interprets the time from diagnosis to reperfusion therapy. These are the two main causes of delays from the beginning of symptoms to the primary PCI process.[14] This study was conducted to evaluate the barriers to achieving timely primary PCI in patients with STEMI.

Patients and methods

This is an observational/cross-sectional study conducted in Sulaimani city, Kurdistan Region of Iraq, the 200 patients who were admitted from Sulaimani Cardiac Hospital (SCH) between January 1, 2024, and November 10, 2024, and who had been diagnosed with STEMI lasting less than 12 hours, came into the study, additionally to those who arrived later and continued to have ongoing ischemia, and a minimum of two neighboring ECG leads with ST-segment elevation more than 2.5 mm in men below 40 years, more than 2 mm in men above 40 years, or greater than 1.5 mm in women in leads V 2, V 3 and/or greater than 1 mm in the other leads. After bedside transthoracic echocardiography and first treatment with loading doses of dual antiplatelet therapy (DAPT), parenteral anticoagulation, and analgesics, for primary PCI, the catheterization laboratory was activated right away. Every patient had their data recorded; informed consent was obtained prior to enrollment, explaining the goal and potential benefits of the research; patients who had taken thrombolytic and STEMI equivalents were not included. The characteristics that were examined included age, sex, hypertension, diabetes mellitus, smoking, family history of CAD, culprit vessels, primary PCI results, time duration from onset of symptoms to balloon, causes of delays, and

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ejection fraction. The amount of the time (measured in minutes) between the onset of chest discomfort and the cath lab visit was known as the Total Ischemic Time (TIT), which was calculated when the patient arrived at the hospital. The time (in minutes) from arrival to discharge at the first hospital to transfer from that hospital to the percutaneous coronary intervention hospital was calculated as the door-in to door-out (DIDO) time. The estimated door-to-balloon (DTB) time was the amount of time (measured in minutes) that passed between the coronary interventional hospital upon arrival and the Cath lab. The study was approved by the Kurdistan Higher Council of Medical Specialties research protocol ethics committee (No. 1610 on 3rd of July 2024). An Excel spreadsheet was used for data entry, and the IBM SPSS Statistical Package for the Social Sciences, version 26.0, was used to complete the statistical analysis. The categorical data between these two groups of patients was compared using chi square testing with respect to several research variables. Standard deviation and mean were used to express quantitative continuous variables. To compare the means of the two groups, independent tests were used. In addition to mean and SD, the non-normally distributed quantitative variable that serves as the entrance to balloon time was also characterized by median and mean rank. For comparison, a one-way ANOVA test was employed in addition to the t-test. The cut-off point for statistical test significance was set at p values of 0.05.

Results

A total of 200 patients, including nine patients, didn't undergo angiography within 24 hours because of patients' refusal and financial cause in 8 of them, and one patient passed away before PCI. Finally, 191 patients were selected; the mean age was 60.69 years [standard deviation (SD): 12.16], 153 (80.1%) male and 38 (19.9%) female. Of all, 186 (97.4%) were Kurdish and 5 (2.6%) were Arabic nation, 114 (59.7%) were hypertensive, 75 (39.3%) were diabetic, 61 (31.9%) were smokers, eleven (5.8%) had family history of CAD, and 2 (1%) had renal impairment. The median of DTB was 50 (1200–10) min, DIDO was 60 (1080–60) min, and STD was 180 (2800–10) min. Prolonged TIT was found to be correlated with gender (0.016), STB, DIDO, and DTB (< 0.001), Table (1).

Table (1): Baseline demographic and clinical traits categorized according to the overall ischemia duration.

