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In-hospital and Late Outcome of Rescue Vs. Primary Percutaneous Coronary Intervention in Patients with ST-segment Elevation Myocardial Infarction

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Abstract

Introduction: Despite high technical success of rescue Percutaneous Coronary Intervention (PCI) and also its significant impact on left ventricular function, the therapeutic outcome of this PCI technique in comparison with primary PCI for coronary reperfusion has remained uncertain. The present study aimed to conduct a comparative analysis of early and long-term results of patients with ST-Elevation Myocardial Infarction (STEMI), who had undergone primary or rescue PCI.

Methods: One hundred and twenty-nine consecutive patients with the diagnosis of STEMI, who underwent primary PCI (n = 107) or rescue PCI (n = 22) from April 2012 to September 2013 were retrospectively included. In addition to early assessment of procedural consequences, the patients were followed-up to assess and compare long-term mortality and major adverse cardiovascular events.

Results: Comparing in-hospital consequences of the two rescue PCI and primary PCI procedures showed no significant differences in in-hospital mortality (9.5% vs. 3.7%, P = 0.255), total hospital stay (6.32 ± 2.24 days vs. 6.61 ± 3.43 days, P = 0.720) and also in early procedural complications. Long-term death was found only in 1.9% of patients in the primary group and none of the patients in the rescue group (P = 0.999). There was also no difference in the prevalence of late stent thrombosis between the two groups. However, the in-hospital Left Ventricular Ejection Fraction (LVEF) was lower in the rescue PCI group vs. primary PCI group (36.82 ± 11.19 vs. 43.48 ± 9.14, P = 0.014), but after six months, LVEF was similar between the two groups (41.05 ± 9.57 vs. 44.29 ± 10.35, P = 0.082).

Conclusions: Our study showed no difference in early and late procedural outcome between the primary and rescue PCI techniques in STEMI patients, but LVEF had better improvement in the rescue PCI group.

INTRODUCTION

Fibrinolytic therapy is a standard treatment for establishing myocardial reperfusion following acute ST-Elevation Myocardial Infarction (STEMI) [1]. However, the application of this treatment option is limited by some potential contraindications including intracranial bleeding, re-occlusion, and recurrent ischemic events [2, 3]. In this regard, most cardiologists prefer to the use of Primary Percutaneous Coronary Intervention (PCI) as the main therapeutic strategy for STEMI. Applying primary PCI has led to achieve a coronary artery TIMI-3 flow of higher than 90% leading to lower rates of recurrent ischemia and occlusion, higher patency, lower incidence of re-infarction and stroke as well as lower mortality rate in the long-term follow-up assessment in comparison with fibrinolytic therapy [4-6]. In total, primary PCI is strongly recommended for patients with STEMI that initially refer to emergency wards and need a rapid clinical intervention [7-9]. According to new recommendations released by the European Society of Cardiology and American College of Cardiology guidelines for the management of acute

myocardial infarction, in patients presenting STEMI faced with failed fibrinolysis, or with the presence of some evidences on re-infarction or coronary artery re-occlusion, immediate angiography and rescue PCI should be considered [1]. Despite high technical success of rescue PCI and also its significant impact on left ventricular function, recent studies revealed high mortality rate and also high re-occlusion rate related to this procedure if unsuccessful [10]. Also, the appropriate outcome of this treatment option can be achieved in case of prompt recognition of failed fibrinolysis and also rapid transfer of the patient to the catheterization lab [11].

Despite identified clinical benefits of rescue PCI in failed fibrinolytic conditions, the clinical early and long-term consequences of this procedure particularly in comparison with primary PCI is still controversial. In fact, primary PCI has been considered as the gold standard, but the therapeutic state of rescue PCI for coronary reperfusion has remained uncertain [8-10, 12]. Hence, the present study aimed to conduct a comparative analysis of early and long-term results from patients with STEMI, who had undergone primary or rescue PCI to highlight the therapeutic role of rescue PCI in comparison with primary PCI.

