Pak Heart J

OUTCOME OF PRIMARY PERCUTANEOUS CORONARY INTERVENTION WITH EARLY AND LATE ST RESOLUTION - EARLIER IS BETTER!

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Contribution

All the authors contributed significantly to the research that resulted in the submitted manuscript.

All authors declare no conflict of interest.

ABSTRACT

Objective: To compare the outcome of Primary PCI in patients presenting with early ST resolution versus those presenting late ST resolution after the procedure.

Methodology: This observational prospective study was conducted in the Catheterization Laboratory of a Tertiary Care Cardiovascular Centre of Pakistan. Those patients who under went primary PCI were enrolled. All patients were pre treated with Aspirin 300 mg, and Clopidogrel 600mg. Platelet glycoprotein IIb IIIa inhibitor was given in the Catheterization Laboratory before the commencement of procedure. Primary PCI was done in a standard fashion. Procedural details, angiographic and electrocardiographic signs were recorded after PCI and clinical follow up was documented up to 1 year.

Results: A total of 150 consecutive patients underwent primary PCI. 112 patients showed ST resolution within 60 minutes while 38 patients showed ST resolution after 60 minutes. Patients with early ST resolution showed significant procedural success (100 % vs. 94.7 %; P=0.014), and stable follow up at 30 days (92 % vs. 50 %; P= <0.001) and one year (88.3 % vs. 60.6 %; P=< 0.001). Mortality at 30 days was significantly lower (0.9% vs. 7.9 %; P=0.019) in patients with early ST resolution while coronary artery bypass surgery was also significantly lower at 30 days (1.7 % vs. 15.8 %; P=0.001) and one year (2.7 % vs. 15.8 %; P=0.004). Patients with late ST resolution were significantly aged (54.5±8.1 vs. 50.4±12.9; P=0.023), more diabetic (39.5 % vs. 19.6 %; P=0.014), having longer (>120 minutes) chest pain to ER time (34.2 % vs. 17.9%; P=0.03), and having diffusely diseased vessels (73.7% vs. 52.7%; P=0.023). Three vessel disease was also more frequently seen in patients with late ST resolution (36.9% vs. 17.9%; P=0.015).

Conclusion: Outcome of patients showing early ST resolution is significantly better than those showing late ST resolution. Elderly, diabetes, longer chest pain to ER time and diffuse three vessel disease are associated with late ST resolution.

Key Words: Outcome, Primary Percutaneous Coronary Intervention, ST Resolution

INTRODUCTION

Primary Percutaneous coronary intervention (PCI) is considered a preferable treatment of acute ST elevation myocardial infarction (STEMI).[1,2] It is now being done successfully in many tertiary care centers of Pakistan.[3,4] Although the restoration of epicardial coronary flow with primary PCI is achieved in majority of patients and it is far better than the pharmacological revascularization.[1,2] However, considerable number of patients showed suboptimal and unsatisfactory results manifested by unstable hemodynamic status, persistence of symptoms, abnormal myocardial blush and incomplete or absent ST resolution on surface electrocardiogram (ECG).[5-8]

Absent or incomplete ST resolution after PCI is a strong predictor for adverse events and abnormal left ventricular function. In contrast, patients with early ST resolution show smaller infarct size and lower incidence of cardiac death at one year. These differences remained significant even after adjustment of myocardial blush grade (MBG).[5-9]

In our resource limited country, the average age of patients suffering STEMI is younger than the western population.[3,4] Moreover, overall risk profile is poorer considering the fact of having more uncontrolled diabetes and hypertension.[10] In addition, due to lack of awareness and poor education, patients are usually used to present late after having symptoms of acute MI.[11] This complicates the management and the results may not be the same as shown by the western studies. Therefore, in addition to outcome we also evaluated the predictors of late ST resolution in this study. We believe that the local data is scarcely available in this regard and our study not only adds on the available data but also provides the new piece of information regarding the above mentioned issue.

The aim of our study was to compare the outcome of Primary PCI in patients presenting with early ST resolution versus those presenting late ST resolution after the procedure.

METHODOLOGY

This observational, prospective, single centre study was conducted at a tertiary care cardiovascular teaching hospital (National Institute of Cardiovascular Diseases, Karachi-Pakistan) from January 1st 2011 to October 31st 2012. All adult patients ($\geqslant$ 18 years old) with chest pain lasting > 30 minutes and ST elevation of $\geqslant$ 1 mm in $\geqslant$ 2 contiguous leads were included in this study. In case of posterior MI, ST depression of $\geqslant$ 2 mm in $\geqslant$ 2 precordial leads were also considered eligible for the study. Informed consent was taken and detailed questionnaire was filled of those patients who underwent primary PCI.