Characteristic	Total (N=191)	Total ischemic time			p-value
		≤120 minutes (n=19) 9.90%	120-240 minutes (n=31) 16.23%	>240 minutes (n=141) 73.82%	
Mean age, years	60.69 ± 12.16	60 ± 11.28	56.83 ± 11.32	61.60 ± 12.35	0.727
Male	153 (80.1%)	18 (11.46%)	29 (18.47%)	107 (68.15%)	0.016*
Female	38 (19.9%)	1 (2.32%)	2 (4.65%)	36 (83.72%)	
HTN	114 (59.7%)	8 (9.85%)	20 (16.06%)	86 (74.09%)	0.242
DM	75 (39.3%)	6 (8%)	11 (14.66%)	58 (77.33%)	0.649
Smoker	61 (31.9%)	4 (6.55%)	13 (21.31%)	44 (72.13%)	0.287
Family history of IHD	11 (5.8%)	1 (9.09%)	2 (18.18%)	8 (72.72%)	0.981
Renal Impaired	2 (1%)	0	0	2 (100%)	0.699

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Previous CAD	35 (18.5%)	4 (11.42%)	6 (17.14%)	25 (71.42%)	0.928
Mean ejection fraction	51.44 ± 8.60	49.42 ± 10.07	51.77 ± 7.76	51.63 ± 8.59	0.560
Symptom to hospital arrival time (min) median	180[2800-10]	30[90-15]	60[210-20]	300[2800-10]	<0.001*
Door-in to door-out time (min) median	60[1080-10]	15[20-15]	30[90-10]	60[1080-15]	<0.001*
Door to balloon time (min) median	50[1200-10]	40[90-15]	40[120-15]	60[1200-10]	<0.001*

- IQR interquartile range- significant at 5%.

Patients are subdivided into two major groups: group A, those that presented to PCI-capable centers, seventy-three (38.21%), and group B, those that presented to non-PCI-capable hospitals, 118 (61.8%), which were away from PCI-centers and had a large effect on delaying timely PCI, which prolonged TIT in correlation with address and residency (p = 0.037, <0.001, respectively) and was statistically significant, Figures (1) and (2).

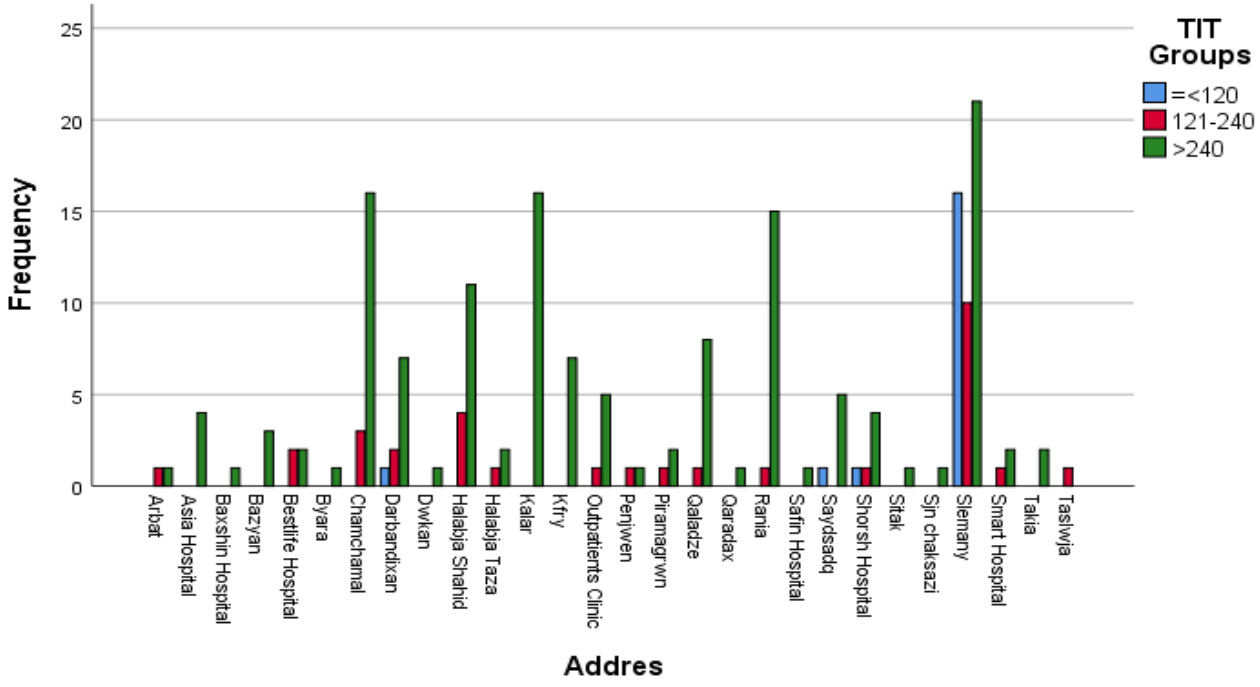

Figure (1): Correlation of patients' location with total ischemic time.

