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Original Article

Comparison of the Prevalence of Postprocedural Myocardial Infarction Between Diabetic and Nondiabetic Patients in a Non-Emergent Setting

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ABSTRACT

Background: Diabetes is the cause of 25% of all the cases of coronary artery disease and myocardial infarction (MI). One of the best interventions for coronary artery occlusion treatment is percutaneous coronary intervention (PCI). In PCI, myocardial area size, lesion morphology, cardiac function, renal failure, and other comorbidities are very important. Evaluation of the periprocedural MI prevalence is significant for comparing diabetic and nondiabetic patients.

Methods: This cross-sectional study was done in Rajaie Cardiovascular, Medical, and Research Center by convenience sampling in 2009. PCI was performed on 605 patients, comprising 171 diabetic and 434 nondiabetic patients. Our information form included the type of contrast, arterial access, diabetic type, blood glucose control, lab tests, and number of coronary artery lesions. The incidence of postprocedural MI was evaluated by the measurement of CK-MB. The data were then entered into SPSS before they were described and analyzed. The χ^2 test and the *t*-test were employed for data evaluation.

Results: The incidence of post procedural MI was 2.9% in the diabetics and 2.5% in the nondiabetics. Moreover, 71.7 % of the patients were diabetic and 28.3% were nondiabetic. The blood glucose level was controlled in 12.6% of the study population, while it was not controlled in 87.4%. The *P* value for the comparison of periprocedural MI between the diabetic and nondiabetic patients was 0.788. All of the 5 diabetic patients with periprocedural MI belonged to the uncontrolled blood glucose group. The highest frequency of MI was in the patients with 3-vessel PCI (*P*=0.027).

Conclusions: No significant statistical difference was observed regarding postprocedural MI between the diabetic and nondiabetic patients. Preprocedural MI was more frequent in the patients with 3-vessel PCI. PCI is a safe procedure with a low incidence rate of postprocedural MI. ***(Iranian Heart Journal 2017; 18(2):36-42)***

Keywords: Myocardial infarction, Stent, troponin, Arterial access, Coronary artery disease, Percutaneous coronary intervention

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Coronary artery disease (CAD) is the most common cause of death in humans. More than half of the deaths are due to the involvement of the coronary arteries. [1] Heart diseases cause 38% of all deaths in North America. Therefore, a better understanding of this disease and its treatment and preventive measures is vitally important for medical management strategies. [2, 3] Type I diabetes is one of the most common chronic diseases and risk factors for CAD. The probability of CAD in diabetic patients is 2 to 4 times more than that in nondiabetic patients. [2] In diabetics, inflammation and prothrombotic status are involved in CAD. The main treatment of CAD includes prescription of anticoagulant drugs and heparin as well as early invasive interventions. [4] Blood lipid-lowering drugs also play an important role in preventing myocardial infarction (MI) in diabetic and nondiabetic patients. [5] On average, a quarter of patients with CAD and MI have diabetes. [6] One of the intervening methods to remove the obstruction of the coronary arteries is percutaneous coronary intervention (PCI). One million PCI procedures are performed in the United States annually, which is more than the number of the cases of coronary artery bypass graft surgery (CABG). [1] Evidence suggests that diabetic patients with MI have a worse prognosis after MI than nondiabetic patients, and they need highly aggressive treatments such as PCI. [1] Currently, the number of PCI cases is more than that of CABG cases. [1] In diabetic patients with CAD who undergo PCI, the mortality rate is 3.3%, while it is 2.1% in nondiabetic patients. [5] Coronary angioplasty was performed for the 1st time by balloon (percutaneous transluminal coronary angioplasty [PTCA]) in 1977 and it has been markedly developed since then. Significant improvements in this method include the use of vascular stents, embolic protection devices, and endarterectomy devices. In the absence of major coronary stenosis and diffuse CAD, PCI is the preferred revascularization method in the United States and many other countries. [1] Periprocedural PCI is one of the most common side effects of it, and there are 2 classification systems to classify MI. In a common system, MI is defined as increased postprocedural CK-MB 3 times or more than the normal value. [7] No reflow after successful PCI has been seen in diabetic patients or patients with high blood glucose levels compared to nondiabetic patients. [1] Some of the most important considerations in patients with PCI include myocardial area at risk, morphology of the lesion, underlying cardiac performance, renal failure, and associated illnesses. One important factor in the success of PCI is the type and shape of the lesion. PCI success is low in chronic total occlusion, PCI on saphenous vein grafts, calcified lesions, bifurcation, and thrombotic lesions. [1] In a study conducted by Brighori et al, [8] 280 patients with type 2 diabetes undergoing elective PCI successfully were evaluated and major cardiovascular events—including nonfatal MI and need for repeated revascularization in the PCI vessel—were examined. Major cardiovascular events significantly decreased in the diabetic patients. Brighori and colleagues, accordingly, highlighted the effects of intensive treatment and risk factors on the reduction of mortality in diabetic patients. [8] In a study conducted by Chong-Jian et al, [7] it was found that acute and subacute thrombosis was higher in diabetics than in nondiabetics, and diabetes was not an independent predictor of major cardiac events (even after matching in terms of age, sex, blood pressure, body mass index, dyslipidemia, smoking, and family history of heart disease) during hospitalization. Elsewhere, Laskey et al [9] studied diabetic and nondiabetic patients undergoing PCI and compared them in terms of annual consequences and consequences during hospitalization. The authors reported

