

Factors affecting outcome of primary percutaneous coronary intervention for acute myocardial infarction

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Original Article

Abstract

BACKGROUND: Primary percutaneous coronary intervention (PCI) is the main treatment for patients with ST-segment elevation myocardial infarction (STEMI). We investigated factors affecting the major complications of this procedure.

METHODS: This case-control study assessed 200 patients receiving primary PCI for STEMI. Effects of some factors including age, sex, coronary artery risk factors, left ventricular function, thrombolysis in myocardial infarction (TIMI) flow, and number of involved vessels on major adverse cardiac events (MACE) were studied.

RESULTS: Two thirds of patients were male but sex had no significant effect on MACE. Similarly, age, hypertension, and hyperlipidemia did not significantly affect the incidence of MACE. However, Killip class, left ventricular ejection fraction, diabetes, TIMI flow, and type of involved vessels had significant relations with the incidence of MACE.

CONCLUSION: According to our findings, factors such as diabetes, left ventricular function, left anterior descending artery involvement, and low TIMI flow are risk factors of MACE.

Keywords: Primary Percutaneous Coronary Intervention, ST-Segment Elevation Myocardial Infarction, Major Adverse Cardiac Events

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Introduction

Myocardial infarction is one of the main causes of mortality in the world which is mainly treated with fibrinolytic drugs and percutaneous coronary intervention (PCI).¹ While one third of patients undergoing primary PCI are women, mortality rates are higher among women than in men.² Moreover, some studies have identified high age as a predictor of major adverse cardiac events (MACE) after primary PCI for myocardial infarction.^{3,4} Patients with diabetes who receive primary PCI for ST-segment elevation myocardial infarction (STEMI) are also at higher risk of mortality especially during hospitalization and the first year following the procedure.⁵⁻⁷ On the other hand, some studies have demonstrated better reperfusion after PCI in

smokers compared to nonsmokers.⁸

Arterial hypertension is a poor prognostic risk factor in patients with acute coronary syndrome.^{9,10} In patients with myocardial infarction, high lipoprotein (a) levels have been found to be associated with adverse long-term results.¹¹ In addition, many studies have suggested thrombolysis in myocardial infarction (TIMI) flow grade 3 to improve survival rates and reduce complications.¹²⁻¹⁴ Patients undergoing primary PCI will also have an increased risk of MACE in presence of multivessel coronary artery disease.^{15,16} Another risk factor of MACE in patients receiving primary PCI is lower left ventricular ejection fraction (LVEF).^{17,18} Finally, shorter interval between the onset of myocardial infarction

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symptoms and primary PCI will lead to better results. The most favorable interval has been determined as 90 minutes.^{19,20} The present study was conducted to determine factors that influence the outcome of patients who underwent primary PCI due to myocardial infarction.

Materials and Methods

This case-control study was performed in Chmaran Hospital (Esfahan, Iran) in 2011-2012. Considering $\alpha = 0.05$, $\beta = 0.2$, and $d = 0.5$, the number of participants in each group was determined as 100. Patients admitted with acute chest pain within 6 hours and ST elevation in two leads on one surface of 12-lead EKG or patient with STEMI without response to streptokinase who were suitable for primary PCI were included in this study. Patients with contraindications to PCI, e.g. left main coronary artery involvement or not knowing the responsible vessel, were excluded from the study. During hospital stay, patients who died or had complication including serious arrhythmias (ventricular fibrillation and ventricular tachycardia), heart failure, bleeding of the artery that needed blood transmission, or needed a second PCI of the same vessel were allocated to the case group and other patients that had not this complications were allocated to the control group.

At admission, the patients' demographic information (age, sex, and occupation) and risk factors including diabetes, smoking, hypertension, hyperlipidemia, and family history were obtained. Left ventricular function was assessed using echocardiography before coronary angiography or left ventricular angiography. During angiography, TIMI flow and number of involved vessels were determined. The intervals between the onset of symptoms and hospital admission and between hospital admission and PCI were also recorded. Qualitative items were obtained by check list. Blood pressure was assessed using mercury barometer and adult cuff. LV function in patient without LV angiogram was assessed using two-dimension echocardiography in three planes by a colleague. Severity of coronary stenosis and TIMI flow were assessed by interventionist and then reevaluated by investigator for prevention of operator biases.