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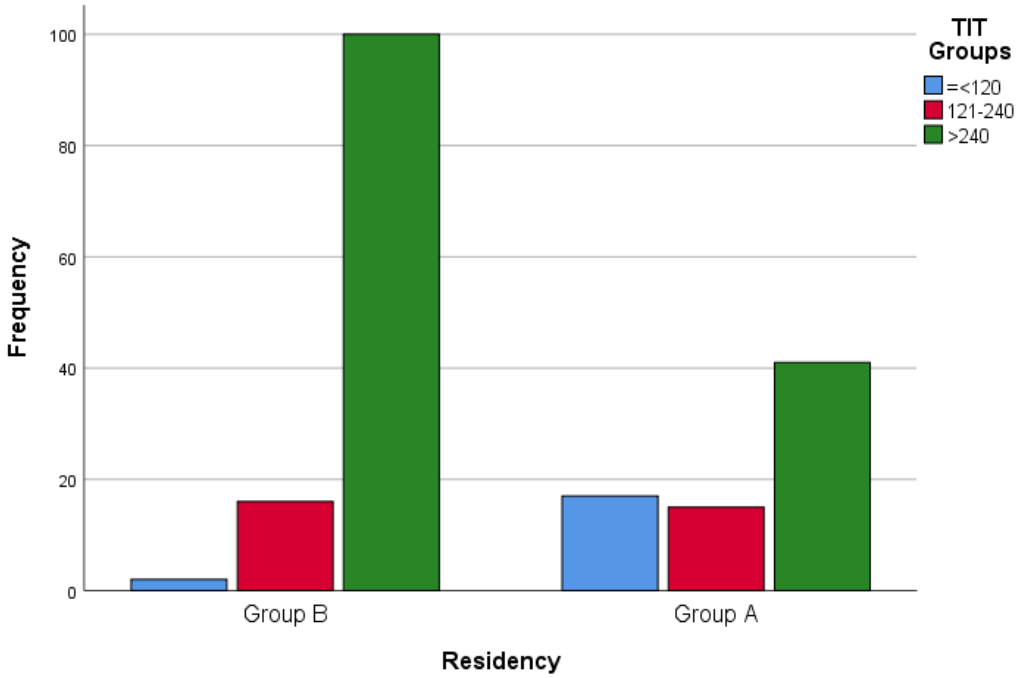

Figure (2): Correlation of patients' residency with total ischemic time.

Almost all patients presented with anterior STEMI 99 (51.8%), inferior STEMI 90 (47.12%), and lateral STEMI 2 (1%). Culprit vessels were LAD 90 (47.1%), RCA 57 (29.8%), LCX 18 (9.4%), LMS 1 (0.5%), three vessel diseases 15 (7.9%), and non-significant lesions were 10 (5.2%). Of all, 166 (86.8%) received stents, 10 (5.2%) for optimal medical therapy, and 15 (7.9%) were sent for CABG surgery, Figure (3).