that in-hospital mortality was markedly higher in the diabetics and 1-year mortality in the diabetic patients was significantly higher than that in the nondiabetics. Additionally, the PCI success rate was similar between their both groups, but mortality was higher in the diabetic patients after 1 year.

Given the prevalence of diabetes and the importance of diabetes in patients undergoing PCI, we sought to measure periprocedural MI in patients referred to Rajaie Cardiovascular, Medical, and Research Center (a major referral center in Tehran, Iran) and to compare its incidence between diabetics and nondiabetics.

METHODS

The present research was conducted on patients in the angiography and admission wards of Rajaie Cardiovascular, Medical, and Research Center, Tehran, Iran, in 2009, in a cohort method. Diabetics and nondiabetics undergoing elective coronary angiography were included in the study after PCI. Thereafter, they underwent cardiac enzyme examination (troponin 1 and CK-MB) and ECG during a 24-hour period. According to the formula $n = 2 (z\ 1\text{-}\alpha / 2 + z\ 1\text{-}\beta)\ 2 \times p\ (1\text{-}p) / (p1\text{-}p2)\ 2$, the sample size was obtained. There were 111 subjects in each group by calculating an alpha error of 0.05, beta error of 0.1, p1 (10%), and p2 (25%). Patient information included demographic characteristics (age, sex, body mass index, and blood pressure), coronary disease risk factors (hypertension, smoking, hyperlipidemia, and family history of CAD), lesion characteristics (non c-patent, non c-occluded , type c patent, and type c occluded), left ventricular function, coronary artery status (number of vessels involved and type of PCI vessel), volume and type of the consumed contrast in periprocedural MI (based on CK-MB ECG changes and chest pain), diabetic status (presence or absence of diabetes, type of diabetes, type of medication for diabetes, average fasting blood glucose levels, and average blood glucose 2 hours after a meal), laboratory tests (hemoglobin, sodium, potassium, , BUN, creatinine, and glomerular filtration rate), and vascular access (femoral or non-femoral); the data were collected through forms and were analyzed. In each patient, the amount and type of the contrast agent used in the periprocedural MI patients were recorded based on CK-MB, ECG changes, and chest pain. The patients, who selectively underwent coronary angiography and PCI, were divided into 2 groups of diabetics and nondiabetics. After the transfer of the patients to the ward for ECG, 6 hours later and investigating cardiac enzymes such as CK-MB for 3 sessions at 8-hour intervals and 1 session of CTni, their information was recorded in the checklist and included in the form. The results were analyzed using SPSS. To analyze the data, we utilized the χ^2 test and the *t*-test and calculated the relative risk. Removal of the confounding variables was performed by using appropriate regression models such as logistic regression.

