

Angiographic Evaluation of TIMI 3 Flow (Normal Flow) in STEMI Patients Undergoing Primary PCI at Tertiary Cardiac Care Centre

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ABSTRACT

Objective: To determine the frequency of TIMI 3 flow rates in ST segment elevation myocardial infarction patients undergoing Primary PCI.

Methods: This cross sectional study was conducted in the Department of Cardiology, National Institute of Cardiovascular Diseases (NICVD) at Karachi during April 2014 to October 2014 by using convenience sampling technique. This study includes 169 study subjects of either gender having age between 35-75 years, presented with chest pain were included. Patients were moved to Cath lab where primary PCI was done to accomplish TIMI flow grade 3 and the descriptive data was calculated and statistically analyzed.

Results: There were 127 (75.14%) male and 42 (24.86%) female patients with mean age group 57.31 ± 10.58 . Among all, 9.5% patients had symptoms since 60 minutes, 14.2% since 90 minutes, 32.0% since 120 minutes, and 44.4% patients had symptoms since >120 minutes. TIMI flow of grade 3 after PCI was achieved in 127 (75.1%) patients. No significant association of TIMI flow grade 3 was observed with gender, age, hypertension, diabetes, smoking, and ECG diagnosis ($p > 0.05$).

Conclusion: STEMI cases treated by primary PCI, TIMI-3 flow grade was accomplished in about 75% of cases with the door-to-balloon time a key factor.

Key Words: Primary PCI, TIMI-3 Flow Grade, ST Elevation, Myocardial Infarction.

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INTRODUCTION:

Acute ST-elevation myocardial infarction (STEMI) is developed because of the rupture or fissure of a formerly stable atherosclerotic plaque superimposed by platelet aggregation and thrombus formation leading to coronary obstruction resulting full-thickness myocardial necrosis.¹⁻³ Percutaneous Coronary Intervention

(PCI) is an invasive procedure used for the patients who may have already coronary artery disease (CAD). PCI involves by introducing balloon catheter in the affected coronary vessel and inflating the balloon inside the stenosis (narrowing of the artery) for the opening the affected artery. In general, a small mesh tubular object or device (stent) is permanently placed within the stenosis to prevent abrupt artery closure.⁴

The door-to-balloon time explains the duration of time from the patient's advent at the hospital up to first intracoronary balloon inflation, which is considered a basic index for estimating the quality of acute ST-elevation MI care.⁵⁻⁷ American Heart Association (AHA) and American College of Cardiology (ACC) has recommended a new gold standard of 90 minutes door-to-balloon time for primary PCI.⁸ Primary PCI has good results if there is a catheterization,

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laboratory and interventional cardiologist availability along with the procedure time within 90 minutes of the patient arriving at the hospital.^{9,10} In determining the reasons for door-to-balloon time delay for primary PCI in STEMI cases offers a good opportunity to increase the care value in such cases. The factors delaying the door-to-balloon time includes age 65 years or higher, female gender, nonspecific clinical feature without chest pain at presentation, contraindication to thrombolytic therapy³⁹ and the "environmental" challenges presented by provision of care on time on holidays, weekends, and off-hours.^{11,12}

The TIMI flow grade has become one of standard for assessing level of coronary blood flow assessed for PCI. Determination of TIMI flow grade after coronary reperfusion yields main prognostic data in the cases with AMI. The study subjects with TIMI flow grade 3 show improved segmental and overall function of left ventricular, decreased enzyme peaks, and declined morbidity and mortality rates when compared with patient's flow grades 0, 1, or 2 in TIMI cases¹³. The advantages of reperfusion treatment laid upon rapid blood flow normalization in the IRA, which may be defined as thrombolysis in MI, TIMI flow 3.¹⁴

Although quality technique of primary PCI has enhanced from 18% to 53% worldwide during the previous years with an expected reduction in the of fibrinolytic treatment ranging from 50% to 28% while almost 30% of patients still do not receive either forms of treatment even in the absence of contraindications.¹⁵

PCI for elevated ST infarction revealing higher to thrombolytic treatment in relation of its capability to get increased patency rates, decrease infarct size, progress to left ventricular function, as well as lower reinfection rates and stroke.¹⁶⁻¹⁸

METHODS:

Total 169 consecutive patients of both genders with age 35 to 75 years presented with pain in the chest were included in this cross sectional study, which was performed in the cardiology department of NICVD, Karachi

during April and October 2014. The study subjects were diagnosed as STEMI when they met any two of the four criteria: i) ≥ 2 mm elevated ST segment found in 2 adjacent precordial leads in men and 1.5 mm in women, ii) ≥ 1 mm in two other contiguous leads, iii) Apparent new onset left bundle branch block (LBBB), iv) raised cardiac bio markers: cTnI > 0.4 ng/ml, cTnT > 0.01 ng/ml and CK-MB > 25 units/dl.

