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Original Article

Outcome of Primary PCI in ST-Segment-Elevation Myocardial Infarction

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ABSTRACT

Background: We sought to assess the feasibility and outcome of primary percutaneous coronary intervention (PCI) for ST-segment elevation myocardial infarction (STEMI).

Methods: Between April 2014 and April 2015, consecutive STEMI patients who underwent primary PCI were prospectively enrolled in a primary PCI registry. The patients' demographics, risk factors, procedural characteristics, and in-hospital and 6-month major adverse cardiac events (MACE) were assessed.

Results: A total of 393 patients underwent primary PCI during this period. The mean age was 58±11 years and 80.6% were male. Additionally, 40.7% of the patients were hypertensive, 37.9% had dyslipidemia, 37.7% were smokers, and 29% had diabetes mellitus. Single-vessel disease was found in 36.6% of the study population, 2-vessel disease in 30.5%, and multivessel disease in 27.7%. At admission, 74.5% of the patients had TIMI grade 0 flow. Following revascularization, 74.7% achieved TIMI grade 3 flow, 22% TIMI grade 2 flow, and 1.8% TIMI grade 1 flow—whereas 1.5% had TIMI grade 0 flow. The predictors of the TIMI flow grade after primary PCI included history of diabetes mellitus, lesion severity, time elapsed from symptom onset to admission, and use of thrombectomy. Stent thrombosis developed in 5.6% of the patients; it was more frequent among those receiving bare-metal stents. The in-hospital and 6-month mortality rates were 5.9% and 2.3%, correspondingly. In-hospital mortality was strongly related to the TIMI flow grade.

Conclusions: Our study demonstrated that the outcome of primary PCI was strongly related to the postprocedural TIMI flow grade. Patients with lower TIMI flow grades postprocedurally should receive special attention. ***(Iranian Heart Journal 2016; 17(3):6-11)***

Keywords: ST-segment elevation myocardial infarction ■ Primary PCI■ Thrombolysis in myocardial infarction (TIMI) flow ■ Major adverse cardiovascular events

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Over the past decade, cardiovascular disease (CVD) has emerged as the single most important cause of death worldwide. In 2010, CVD accounted for approximately 30% of all deaths and 11% of all the disability-adjusted life years lost that year.

Ischemic heart disease may be manifested clinically as chronic stable angina or acute coronary syndrome. The latter, in turn, can be subdivided into ST-segment-elevation myocardial infarction (STEMI), non-ST-segment-elevation myocardial infarction (NSTEMI), and unstable angina.

The clinical diagnosis of MI requires a clinical syndrome indicative of myocardial ischemia with some combination of evidence of myocardial necrosis on biochemical, ECG, or imaging modalities.

Despite advances in diagnosis and management, STEMI remains a major public health problem in the industrialized world and is on the rise in developing countries. The overall number of deaths from STEMI, following a steady rise in the final decades of the previous century, has stabilized over the past decade. According to estimates from the American Heart Association, the short-term mortality rate of patients with STEMI ranges from 5% to 6% during the initial hospitalization and 7% to 18% at 1 year. The rate of appropriate initiation of reperfusion therapy varies widely, with up to 30% of patients with STEMI eligible to receive reperfusion therapy not receiving this lifesaving treatment according to some registries.[1]

The past 2 decades have witnessed dramatic changes in the care of patients with STEMI. Randomized controlled trials in the early 1990s showed that primary percutaneous coronary intervention (PCI) was superior to fibrinolytic therapy, and a 2003 meta-analysis of 23 clinical trials firmly established primary PCI as the preferred treatment for STEMI patients.[2] Primary PCI is generally the preferred option provided that an experienced operator and team can perform it in a timely fashion. This approach has evolved from the passage of a balloon catheter over a guide wire to potent oral antiplatelet therapy, multiple options for anticoagulants, coronary stents, and thrombectomy. Missed opportunities for improvement in the care of STEMI include failure to deliver any form of reperfusion therapy in approximately 20% of patients and failure to minimize delays in reperfusion because of inefficient systems of care.[1]

The introduction of primary PCI has reduced patient mortality and improved outcomes in comparison with fibrinolysis, which was the previous standard.[3]

The present paper reviews the outcome of primary PCI in patients with STEMI.