Patients who received Thrombolytic therapy within 24 hours of hospital admission, those who were diagnosed as Non ST elevation Myocardial Infarction (NSTEMI) and those presenting beyond 24 hours with resolved symptoms were excluded from the study. Patients with history of MI in the same territory and those whose surface ECG could not be evaluated due to persistent electrical problem like left bundle branch block, paced or ventricular rhythm, WPW syndrome etc were also excluded from the study.

Primary PCI was performed in standard method using a variety of guiding catheters, coronary wires, balloons and stents. The majority of interventions were performed through the femoral route. However, the choice of access was on discretion of operators and considerable number (18 %) of interventions was performed through radial route. All patients received 5000-10,000 units of intravenous unfractionated heparin, Aspirin 300 mg, clopidogrel 600 mg (loading dose), and Platelet glycoprotein IIb IIIa inhibitor. Thrombus extraction catheter (Export catheter 6-F; Medtronic Corporation, USA) was used when obvious clot was visible in the infarct related artery (thrombus class 2-5). Intracoronary nitroprusside and adenosine use were at the discretion of operators. All patients were prescribed Aspirin 300 mg, Clopidogrel 75 mg and Atorvastatin 20-40 mg / Rosuvastatin 10-20 mg daily at the time of discharge from the hospital.

The prospective information on variables including age, gender, history of diabetes, hypertension, hyperlipidemia, smoking, angiographic and procedural details (number of vessels, segment of vessel, use of aspiration catheter, clot retrieval, use of stents, GP IIb IIIa inhibitors, Thrombolysis in Myocardial Infarction (TIMI) flow, and Tissue Myocardial perfusion (TMP) grade and Electrocardiogram (ECG) findings were recorded.

TIMI flow, TMP grades and ST resolution (on 12- lead ECG strips) were visually determined and documented by two independent observers before and after PCI and in case of controversy third expert opinion was taken as final.

Intracoronary thrombus was classified as: zero - No thrombus, 1 - reduced contrast density / possible thrombus, 2 - small size thrombus / greatest dimension $\leqslant$ ½ of vessel diameter, 3 - moderate size thrombus / greatest dimension > ½ and < 2 vessel diameter, 4 - large size thrombus / $\geqslant$ 2 vessel diameter, 5 - total occlusion.[12]

PCI success was defined as achievement of vessel patency to a residual $\leqslant$ 30 %. Major bleeding was defined as a hematoma $\geqslant$ 10 cm in diameter or bleeding requiring transfusion, vascular surgery or resulting in major morbidity.

TIMI flow grades were defined as: Zero - total occlusion resulting in no antegrade flow, 1 - minimal penetration of contrast across the obstruction but fails to opacify the vessel, 2 - contrast opacifies the vessel beyond the

occlusion but with delay, 3 - normal complete perfusion of entire vessel without any delay.[13]

TMP grades were defined as: Zero - minimal or no myocardial blush, 1 - dye stains the myocardium and this stain persists on the next injection, 2 - dye enters the myocardium but washes out slowly and strongly persists at the end of injection, 3 - normal entrance and exit of dye in the myocardium.[14]

Early ST resolution was defined as ⩾ 50% ST segment resolution within 60 minutes of primary PCI, whereas, late

Table 1: Baseline Demographic and Angiographic features of Patients Underwent Primary PCI within 60 and after 60 Minutes of ST Resolution

Variables	ST Resolution within 60 mins n=112	ST Resolution after 60 mins n=38	P-value
Age in years [Mean ±SD]	50.4 +12.9	54.5 +8.1	0.023
Gender Male	103 (92%)	32 (84%)	0.169
Height in cm [Mean ±SD]	172.2 +7.1	170 +7.2	0.093
Weight in Kg [Mean ±SD]	77.8 +12.2	75.8 +8.4	0.281
Diabetes	22 (19.6%)	15 (39.5%)	0.014
Hypertension	54 (48%)	16 (42%)	0.514
Smoking	46 (41%)	10 (26%)	0.104
History of previous MI	22 (19.6%)	12 (31.6%)	0.129
Symptom onset to ER time in minutes [Mean ±SD]*	113.9 +137.5	141.4 +128.5	0.074
Door to Balloon time in minutes; [Mean ±SD]*	101.6 +54.3	105.6 +72.0	0.586
⩽ 90 minutes	55 (49%)	23 (60.5%)	0.223
> 90 minutes	57 (51%)	15 (39.5%)	
Infarction territory			
AWMI	76 (68%)	25 (66%)	0.814
IWMI	36 (32%)	13 (34%)	
Culprit Artery			
LAD, Diagonal	72 (64.3%)	25 (65.8%)	0.875
RCA	23 (20.5%)	10 (26.3%)	0.469
LCx, Ramus	17 (15.2%)	03 (7.9%)	0.247
Lesion Risk			
Type A, B	53 (47.3%)	10 (26.3%)	0.023
Type C	59 (52.7%)	28 (73.7%)	
Number of Diseased vessels			
SVD	70 (62.5%)	23 (60.5%)	0.816
2VD	22 (19.6%)	01 (2.6%)	0.012
3VD	20 (17.9%)	14 (36.9)	0.015

ST resolution was defined as any resolution or no resolution after 60 minutes of Primary PCI. Complete ST resolution was defined as ⩾ 70% ST resolution compared to baseline ECG. No ST segment resolution was defined as persistent ST segment elevation or ⩽ 30 % resolution of ST segment.[15]

Patients were followed in outpatient department (OPD) after one month, and at 1 year. Those patients who could not come in OPD, they were contacted through telephone and follow up documented.