During the hospital stay, patients were examined daily to find any major complications following PCI (as mentioned for definition of case group). We defined heart failure as the simultaneous occurrence of low LVEF with dyspnea, orthopnea, and pulmonary rale, or the third heart sound.

Informed consents were obtained from all patients to participate in the study. The study protocol was also approved by the research ethics committee of Isfahan University of Medical Sciences (Isfahan, Iran). The confidentiality of information was ensured. The collected data was analyzed with Student's t-test and chi-square test in SPSS software (SPSS Inc., Chicago, IL, USA). Ethical approval code was 391372 obtained in 17 January 2012.

Results

In this study, 200 patients [46 (23%) females] with STEMI who underwent primary PCI were evaluated in two groups of case and control. Although two thirds of the patients in both groups were men, sex had no significant effect on patients' outcome. The mean age of the subjects in the case and control groups was 60.2 and 59.3, respectively ($P = 0.669$) (Table 1).

The mean diastolic and systolic blood pressure of the case group was 80.7 and 113.5 mmHg, respectively. The corresponding values were 83.1 and 120.3 mmHg in the control group. Despite the lower values in the case group, the two groups were not significantly different in terms of diastolic or systolic blood pressure (Table 1).

On the other hand, the majority of patients with Killip class 2 or 3 were in the case group and the two groups were significantly different in this regard ($P < 0.001$). In contrast, no significant associations were found between hyperlipidemia or family history and outcome of patients who received primary PCI ($P = 0.747$). Smoking was slightly more frequent in the case group but the difference between groups was not statistically significant ($P = 0.5$). Diabetes was detected in 34 patients in the case group and 13 patients in the control group ($P < 0.05$) (Table 1).

The average time interval between symptoms onset and hospital admission was 10.5 hours in the case group and 7.6 hours in the control group ($P = 0.391$). The average time interval between hospital admission and PCI was 3.4 hours in the case group and 3.6 hours in the control group ($P = 0.241$). However, the mean time from the onset of symptoms until PCI was 13.5 minutes in the case group and 11.2 minutes in the control group ($P = 0.046$) (Table 1).

Furthermore, the cases and controls were not significantly different in terms of the number of vessels with stenosis. While the two groups had significant differences in left anterior descending

artery (LAD) involvement or absolute obstruction, no significant differences were observed in other coronary arteries. The number of patients who underwent PCI for two or three vessels simultaneously was higher in the case group but this

difference was not statistically significant (Table 2).

The mean TIMI flow grade was 2.49 in the case group and 2.80 in the control group ($P < 0.05$). The mean LVEF in the case and control groups was 35.5% and 41.0%, respectively ($P < 0.05$).

Table 1. Demographic characteristics of patients undergoing percutaneous coronary intervention (PCI) for myocardial infarction

Variables	Groups		P
	Case (n = 100)	Control (n = 100)	
Gender (female)	24	22	1.000
Age (years)	60.20 ± 14.20	59.30 ± 10.70	0.669
Interval between symptoms onset and hospital admission (hours)	10.50 ± 19.00	7.85 ± 14.30	0.048
Interval between hospital admission and PCI (hours)	2.45 ± 2.05	3.58 ± 7.19	
Hyperlipidemia	21	24	0.703
Diabetes	34	13	0.005
Hypertension	31	33	0.747
Smoking	29	22	0.383

Values are mean ± SD or numbers (as both group included 100 subjects, percentages are not provided)
PCI: Percutaneous coronary intervention

Table 2. Vascular status and left ventricular function of patients undergoing percutaneous coronary intervention for myocardial infarction