METHODS

In a comparative study, 129 consecutive patients with the diagnosis of STEMI that received fibrinolytic therapy in other centers and referred to our hospital to undergo rescue PCI, or candidate for primary PCI at our center from April 2012 to September 2013, were assessed. The study protocol was approved by the board review of the cardiovascular research center. All the information was collected by reviewing the hospital recorded files including gender, age, cardiovascular risk factors (family history of Coronary Artery Disease (CAD), hypertension, hyperlipidemia, diabetes mellitus, current smoking, recent myocardial infarction, and renal failure), history of revascularization by Coronary Artery Bypass Graft (CABG) or PCI, oral medications, laboratory parameters, level of cardiac enzymes on admission, electrocardiography findings, results of angiography reports including number and types of diseased coronary vessels, and echocardiography parameters such as left ventricular diameters and ejection fraction. In the rescue group, patients were previously treated with fibrinolytic agents and underwent rescue PCI based on the discretion of the clinician, during the first 24 hours of the acute event. The study endpoint was first to compare in-hospital mortality, length of hospital stay, and Major Adverse Cardiovascular Events (MACE) that occurred within hospitalization including minor or major bleeding, need of blood transfusion, hematoma, stent thrombosis, and changes in left ventricular function level based on echocardiography assessment before discharge. Then, to assess the long-term efficacy of the two procedures, the patients were followed-up with a mean follow-up time of six months to assess and compare late Left Ventricular Ejection Fraction (LVEF), long-term mortality and MACE, defined as repeated coronary angiography, CABG, or PCI or occurrence of ischemic cardiovascular or cerebrovascular accidents.

For statistical analysis, results were presented as mean ± Standard Deviation (SD) for quantitative variables and were summarized by frequencies (percentages) for categorical variables. Continuous variables were compared using the t test. Non-parametric Mann-Whitney test was used whenever the data did not appear to have normal distribution or when the assumption of equal variances was violated across the study groups. Categorical variables were, on the other hand, compared using chi-square test. Change in study parameters was assessed using paired t test or McNamara test. The multivariate cox proportional hazard modeling was used to assess the differences in study outcomes between primary and rescue PCI groups with the presence of baseline variables as the confounders. For the statistical analysis, the SPSS statistical software version 21.0 for windows (SPSS Inc., Chicago, IL) was used. P values of 0.05 or less were considered statistically significant.

RESULTS

Baseline characteristics: In total, 129 patients were assessed regarding baseline characteristics as well as early and long-term outcome of PCI procedure, where 22 underwent rescue PCI and 107 underwent primary PCI. The average age of the participants was 55.64 ± 11.00 years and 57.04 ± 10.90 years (P = 0.119) in the rescue PCI and primary PCI group, respectively. Also, with regards to gender distribution, 95.5% and 82.2% were male, respectively (P = 0.358). The two groups were similar in terms of the prevalence of cardiovascular risk factors, history of oral medications, and level of baseline laboratory parameters (Table 1). With regards to baseline ECG pattern, inferior MI was found in 27.3% and 24.8%, anterior MI in 27.3% and 22.9%, and extensive MI in 18.2% and 13.3%, in the rescue PCI and primary PCI group, respectively, with no difference in overall ECG patterns. Also, no difference was revealed in the number of involved coronary vessels, where single, two, and three-coronary involvement was found in 45.5%, 50.0% and 4.5% in the rescue group and 43.9%, 36.4%, and 19.6% in the primary PCI group, respectively. There were also no differences between the two groups in the type and number of used stents, but the mean left ventricular ejection fraction was significantly lower in the rescue PCI group (Table 2).

In-hospital outcome: Comparing in-hospital consequences of the two rescue PCI and primary PCI procedures (Table 3) showed no significant differences in in-hospital mortality (9.5% vs. 3.7%, P = 0.255), total hospital stay (6.32 ± 2.24 days vs. 6.61 ±3.43 days, P = 0.720) and also in early procedural complications including minor local bleeding, hematoma, gastrointestinal bleeding and post-catheterization hemodynamic status. Regarding TIMI flow grading before discharge, TIMI flow grade 3 was found in 87.5% in the rescue PCI group and 98.5% in the primary PCI group with no difference (P = 0.869).