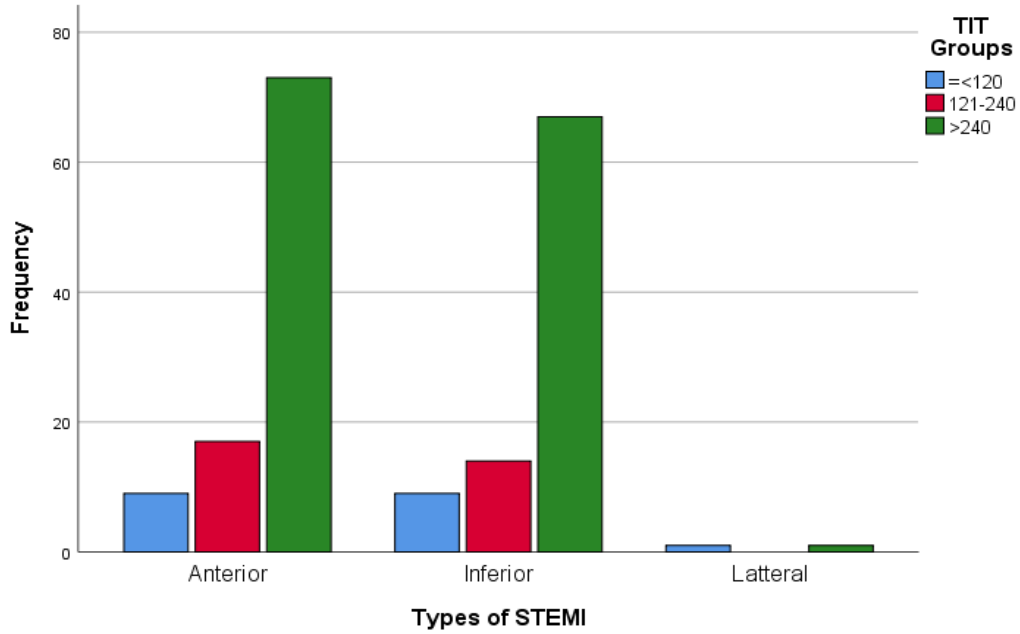

Figure (3): Types of STEMI in relation with total ischemic time.

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Among factors belong time delay PCI divided to patient delay and system delay that most prevalent factor is patient delay 167 (87.4 %), then delay in non-PCI hospital (DIDO) 99 (51.8 %), delay during transferring to PCI capable hospital 99 (51.8 %), PCI decision delay 45 (23.6 %), delay due to off-time presentation 23 (12%), PCI team delaying 22 (11.5 %) , atypical presentation 6 (3.1 %), consent delay 4 (2.1 %) , cardiogenic shock 2 (1%), borderline ECG 2 (1%), financial delay 1 (0.5%), prolongation of TIT was statistically significant in relation with patient delay, non-PCI hospital delay and delay during transfer (p = <0.001) and delay due to PCI decision (p = 0.003), Table (2).

Table (2): Barriers of timely PPCI in relation to total ischemic time

Barriers of timely PPCI	Total (N=191)	Total ischemic time			p-value
		≤120 minutes (n=19) 9.90%	120-240 minutes (n=31) 16.23%	>240 minutes (n=141) 73.82%	
Patients delay	167(87.4%)	10 (16.7%)	25 (41.25%)	132 (79.04%)	<0.001*
Non-PCI hospital delay	99 (51.8%)	1 (1.01%)	6 (6.01%)	92 (92.92%)	<0.001*
Transfer delay	99 (51.8%)	3 (3.03%)	12 (12.12%)	84 (84.84%)	<0.001*
PCI hospital delay	45 (23.6%)	1 (2.22%)	2 (4.44%)	42 (93.33%)	0.003 *
Off-time presentation**	23 (12%)	1 (4.34%)	1 (4.34%)	21 (91.30%)	0.124
Team delay	22 (11.5%)	1 (4.54%)	1 (4.54%)	20 (90.90%)	0.149
Atypical presentation	6 (3.1%)	0	0	6 (100%)	0.333
Consent delay	4 (2.1%)	0	0	4 (100%)	0.485
Cardiogenic shock	2 (1%)	0	0	2 (100%)	0.699
Borderline ECG	2 (1%)	0	0	2 (100%)	0.699
Financial delay	1 (0.5%)	0	0	1(100%)	0.837

*Significant at 5%.