Variable		Group		P
		Case (n = 100)	Control (n = 100)	
Number of involved vessels	1	86	91	0.248
	2	12	9	
	3	2	0	
Number of vessels receiving PCI	1	34	43	0.505
	2	51	36	
	3	15	21	
Left main coronary artery status	Normal	87	95	0.244
	Non-significant	11	5	
	Significant	0	0	
	Cut-off	2	0	
Left anterior descending artery status	Normal	9	13	0.046
	Non-significant	8	3	
	Significant	37	57	
	Cut-off	46	27	
Left circumflex artery status	Normal	56	56	0.271
	Non-significant	11	3	
	Significant	22	32	
	Cut-off	11	9	
Right coronary artery status	Normal	33	35	0.275
	Non-significant	10	2	
	Significant	32	33	
	Cut-off	25	30	
Ramus circumflexus status	Normal	92	98	0.013
	Non-significant	1	0	
	Significant	5	2	
	Cut-off	2	0	
Thrombolysis in myocardial infarction flow		2.49 ± 0.80	2.80 ± 0.53	0.010
Left ventricular function		35.5 ± 12.1	41.0 ± 11.00	0.013

Values are mean ± SD or numbers (as both group included 100 subjects, percentages are not provided)
PCI: Percutaneous coronary intervention

Discussion

This study sought to identify factors affecting MACE in patients who underwent primary PCI for STEMI. Although two thirds of patients were men, sex had no significant effect on MACE. However, some studies have found higher mortality rates in women than in men.² The absence of such a higher risk among our female participants emphasizes the benefits of primary PCI in women.

While according to our findings the incidence of MACE was not related with age, increased age generally increases the risk of mortality in patients with myocardial infarction.^{3,4} Since very old patients with STEMI did not undergo primary PCI and were prescribed with pharmacological treatment instead, this difference is justifiable.

We found diabetes to increase the risk of MACE in patients who received primary PCI for STEMI. In other words, diabetes was significantly more prevalent in the group with complications than in the control group. Various studies have also highlighted the short-term (during hospitalization and the first year after the disease) and long-term effects of diabetes on the MACE.⁵⁻⁷ Diabetes can thus be considered as a risk factor for MACE after primary PCI.

Smoking is another major risk factor for coronary artery disease. The importance of smoking in the incidence of MACE after primary PCI is a matter of concern. In this study, smoking did not have any negative effects on MACE. However, a previous research reported better reperfusion rate after PCI in smokers.⁸

High arterial blood pressure is a risk factor for coronary artery disease and increases the risk of complications after acute coronary syndrome.^{9,10} However, we not find significant differences in level of blood pressure between the two groups.

Despite the fact that hyperlipidemia is a risk factor for coronary artery disease, it had no significant effects on the incidence of MACE in this study. Some studies have identified high levels of lipoprotein (a) to be associated with poor outcome in patients with acute myocardial infarction.¹¹

TIMI flow is one of the important factors in determining the outcome of PCI in patients with STEMI. Good TIMI flow at the time of angiography and PCI is a determinant of MACE in patients undergoing primary PCI. Patients with TIMI flow grade 3 are expected to have higher survival rates and fewer complications following primary PCI.¹²⁻¹⁴ In the present study, TIMI flow grade 3 was associated with reduced MACE in

patients receiving primary PCI for STEMI.

A major determinant of patients' survival and the incidence of MACE after primary PCI is left ventricular function. Better left ventricular function is associated with improved survival. On the other hand, low LVEF leads to higher incidence of MACE.^{17,18} In the current study, low LVEF had statistically significant effect on MACE in patients undergoing primary PCI.

We also observed a significant relation between higher Killip class and increased incidence of MACE. Killip class is a kind of classification for heart failure rate after a myocardial infarction based on clinical symptoms. Higher Killip classes are usually associated with lower LVEF.

There was no significant relationship between the number of involved vessels in patients and MACE. However, LAD involvement was significantly more prevalent in patients who developed complications following STEMI than in the controls. This finding confirms the importance of LAD involvement in patients with myocardial infarction. Some studies have also introduced multivessel involvement in patients to increase the risk of primary PCI complications.^{15,16}

In the present study, the mean interval between the onset of symptoms and hospital admission was too long. Similarly, the interval between entrance to emergency department and PCI was much longer than the recommended time (90 minutes from door to PCI).^{19,20} As such long delays increase patients' mortality and risk of MACE, their reasons need to be investigated.

Conclusion

In this study, factors with effect on outcome in patients under primary PCI included diabetes mellitus, low left ventricular function, left anterior descending artery involvement, and low TIMI flow.

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Conflict of Interests

Authors have no conflict of interests.

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