METHODS

This is a single-center trial with a prospective cross-sectional design of acute STEMI patients undergoing primary PCI. Totally, 393 patients were initially evaluated between April 2014 and April 2015. Patients were considered eligible if they were >18 years of age, with acute STEMI, and indication for primary PCI based on clinical and ECG characteristics. The exclusion criteria were comprised of late comers (>24 hours from the onset of chest pain), coronary anatomy or mechanical complications of acute MI requiring emergent surgery, failed thrombolysis, and post CABG patients. The institutional Ethics Committee of Rajaie Cardiovascular, Medical, and Research Center approved the trial design.

Procedural Protocol and Follow-Up

The clinical, laboratory, and procedural characteristics of the studied patients were collected and entered in a questionnaire.

The patients received 325 mg of aspirin and 600 mg of clopidogrel in the emergency department. Coronary angiography and primary PCI procedures were performed according to the standard routines. The intention to treat was for the culprit artery.

Heparin was administered with the dose of 50–100 IU/kg to maintain an activated clotting time >250–300 s depending on the use of concomitant glycoprotein IIb/IIIa inhibitors. Manual thrombectomy was carried out in cases with large thrombus burden. Peak cardiac troponin I (cTnI) and creatine-kinase MB (CK-MB) levels were defined as the highest amount obtained by serial (3 times) enzyme check during the first 24 hours of admission. A complete echocardiographic study was performed on the patients the day after primary PCI. The left ventricular ejection fraction was estimated using the Simpson equation in the 4-chamber view. All the echocardiograms were performed by a single attending physician to avoid interobserver variability.

The patients were observed during the hospitalization and a 6-month period.

Primary and Secondary End Points

The primary end points of this study were the pre- and postprocedural epicardial blood flow of the culprit artery measured as the thrombolysis in myocardial infarction (TIMI) flow, and the secondary end points were in-hospital mortality and 6-month major adverse cardiac events (MACE) (defined as death, acute coronary event, target vessel revascularization, and cerebrovascular events).

RESULTS

A total of 393 patients were enrolled in the present study. The mean age of the participants was 58±11 years, and 317 (80.66%) of the patients were male.

The most common cardiovascular risk factor was hypertension, observed in 160 (40.7%) patients, followed by dyslipidemia, seen in 149 (37.9%) patients. Additionally, 148 (37.7%) patients were smokers, 114 (29%) had diabetes mellitus, and 63 (16%) had a positive family history of CVD.

The time elapsed from symptom onset to admission was <2 hours in 71 (18%) patients, between 2 and 6 hours in 140 (35.6%), between 6 and 12 hours in 107 (27.2%), and >12 hours in 75 (19.1%).

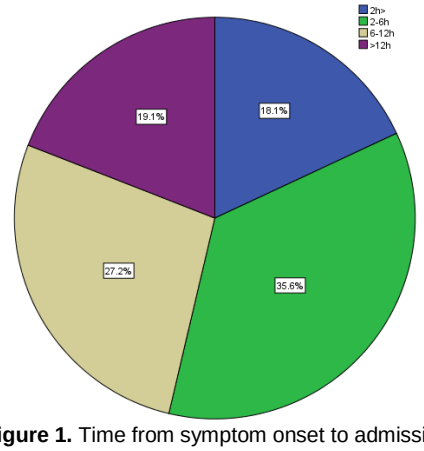


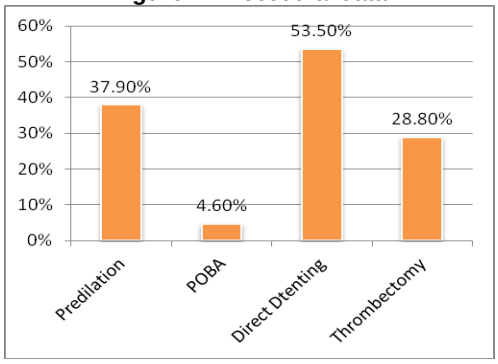
Figure 1. Time from symptom onset to admission

The prevalence of the different number of diseased vessels among the study population comprised single-vessel disease in 144 (36.6%) patients, 2-vessel disease in 120 (30.5%), and multivessel disease in 109 (27.7%). Left main lesion was observed in 12 patients.

The most common culprit lesion severity was total occlusion, observed in 273 (69.4%) patients, followed by 90–99% occlusive lesion in 95 (24.1%), 70–90% occlusive lesion in 19 (4.8%), and 50–70% occlusive lesion in 1.