**Defined as showing up at a hospital any time on the weekends and before 8 am or after 2 pm on weekdays.

Discussion

Our goal in this study, was to evaluate the obstacles to completing primary PCI. We discovered that patients' inattention and length of time taken by patients in discovering symptoms were key contributors to prolonging TIT, with a median STD of 180 min (p = <0.001), like in an Indian study conducted by Doddipalli et al. where the primary cause of the delay was the patients' inability to recognize the symptoms; the median was 150 min. [15] Since the majority of study participants in this study (61.8%) were from rural Sulaimani, the primary reason for this delay was a lack of awareness among rural inhabitants regarding the signs of ischemia. The longest median reperfusion time is thought to be the symptom-to-door time which is followed by DIDO timings, median 180 minutes (interquartile range:10-2800 min) and median 60 minutes (interquartile range: 10-1080 min), respectively, as in the Canadian study by Shi et al. The median DIDO time was 55 minutes (interquartile range: 35–112 min), and symptom-to-door time was ≥60 minutes in 69% of patients.[16] Total ischemic time delay was more prevalent among women than men (p-value 0.016), while DTB time delay was not significant; however, one fifth of our patients were female. This is partially explained by unusual symptoms, longer decision-making process, and hesitation to visit the hospital are factors associated with longer delays in women. Consistent with Emami M et al. and Babiolakis et al.

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Future research is required to attempt and clarify and minimize sex-based frontline therapy delays for female STEMI patients as evidenced by Babiolakis et al study that found longer DTB times and STB times in female patients presenting with STEMI and transferred to PPCI as compared to male patients.[17,18] Compared to Hameed et al. study in which over 25% of Canadians do not reside within an hour's drive of a hospital of PCI facility, and they frequently need to be referred to a hospital that have PCI capability.[19] And Park et al. showed 50.9% of the patients were referred from hospital of non-PCI capability. Our study included more than half (61.8%) of the STEMI patients were referred from other hospitals and were not near PCI-capable centers.[20] Chandrasekhar et al. a study conducted in the Australian population revealed that more than one third, or 305 patients out of total 893 (34.2%) of the STEMI patients had TIT (>240 min). [21] Our study reported prolonged TIT (>240 min) was nearly three quartiles 141 patients out of total 191 (73.82%) of the STEMI patients. The median time from door-in to door-out was 60 min (10-1080 min). 23.6% had timely DIDO (≤30 min) and had a positive correlation with overall ischemia time ($p < 0.001$) compared to Dakota et al. whose median DIDO time was 180 minutes (120-252 minutes) who's positively correlated with overall ischemia time ($p < 0.001$). [22] Sixty-nine percent of the participants (69.1%) reached the DTB time cut off ≤ 60 minutes, with a median door to balloon time of 50 minutes compared to Zamani et al whose median DTB time was 70 minutes and (71%) had on time (DTB time ≤90 min), and Li et al a study showed an overview of the delay of DTB time in Asia that the majority of Asian nations lack national quality improvement institutions to surpass guidelines in their practices and reduce variation across hospitals; only Taiwan, Singapore, and Israel had a DTB median time of fewer than 90 minutes, but no nation met the USA's requirement that 90% of DTB times be less than 90 minutes.[23,24] The presentation of patients to a hospital with PCI capacity at any time on weekends or public holidays, and before 8 am or after 2 pm on weekdays, was deemed to be an important factor contributing to the extension of DTB time (P-value 0.041), as demonstrated by the Ikemura et al. 64.9% of arrivals occurred outside of regular business hours at any time on weekends or public holidays and on weekdays, between 6 pm to 8 am ($p < 0.001$).[25]

Limitations of the study

The trial was conducted at a single center and was not randomized. Furthermore, we were unable to completely minimize the impact of recall bias because the time when the chest discomfort first appeared was recorded according to what the patient or attendant remembers.

Conclusions

The mainstay of management in patient with acute STEMI is reperfusion in a timely manner, and our research detected that most barriers to timely primary PCI were patient delay, non-PCI-capable hospital delay, delay during transfer to the PCI center, and off-hour arrival. Focus on patient's education and alertness program for acute chest pain, and modifiable factors such as time remaining in a non-PCI facility hospital, the emergency medical service (EMS), and off-hour performance of PCI play a pivotal role in improving TIT.

Conflict of interest

There were no conflicts of interest.

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