Late outcome: Long-term death was found only in 1.9% of patients in the primary group and none of the patients in the rescue group (P = 0.999). Also, none of the cases underwent late CABG after the initial rescue group and only one patient in the primary PCI group underwent CABG. There was also no difference in the prevalence of late stent thrombosis between the two groups. However, the greater need for repeat angiography and PCI was found in patients of the primary PCI group, after initial treatment with PCI (Table 4). Using cox proportional hazard analysis and with the presence of baseline variables (Table 5), although the need for coronary angiography and repeat PCI was univariately more frequent in primary PCI group than in rescue PCI group, but need for late PCI was independent to the type of PCI procedure in multivariable analysis. In this regard, the number of involved coronary vessels was the only main predictor of the requirement for repeat PCI in the study population. Late LVEF was similar between rescue and primary PCI group after six months (41.05 ± 9.57 vs. 44.29 ± 10.35, respectively; P = 0.082).

Table 1: Baseline Characteristics and Clinical Data in Primary PCI and Rescue PCI Groups

Characteristics	Rescue PCI Group, (n = 22)	Primary PCI Group, (n = 107)	P value
Male gender	21 (95.5)	88 (82.2)	0.119
Age, year	55.64 ± 11.00	58.04 ± 10.90	0.358
Hypertension	10 (45.5)	35 (32.7)	0.253
Diabetes mellitus	5 (22.7)	29 (27.1)	0.671
Dyslipidemia	9 (40.9)	40 (37.4)	0.756
Renal failure	1 (4.5)	2 (1.9)	0.432
Family history of CAD	8 (36.4)	25 (23.4)	0.203
Cigarette smoking	11 (50.0)	52 (48.6)	0.905
Opium use	4 (18.2)	12 (11.2)	0.367
Previous MI	0 (0.0)	2 (1.9)	0.999
Previous PCI	1 (4.5)	7 (6.6)	0.717
Aspirin use	4 (18.2)	14 (13.1)	0.530
Plavix use	0 (0.0)	2 (1.9)	0.999
Beta-blocker use	2 (9.1)	14 (13.2)	0.737
Statin use	0 (0.0)	8 (7.5)	0.349
ACE-inhibitor use	4 (18.2)	6 (5.7)	0.069
Hemoglobin, mg/dl	14.73 ± 1.45	14.02 ± 1.94	0.108
Creatinine, mg/dl	1.19 ± 0.25	1.12 ± 0.23	0.239
Platelet, /mm^3 × 1000	242.00 ± 56.33	241.27 ± 78.32	0.959
Cholesterol, mg/dl	184.73 ± 55.25	181.52 ± 42.45	0.800
HDL, mg/dl	39.95 ± 13.59	40.30 ± 9.55	0.912
Triglyceride, mg/dl	197.59 ± 96.49	137.37 ± 95.04	0.214
LDL, mg/dl	104.50 ± 36.50	110.72 ± 33.88	0.469
Fasting blood sugar, mg/dl	149.26 ± 63.27	151.01 ± 57.24	0.912
Troponin T	15.48 ± 15.90	11.76 ± 17.53	0.422

Data in table are presented as No. (%) or Mean ± SD.
CAD: Coronary artery disease; MI: Myocardial infarction; PCI: Percutaneous coronary intervention; ACE: Angiotensin converting enzyme; HDL: High-density lipoprotein; LDL: Low-density lipoprotein.

Table 2: Baseline Cardiovascular Status in Primary PCI and Rescue PCI Groups

Characteristics	Rescue PCI Group, (n = 22)	Primary PCI Group, (n = 107)	P value
Intra-aortic balloon pump use	1 (4.5)	7 (6.5)	0.724
ECG pattern			
Inferior MI	6 (27.3)	26 (24.8)	0.821
Anterior MI	6 (27.3)	24 (22.9)	0.703
Anteroseptal MI	2 (9.1)	10 (9.5)	0.999
Lateral MI	1 (4.5)	5 (4.8)	0.999
Extensive MI	4 (18.2)	14 (13.3)	0.527
RV-inferior MI	2 (9.1)	24 (22.9)	0.372
Inferoposterior MI	1 (4.5)	0 (0.0)	0.999
Number of diseased vessels			
Single-vessel disease	10 (45.5)	47 (43.9)	0.935
Two-vessel disease	11 (50.0)	39 (36.4)	0.444
Three-vessel disease	1 (4.5)	21 (19.6)	0.200
Infarcted vessel			
LAD	12 (54.5)	50 (46.7)	0.697
LCX	1 (4.5)	14 (13.1)	0.466
RCA	9 (40.9)	43 (40.2)	0.967
Type of stent			
BMS	20 (93.8)	82 (77.0)	0.617
DES	2 (6.2)	15 (23.0)	0.739
Number of stents			
1	16 (75.0)	81 (75.8)	0.911
2	3 (12.5)	20 (19.2)	0.768
3	3 (12.5)	6 (5.1)	0.208
LVEF (angiography)	36.82 ± 11.19	43.48 ± 9.14	0.014