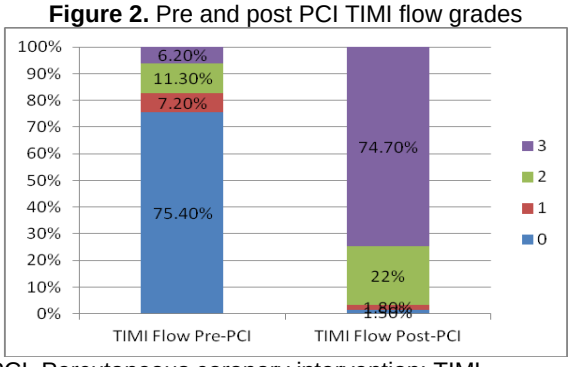
Type A coronary lesion was observed in 9 (2.2%) patients, type B in 78 (19.8%), and type C in 252 (64.1%). Additionally, significant calcification was seen in 33 (8.3%) patients.

Figure 1. Procedural data



POBA, Plain old balloon angioplasty

Figure 2. Pre and post PCI TIMI flow grades



PCI, Percutaneous coronary intervention; TIMI, Thrombolysis in myocardial infarction

The median of peak post-PCI troponin levels among the patients was 9.97 (2.6–23.5), and the median of peak post-PCI CK-MB levels was 219 (91–350).

Figure 3. Prevalence of procedural complications

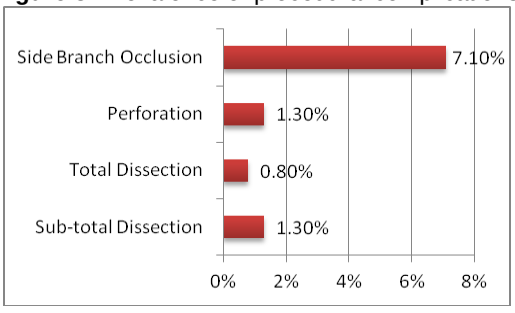
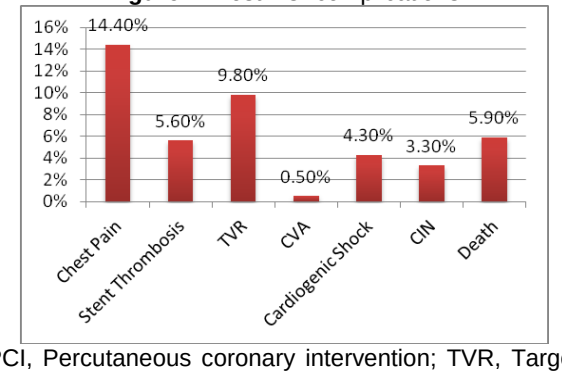


Figure 4. Post PCI complications



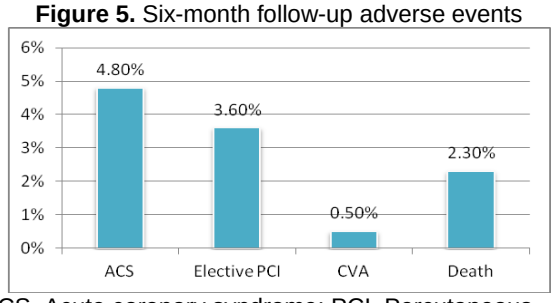
PCI, Percutaneous coronary intervention; TVR, Target vessel revascularization; CVA, Cerebrovascular accident; CIN, Contrast-induced nephropathy

The mean of the postprocedural left ventricular ejection fraction was 36%. Mild mitral regurgitation was observed in 322 (81.9%) patients and moderate mitral regurgitation in 47 (11.9%); 24 (6.1%) patients had no mitral regurgitation.

ST-resolution was seen in 278 (70.7%) patients.

Q-wave formation was observed in 269 (64.8%) patients postprocedurally.

Figure 5. Six-month follow-up adverse events



ACS, Acute coronary syndrome; PCI, Percutaneous coronary intervention; CVA, Cerebrovascular accident

CONCLUSIONS

The present study was conducted on 393 patients (80.6% male) at a mean age of 58±11 years. Hypertension was detected in 40.7% of the patients, dyslipidemia in 7.9%, and diabetes mellitus in 29%. Smokers accounted for 37.7% of the whole study population. Single-vessel disease was found in 36.6%, 2-vessel disease in 30.5%, and multivessel disease in 27.7% of the study group. The most common culprit lesion severity was total occlusion, which was observed in 69.4% of the patients with type C lesions.

Growing evidence suggests that a poor coronary blood flow after primary PCI is associated with unfavorable clinical outcomes.[4] In our study, 74.5% of the patients had TIMI grade 0 flow at admission. However, after revascularization, 74.7% achieved TIMI grade 3 flow, 22% TIMI grade 2 flow, and 1.8% TIMI grade 1 flow—while 1.5% of the study population had TIMI grade 0 flow.