Patient's demographics and clinical history was recorded. The ECG of all the study subjects was reviewed to establish the diagnosis of STEMI. All the recruited patients were shifted to Cath lab for primary PCI and their door to balloon time was noted. The TIMI grade flow was observed to assess the levels of coronary blood flow during primary percutaneous coronary intervention. All the data collected was statistically analyzed and results were tabulated.

RESULTS:

127 (75.14%) male and 42 (24.86%). It was observed that 67.5% patients were hypertensive, 33.7% were diabetics, and 33.1% patients were smokers (Table-1).

Table 1. Demographic Information & Systemic Diseases

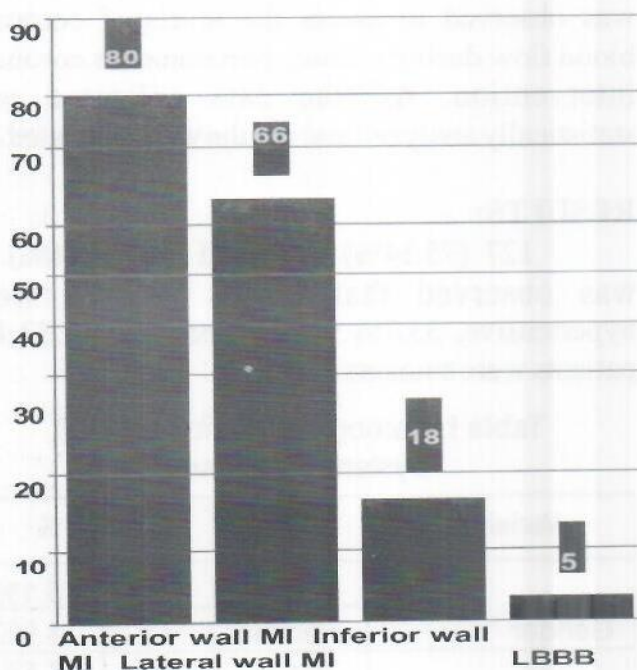
Variable		No	%
Gender	Male	127	75.1%
	Female	42	24.9%
Hypertension	Yes	114	67.5%
	No	55	32.5%
Diabetes Mellitus	Yes	57	33.7%
	No	112	66.3%
Smoking	Yes	56	33.1%
	No	113	66.9%

We found 57.31 ± 10.58 mean age, with range of 40(35-75) years. 79 patients were having 55 years or less and 90 cases were more than 55 years. The descriptive statistics of duration of positive comorbidities were calculated and results showed that overall mean duration of hypertension was 19.55 ± 8.29 years, mean duration of diabetes mellitus was 14.07 ± 5.12 years, and mean duration of smoking was 25.32 ± 13.03 years (Table-2).

Table-II: Descriptive statistics of age and duration of positive comorbid.

		n (%)	Mean	SD	Min	Max	Range
Age(years)	Overall	169	57.31	10.58	35	75	40
	d55 Years	79(46.7%)	47.80	5.30	35	55	20
	>55 Years	90(53.3%)	65.67	6.00	56	75	19
Duration (years)	Hypertension	114 (67.5%)	12.95	8.46	7	42	35
	Diabetes	57(33.7%)	15.85	8.13	5	25	20
	Smoking	56(33.1%)	19.33	9.76	2	50	48

The ECG findings showed that anterior MI was observed in 47.3% patients, inferior MI was observed in 39.0% patients, lateral MI was observed in 10.7% patients, and left bundle branch block was observed in 3.0% patients (Graph-1).