Data in table are presented as No. (%) or Mean ± SD.
MI: Myocardial infarction; LAD: Left anterior descending; LCX: Left circumflex; RCA: Right coronary artery; BMS: Bare metal stent; DES: Drug eluting stent; LVEF: Left ventricular ejection fraction.

Table 3: In-hospital Outcome of Procedure in Primary PCI and Rescue PCI Groups			
Characteristics	**Rescue PCI Group, (n = 22)**	**Primary PCI Group, (n = 107)**	**P value**
In-hospital mortality	2 (9.5)	4 (3.7)	0.255
Minor bleeding	1 (4.8)	4 (3.8)	0.832
Hematoma	0 (0.0)	4 (3.8)	0.999
Gastrointestinal bleeding	2 (9.5)	3 (2.8)	0.191
Post-catheterization blood pressure	118.05 ± 9.07	120.48 ± 21.83	0.610
Post-catheterization heart rate, /min	85.18 ± 18.21	81.49 ± 17.29	0.390
Length of stay in hospital, day	6.32 ± 2.24	6.61 ± 3.43	0.720
TIMI flow grade before discharge			
0	2 (12.5)	0 (0.0)	0.092
1	0 (0.0)	1 (1.4)	0.999
3	14 (87.5)	64 (98.5)	0.869

Data in table are presented as No. (%) or Mean ± SD.
TIMI: Thrombolysis in myocardial infarction.

Table 4: Long-term Outcome of Procedure in Primary PCI and Rescue PCI Groups			
Characteristics	**Rescue PCI Group, (n = 22)**	**Primary PCI Group, (n = 107)**	**P value**
Long-term death	0 (0.0)	2 (1.9)	0.999
Repeated angiography	0 (0.0)	20 (18.9)	0.023
Repeated PCI	0 (0.0)	16 (15.1)	0.047
CABG procedure	0 (0.0)	1 (0.9)	0.999
Stent thrombosis	0 (0.0)	1 (0.9)	0.999
Long-term LVEF	41.05 ± 9.57	44.29 ± 10.35	0.082
Mean number of admission	0.05 ± 0.21	0.19 ± 0.62	0.291

Data in table are presented as No. (%) or Mean ± SD.
PCI: Percutaneous coronary intervention; CABG: Coronary artery bypass graft; LVEF: Left ventricular ejection fraction.

Table 5: Main Determinants of Repeated PCI Following First PCI					
Variable	**Beta**	**SE**	**Wald**	**P value**	**Hazard Ratio**
Rescue vs. primary PCI	13.201	621.681	0.000	0.983	5.407
Male gender	-0.573	1.375	0.174	0.677	0.564
Age	-0.005	0.041	0.015	0.901	0.995
Hypertension	-0.967	1.395	0.481	0.488	0.380
Diabetes mellitus	0.997	1.327	0.564	0.453	2.711
Dyslipidemia	-0.571	0.946	0.363	0.547	0.565
Family history of CAD	10.461	1.210	1.456	0.228	4.309
Smoking	0.448	0.973	0.212	0.645	1.566
Opium use	0.642	1.242	0.267	0.605	1.900
Intra-aortic balloon pump	0.313	1.929	0.026	0.871	1.367
Number of diseased vessels	1.613	0.715	5.088	0.024	5.016
Infarcted vessel	0.431	0.499	0.744	0.388	1.538
First TIMI flow grade	-1.165	1.207	0.931	0.335	0.312
Aspirin use	-1.885	1.433	1.729	0.189	0.152
Beta-blocker use	3.062	2.333	1.724	0.189	21.379
ACE-inhibitor use	-0.331	1.848	0.032	0.858	0.718
Drug eluting stent use	-1.439	1.241	1.346	0.246	0.237

PCI: Percutaneous coronary intervention; CAD: Coronary artery disease; TIMI: Thrombolysis in myocardial infarction; ACE: Angiotensin converting enzyme.