Our results revealed that the predictors of the TIMI flow grade after primary PCI included a history of diabetes mellitus, lesion severity, time elapsed from symptom onset to admission, and use of thrombectomy.

Table 1. Relation between the TIMI flow grade and risk factors

	TIMI<3	TIMI=3	*P*
Number	99	292	-
DM	39 (39.4%)	75 (25.7%)	0.009
Multivessel disease	61 (61.6%)	186 (63.7%)	0.710
Type of stenosis			0.367
Type A	3 (3%)	7 (2.4%)	
Type B	33 (33.3%)	98 (33.6%)	
Type C	63 (63.6%)	186 (64%)	
Significant calcification	9 (9.1%)	24 (8.2%)	0.787
Thrombectomy	42 (32.4%)	71 (34.3%)	0.001
Lesion severity			0.05
50 – 70%	0 (0%)	1 (0.3%)	
70 – 90%	2 (2%)	17 (5.9%)	
90 – 99%	20 (20.4%)	75 (25.9%)	
100	76 (77.6%)	197 (67.9%)	
CP onset			0.008
< 6 h	39 (39.4%)	172 (58.9%)	
> 6 h	60 (60.6%)	120 (41%)	

TIMI, Thrombolysis in myocardial infarction; DM, Diabetes mellitus; CP, Chest pain

Adel Jamal et al.[5] showed that the predictors of the TIMI flow grade included diabetes mellitus, symptom duration, Killip class, thrombus burden, pre-dilation, total nature of the occlusion, patency of the infarct-related artery, multivessel disease, and length of deployed stents.

In the hospital course after primary PCI, 14.4% of the patients had episodes of chest pain and 5.6% developed stent thrombosis. Early coronary stent thrombosis occurs most frequently after primary PCI for STEMI, with its specific risk factors including postprocedurally discovered dissection, undersizing and smaller stent diameters, absence of glycoprotein IIb/IIIa therapy, and use of drug-eluting stents.[6] In our study, stent thrombosis was more frequent in the patients receiving bare-metal stents, and there was no relation between stent thrombosis and history of diabetes mellitus, kind of stenosis, significant calcification, multivessel disease, and postprocedurally discovered dissection.

Table 2. Relation between stent thrombosis and risk factors

	No	Yes	*P*
None	369	22	
Diabetes mellitus	109 (29.5%)	5 (22.7%)	0.495
Multivessel	235 (63.7%)	12 (54.5%)	0.388
Type of stenosis			0.562
Type A	10 (2.7%)	0	
Type B	126 (34.1%)	5 (22.7%)	
Type C	233 (63.1%)	17 (77.3%)	
Significant calcification	31 (8.4%)	2 (9.1%)	0.910
Bare-metal stent	226 (61.7%)	14 (63.6%)	0.859
Drug-eluting stent	113 (30.9%)	2 (9.1%)	0.03
Dissection	8 (2.2%)	0	0.626

A simple method for determining prognosis after primary PCI is ST-segment-elevation recovery.[7]

In the current study, ST-resolution was seen in 70.7% of the patients and it provided strong prognostic information regarding the clinical outcomes.

Q-wave formation was observed in 64.8% of our study population. The association between the Q wave and the infarct size is strongest when the classic Q-wave criteria are employed. Q-wave regression is associated with the largest improvement in the left ventricular ejection fraction as assessed with cardiac magnetic resonance imaging.[8] ECG information can be drawn upon for the prediction of the clinical outcome.

After primary PCI, 81.9% of our patients had mild and 11.9% moderate mitral regurgitation, whereas 6.1% of the patients had no mitral regurgitation. Ischemic mitral regurgitation is a frequent finding after primary PCI, and the regression of early ischemic mitral regurgitation during a long-term follow-up is uncommon. Since moderate-to-severe ischemic mitral regurgitation post primary PCI appears to be correlated with worse outcomes, a close follow-up is required.[9]

In the present study, the in-hospital and 6-month mortality rates were 5.9% and 2.3%, respectively. In-hospital mortality is strongly related to the TIMI flow grade and high-risk complications that develop during admission. There were 23 in-hospital deaths in our study: 16 deaths among the patients with TIMI grade <3 flow and 7 deaths among the patients with TIMI grade 3 flow (P<0.001).

Accordingly, patients with high-risk complications and lower TIMI flow grades postprocedurally should receive special attention.

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