All the data was entered and analyzed through SPSS version17. Categorical variables like gender, diabetes, hypertension, smoking, history of previous MI, cardiogenic shock, inotropic support, IABP, infarction territory, route of access etc were presented in frequencies and percentages. Whereas continuous variables like age, height, weight, BMI, symptom onset to ER and door to balloon time were presented as mean ± SD. Chi square test was used for significant association. Independent t-test for normally distributed data and Mann Whitney U test were used for not normally distributed data to compare mean (±SD) values of with and without aspiration of thrombus. P-value < 0.05 was considered as statistically significant.

RESULTS

Out of 150 patients enrolled, 112 (74.6 %) showed ST resolution within 60 minutes. Table 1 is showing baseline demographic, clinical and angiographic features of both groups. Patients who showed ST resolution after 60 minutes were significantly elder than those revealed early ST resolution. Diabetes, Multivessel disease and type C lesions were also more common in patients with late ST resolution (Table 1). Procedural characteristics were almost same in both groups except the TIMI III flow that was significantly more commonly seen in patients with early ST resolution (Table 2).

Table 3 is showing the difference of outcomes of both groups underwent primary PCI. 100% immediate success was achieved in patients showing early ST resolution, while it was ~95% in patients with late ST resolution. At 30 days and 1 year of follow up 103(90%) and 99(88.3%) were stable, respectively, in patients with early ST resolution. While only 19(50%) and 23(60.6 %) were stable in the other group. Similarly, CABG and death were significantly more common in patients with late ST resolution (Table 3). Table 4 is showing the comparison of group of patients with early and late ST resolution whom DBT is ⩽ 90 minutes. Prolonged symptom onset to ER time (91.9±59.6 vs. 167.8±156.7 minutes; p=0.02) was significantly related to late ST resolution.

DISCUSSION

It is evident by our study that outcome of the patients

Table 2: Procedural Characteristics of the Groups of Patients Underwent Primary PCI Showing ST Resolution within 60 and After 60 Minutes

Variables	ST Resolution within 60 mins n=112	ST Resolution after 60 mins n=38	P-value
Grade of stenosis			
Total (100 %)	66 (59%)	26 (68.4%)	0.298
Sub-total (91-99%)	11 (10%)	04 (10.5%)	0.900
Severe (70-90%)	35 (31%)	08 (21.1%)	0.229
Lesion length			
≤ 20 mm	71 (63.4%)	22 (58%)	0.546
> 20 mm	41 (36.6%)	16 (42%)	
Size of culprit artery			
≤ 3 mm	36 (32%)	10 (26.3%)	0.501
> 3 mm	73 (68%)	28 (73.7%)	
Clot retrieved	38 (34%)	14 (37%)	0.752
Adenosine used	23 (20.5%)	09 (23.7%)	0.682
Size of stent deployed			
≤ 20 mm	49 (43.7%)	13 (34.2%)	0.303
> 20 mm	48 (42.9%)	16 (42.1%)	0.939
> one stent	09 (8%)	07 (18.4%)	0.079
stenting not done	06 (5.4%)	02 (5.3%)	0.999
TIMI flow			
Zero – I	0	01 (2.6%)	0.125
II	03 (2.7%)	04 (10.5%)	0.051
III	109 (97.3%)	33 (86.9%)	0.012
TMP Grade			
Zero – I	67 (59.8%)	25 (65.8%)	0.514
II & III	45 (40.2%)	13 (34.2%)	0.514

showing late or no STR after primary PCI is dismal. This group did not show stable follow up and encountered more frequent adverse cardiac events like CABG and death. This finding is consistent with previous studies in which the same issue of STR was addressed. It was previously reported that patients with early STR had more preserved LVEF and smaller infarct size compared to patients with late or no STR.[9] Therefore it is understandable if the patients with late STR showed poor outcome results in our study.