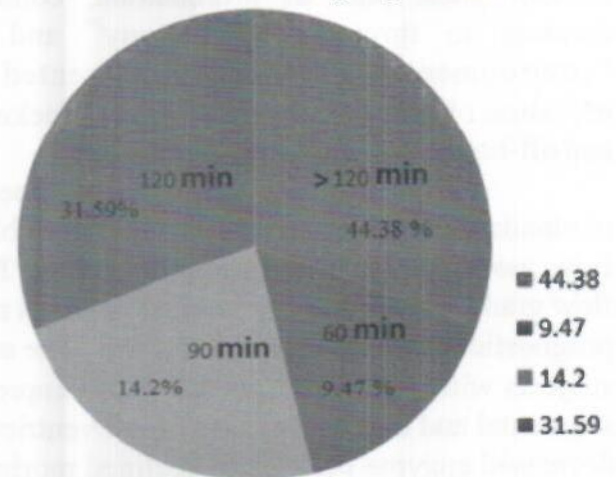


Graph-I: Frequency of ECG Findings

The ECG findings showed that anterior MI was observed in 47.3% patients, inferior MI was observed in 39.0% patients, lateral MI was observed in 10.7% patients, and left bundle branch block was observed in 3.0% patients (Graph-1).

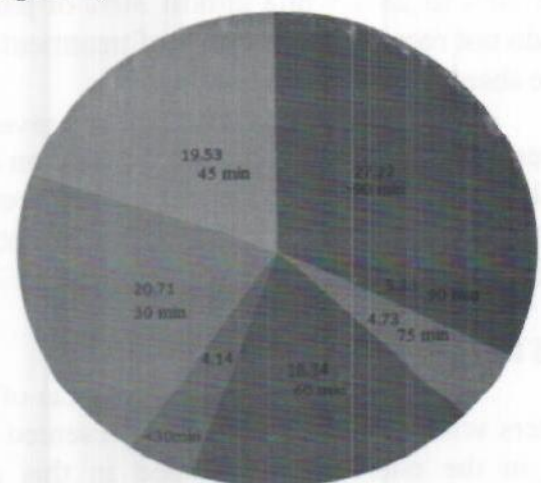
The duration of symptoms and door to balloon time was evaluated according to pre defined groups. The results showed that 16 patients had symptoms since 60 minutes, 24 patients had symptoms since 90 minutes, 54 patients had symptoms since 120 minutes, and 75 patients had symptoms since more than 120 minutes (Graph-II).

Duration of Symptoms



Graph-II: Group Wise Percentage of Duration of Symptoms

As far as door to balloon time is concerned, it was observed that door to balloon time of 7 patients was less than 30 minutes. The door to balloon time of 35, 33, 31, 8, and 9 patients was 30 minutes, 45 minutes, 60 minutes, 75 minutes, and 90 minutes respectively. Door to balloon time was more than 90 minutes was observed in 46 patients (Graph-III).



Graph-III: Group Wise Percentage of Door to Balloon Time

After primary PCI the TIMI-3 flow grade was observed in 127(75.1%) patients. The stratification was done on gender, age, hypertension, diabetes mellitus, smoking, and sides involved to see the association of these with functional outcome i.e. achieve TIMI-3 flow grade by applying Chi square test. P-value \leq 0.05 was considered as significant. The results showed that among patients, who had achieved TIMI-3 flow grade, 95 were male and 32 were female. Age of 63 patients was less than or equal to 55 years and age of 64 patients was more than 55 years. 83 patients were found hypertensive, diabetes was found in 40 patients, and 47 patients were found as smoker. Anterior wall was mostly affected followed by inferior wall. Most of the patients observe less than 90 minutes of door to balloon time only 36 patients were observed door to balloon time more than 90 minutes. No significant association of TIMI-3 flow grade was observed with gender, age, hypertension, diabetes mellitus, smoking, and sides involved (>0.05) (Table-III).

Table-III: Frequency and Association of TIMI-3 Flow Grade.

		N	TIMI-3 Flow Grade		P value
			YES (n=127)	NO (n=42)	
Gender	Male	127	95	32	0.221**
Side Involved	Anterior MI	80	65	15	
	Inferior MI	66	44	22	
	Lateral MI	18	14	4	
	LBBB	5	4	1	
Age	\leq 55 Years	79	63	16	0.195**
	$>$ 55 years	90	64	26	
Hypertension	Yes	114	83	31	0.311**
	No	55	44	11	
Diabetes Mellitus	Yes	57	40	17	0.286**
	No	112	87	25	
Smoking	Yes	56	47	9	0.063**
	No	113	80	33	

** Not significant at 0.05 level

DISCUSSION:

The effective reperfusion therapy can be achieved through mechanical or pharmacological intervention which is the aim in the treatment of patients suffered STEMI.¹⁹⁻²¹ The goal in all PCI is the normalization of TIMI 3 flow in the coronary epicardial vessels. The time for reperfusion is a significant determinant in the matter, as explained in different studies.^{22,23} In a hospital base real world cohort study, data was collected from 500 admitted patients who suffered STEMI. As PCI was performed in several patients, restoration of blood flow may not possible in almost all patients despite of technically high level of experience among the operators, with an overall success rate of 97.6%. The study revealed that post-interventional TIMI flow is the main prognostic factor for indoor mortality and clinical outcome of 6 months post-hospitalization.²⁴ The real world patients cohort study describes achievement frequency of the prime PCI is lesser in higher age Ischemic cases when compared to the younger age patients. Additionally, the patients having STEMI presenting the left anterior descending coronary artery(LAD) or grafts of saphenous vein as the affected artery; are probable to have more lower coronary vessel blood flow. So the age of patient, presentation of symptoms, and the infarction localization seems main determinants affecting the results in the cases suffered ST elevation MI operating through prime PCI. The poor blood flow predictors in the coronary arteries in post-intervention, include triple vessels disease (3VD), cardiogenic shock, diabetes mellitus (DM), and inefficient pre-hospital thrombolysis treatment.¹⁴

Assessment through Angiography depends on myocardial infarction thrombolysis (TIMI) flow grade evolution of epicardial IRA. In relation to ECG changes, the ST-segment monitoring can offer significantly a noninvasive, constant, real time, nutritional cellular reperfusion physiologic marker.^{25,26}

The current study results strengthen the theory of resolution of ST-segment as a persistent, physiologic marker of reperfusion foretells enriched results than a short-lived, structural marker such as angiographic TIMI flow grade in

the infarct related artery.

The results of current study does not vary considerably when assembled in order to TIMI flow grade, while the trends shows better results in the patients with TIMI flow grade 3 when linked to TIMI grades 2 flow.

Primary PCI has now been the initial management of STEMI¹³³ as various randomized clinical trials (RCT) demonstrate the superiority of prompt primary PCI in STEMI patients.^{8,27,28} One of the main goal of primary PCI is to get a rapid initiation with door-to-balloon time less than 90 minutes. Data from NRMI showed that around 29.3% of Ischemic patients undergo primary PCI <90 minutes from the arrival at the hospital.²⁹ In our study this percentage was 68%. So there are two key points for successful reperfusion with primary PCI: a) short delay times and b) a cardiac catheterization laboratory availability including experienced interventional cardiologists along with trained supporting staff. The current study shows that achieving an optimal time is the challenge to be met progressively. It should be considered that the time reduction detected actually was the result of both from the decline in diagnosis time, and in the time between diagnosis and the procedure, hence signifying that two components are sensitive to the protocol implementation. Likewise in current study, IRA TIMI flow grade analysis was not helpful alone to classify the patient's risk, than evident by comparable outcomes in the cases having all of three types TIMI flow grade. Finally the outcomes of this study support the hypothesis that resolution of ST-segment being the constant, physiologic marker of reperfusion predicts superior outcome.²⁵

In another study, thrombolysis in MI (TIMI) flow grade was studied first & later by PCI. Afterward primary PCI, TIMI grade 3 flow was measured in 163 (91%) patients, TIMI grade 2 flow in 13 patients (7%), and TIMI grade 0 or 1 flow (2%) in four study cases and the prominent relation in between infarction size and TIMI flow was noticed. This was observed that , size of infarction remained considerably minor in cases with TIMI grade 3 flow than those with TIMI

grade 2 flow ($15 \pm 16\%$ vs $29 \pm 21\%$ of left ventricular mass, $p=0.007$). After primary PCI, TIMI grade 3 flow restorations was essential for optimum myocardium rescue and TIMI grade 2 flow showed relation to final larger infarct size.³⁰

One of the restrictions is that we are unable to account for the influence of unmeasured confounders on TIMI flow grade and outcomes. We only have information of in-door outcomes and are not able to provide any insight into the relationship of TIMI flow grades and long-term outcomes. The current study is a descriptive study therefore cannot randomize patients to rapid vs slower door-to-balloon times. As this study is limited by its single location in an only urban environment, only those patients were included who mentioned chest pain. It is possible that the study patients who stated ACS equivalents such as difficulty in breathing, neck / shoulder / back pain, generalized weakness and who did not have chest pain but had ACS were missed. The enzymatic infarct size was not available in all patients, with a potential underestimation of the impact of an prompt treatment on myocardial rescue.

CONCLUSION:

In current study patients of STEMI treated with primary PCI, TIMI 3 flow grade was achieved in 75% cases. The door-to-balloon time was identified as a significant factor for successful achievement of TIMI 3 flow.

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