DISCUSSION

Rescue PCI remains an infrequent procedure in various data registry analysis because many clinicians do not assess the success of reperfusion in patients with STEMI, who receive thrombolytic analysis, and only a minority are candidates for rescue PCI due to failed fibrinolysis [13]. As shown in our survey, most CAD patients requiring percutaneous interventions underwent primary PCI; only 17% of the study patients had rescue PCI because of thrombolysis failure. However, some researches have emphasized on the greater effectiveness of rescue PCI compared to primary PCI, while some others discuss the early and long-term consequences following primary PCI when compared to rescue PCI [14-16]. In our observation, both early and late outcome of the two procedures were assessed and compared. We first achieved a baseline balance between the baseline variables including demographics, cardiovascular risk factors, medications, and even cardiovascular functional state between primary PCI and rescue PCI groups. Also, in-hospital mortality, hospital stay and early post-procedural adverse events occurred at similar rates. Moreover, in the long-term follow-up, no differences were found in mortality, late stent thrombosis, and requirement for CABG between the two groups, however the need for repeat PCI was more prevalent in the primary PCI group. Despite this finding, multivariate hazard analysis could not demonstrate a difference in the requirement for repeat PCI in the primary PCI group compared to the rescue PCI group. In fact, the main predictor for greater need for repeat PCI was higher number of diseased coronary vessels, not the type of PCI procedure.

Former clinical trials and series reported contradictory results in early and late outcome of rescue PCI and primary PCI. In a study by Gao and colleagues [14], post-procedural patency rate and TIMI flow grade 3 were lower in the rescue PCI than in the primary PCI group. Also, in thirty-day follow-up, mortality rate and rates of myocardial infarction and bleeding complications was higher in the rescue PCI when compared to primary PCI. Contrary to these findings, Rebuzzi et al. [15] showed lowering rate of heart failure and increasing one-year survival after rescue PCI. Gimelli et al. [16] also showed higher rates of six-month morbidity defined as the occurrence of at least one of the events of death, recurrent MI, repeat PCI, CABG and recurrent angina in the primary group compared to the rescue group, yet this difference was not statistically significant. In our observation, although repeat PCI occurred more in the long-term in the primary PCI group than in the rescue PCI group in univariate analysis, yet this difference was not observed using cox-proportional hazard modeling. On the other hand, there was no difference in long-term mortality and morbidity between the two PCI procedures.

In our study, the number of diseased coronary vessels and thus the number of used stents was only a predictor for PCI requirement following initial PCI procedure. In fact, our study identified CAD severity and therefore the need for more stent implantations as a main determinant for stent restenosis leading to a repeat PCI procedure. In a study which compared the outcome of PCI between youth and elderly, predictors for long-term MACE included multi-vessel coronary disease along with advanced age, occurrence of thrombolysis, and cardiogenic shock [17]. Although various studies have emphasized both patient-related factors (especially medications, diabetes and other inflammatory-based disease conditions) and procedural variables (such as size of stents and multiple stents), in our study, none of the baseline characteristics including the type of used drugs, type of applied stent, and also cardiovascular risk factors could predict late stent restenosis requiring repeat PCI. In fact, multiple stenting due to multi-vessel involvement can be a potential predictor for requiring repeat PCI.

We concluded from the current comparative analysis between the two rescue and primary PCI procedures in STEMI patients that no difference was observable in both in-hospital and long-term mortality and complications. However, the LVEF was lower in rescue PCI group than the primary PCI group during admission, but in late follow-up, it was similar between these two groups. This means that left ventricular function improved more in patients who underwent rescue PCI not primary PCI.

Limitations of the Study

Limitations of this study were small number of participants, thus the findings should be used with care and, further studies need to be accomplished to confirm the results.

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CONFLICTS OF INTEREST

The authors had no conflict of interest.

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