Within 60 minutes of time window three fourths (74.7%) of our patients showed satisfactory STR. While 28 (18.7%) patients showed STR after 60 minutes and 10 (6.7%) patients did not show any resolution. The risk profile of late

STR group was worse than the early STR group. They were aged and majority of them having diabetes, multivessel disease and type C lesions. As a result this was not surprising when they demonstrated a poor prognosis and quite a few of them showed a suboptimal TIMI flow grades immediately after PCI (Table 2). It is a well known fact that aged population has got worse atherosclerotic cardiovascular disease. They have poor microvasculature, and badly diseased endothelium that may not be responded well even following the restoration of coronary blood flow after the primary PCI.[16, 17] Similarly, diabetes badly damages the vascular system in general and microvasculature in particular. Therefore, even after the restoration of coronary vessel myocardium may not be well perfused due to diseased microvasculature and hence, late STR ensued.[18]

Recent studies have shown the increased risk of major adverse cardiovascular events after primary PCI in case of multivessel disease if the other vessels are not intervened.[19,20] Therefore recently published landmark Complete versus Lesion-only Primary PCI Trial (CvLPRIT) study have shown a 55% reduction in major adverse cardiovascular events in those patients presenting for primary percutaneous coronary interventions when the non-

Table 3: Outcomes of the Patients Underwent Primary PCI within 60 and After 60 Minutes of ST Resolution

Variables	ST Resolution within 60 mins n=112	ST Resolution after 60 mins n=38	P-value
Immediate after Procedure			
Successful PCI	112 (100%)	36 (94.7%)	0.014
Major bleeding	0	01 (2.6%)	0.125
Death	0	01 (2.6%)	0.125
Follow up after 30 days			
Stable	103 (92%)	19 (50%)	< 0.001
CABG	02 (1.7%)	06 (15.8%)	0.001
MACE	03 (2.7%)	01 (2.6%)	0.999
Death	01 (0.9%)	03 (7.9%)	0.019
Lost follow up	03 (2.7%)	09 (23.7%)	< 0.001
Follow up after 1 year			
Stable	99 (88.3%)	23 (60.6%)	< 0.001
CABG	03 (2.7%)	06 (15.8%)	0.004
MACE	05 (4.5%)	01 (2.6%)	0.630
Death	04 (3.6%)	04 (10.5%)	0.093
Lost follow up	01 (0.9%)	04 (10.5%)	0.005

PCI=Percutaneous coronary intervention; CABG=Coronary artery bypass grafting; MACE=Major adverse cardiovascular events

Table 4: Comparison Between ST Resolution within & after 60 Mins Who's Door to Balloon Time < 90 mins

Variables	ST Resolution within 60 mins n=55	ST Resolution after 60 mins n=23	P-value
Age in years [Mean ±SD]	50.1 ± 12.6	53.6 ± 8.8	0.165
Gender Male	49 (89%)	20 (87%)	0.999
Height in cm [Mean ±SD]	172.1 ± 7.3	168.8 ± 7.3	0.072
Weight in Kg [Mean ±SD]	78.3 ± 14.7	75.5 ± 8.9	0.309
Diabetes	11 (20%)	08 (35%)	0.165
Hypertension	26 (47%)	10 (43.5%)	0.759
Smoking	23 (42%)	05 (22%)	0.092
History of previous MI	10 (18%)	06 (26%)	0.540
Symptom onset to ER time in minutes [Mean ±SD]*	91.9 ± 59.6	167.8 ± 156.7	0.022

*Man-Whitney U test was used

infarct-related artery is treated on the index admission.[21, 22] In our study although we strictly followed the recent guidelines and did not intervene the non infarct related arteries during the index admission unless the patient was in shock. However, by viewing our data it may be said that patients with multivessel disease have poorer outcome after primary PCI as compare to those having single vessel disease. Thus, our data further support the argument in favor of complete revascularization at the time of primary PCI during index admission.

The another interesting fact that we found in our data that despite of achieving optimum DTB time of 90 minutes, STR was significantly different between early presenter versus late presenter to ER. STR within 60 minutes was achieved more frequently in patients who presented to ER within 90 minutes after symptoms onset. There was remarkable difference of presentation time to ER between both the groups. None of the other factors like age, DM, hypertension, smoking etc. turned significant in this perspective. Hence, it further strengthens the famous saying "Time is Muscle", that means more you waste the time more you lose the muscle.[23, 24] Thus, it is not enough to achieve the optimal DTB to get the better outcome. We must try hard to lessen the symptom onset to ER time to achieve the better outcome. Therefore, increasing awareness about the ischemic symptoms among the patients on the mass level is important at the one end. At the other end development of effective social and health care system is equally necessary that must ensure the early transport of the poor patient of STEMI to the tertiary health care facility without wasting time. This needs effective communication and political will between the government and health care authorities.

CONCLUSION

Outcome of patients showing early ST resolution is significantly better than those showing late ST resolution. Elderly age, diabetes, longer chest pain to ER time and diffuse three vessel disease are associated with late ST resolution. Outcome of late presenter (patients who have longer chest pain to ER time) remains poor even after achieving standard DBT of 90 minutes.

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