RESULTS

In the current study, 605 patients were examined. The study population comprised 434 (71.7%) nondiabetics and 171 (28.3%) diabetics. The other demographic information is depicted in Table 1.

Table 1. Patients' demographic information

Variables	N	%
Sex	Male: 439	72.6
	Female: 166	27.4
HTN HX	280	46.3
Smoking Hx	260	43
HLP Hx	254	42
CAD Hx	51	8.4

HTN, Hypertension; HLP, Hyperlipidemia; CAD, Coronary artery disease; Hx, History

Among the diabetic patients, 10% used insulin and 80.7% blood glucose-lowering

drugs, while 8.7% of the diabetic patients used no drugs. In 4.8% of the patients, the left ventricular outflow was less than 30% (Table 2).

Table 2. Classification of the patients according to the LVEF and the number of occluded coronary arteries

LVEF	N	%
≤30%	29	4.8
30%< ≤40%	86	14.2
40%< ≤50%	234	38.7
>50%	256	42.3

LVEF, Left ventricular ejection fraction

Apropos the coronary artery involvement, 1 coronary artery was involved in 43% of the patients, 2 coronary arteries in 38%, and 3 coronary arteries in 18.3. In this study, the type of lesion was examined based on the classifications of the Society for Cardiac Angiography and Interventions (SCAI). In the patients in whom more than 1 artery was subjected to PCI, the artery that had a lower successful lesion and a higher risk was considered as the criterion (Table 3).

Table 3. Classification of the patients according to the type of vascular lesions

Type of vascular lesions	N	%
Non-c, patent	411	4.8
Non-c, occluded	24	4
Type-c, patent	123	20.3
Type-c, occluded	47	7.8
Total	605	100

In this study, 98.2% of the patients underwent PCI through the femoral access and 8.1% via the non-femoral access. In 54% of the patients, the Ultravist contrast agent was used, and in 46% of the patients, Visipaque was used. According to the definition of periprocedural MI in this study (based on normal threefold or more increase in CK-MB in the first 24 hours after the intervention and 3 times of enzyme checking), the results of the incidence of MI in the diabetics and nondiabetics were obtained. The normal definition based on the testing kits of the hospital was CK-MB less than 24 mg/dL (Table 4).

Table 4. Comparison of the MI incidence after PCI between the diabetics and nondiabetics

Disease Type	MI^-		MI^+	
	N	%	N	%
Diabetic	166	97.1	5	2.9
Nondiabetic	423	97.5	11	2.5
Total	589	97.4	16	2.6
P=0.788				

MI, Myocardial infarction; PCI, Percutaneous coronary intervention

In this study, we obtained a *P* value of 0.788. Controlling blood glucose in this study means fasting blood glucose less than or equal to 130 mg % and blood glucose after 2 hours of eating food less than or equal to 180 mg %. Out of the 171 diabetic patients, information on 5 patients was unreliable and was removed. These 5 cases were not among the MI group. All of the diabetic patients who had periprocedural MI were in the group whose blood glucose was not controlled. In the control group, no case of MI was observed (Table 5).

Table 5. Comparison of periprocedural MI in the patients with diabetes by controlling blood glucose

Diabetes	MI^-		MI^+	
	N	%	N	%
Controlled	21	100	0	0
Uncontrolled	140	96.6	5	3.4
P=0.52				

MI, Myocardial infarction

The frequency of periprocedural MI in the diabetic patients based on vascular lesions (Table 6) and type of arteries involved (Table 7) was obtained in this way.

Table 6. Prevalence of periprocedural MI based on the type of vascular lesions in the diabetic patients

Type of Vascular Lesions	MI^-		MI^+	
	N	%	N	%
Non-c, patent	111	97.4	3	2.6
Non-c, occluded	6	100	0	0
Type-c, patent	35	94.6	2	5.4
Type-c, occluded	141	100	0	0

MI, Myocardial infarction

Table 7. Prevalence of periprocedural MI based on the number of vessels involved in the diabetics

Type of Vascular Lesions	MI⁻		MI⁺	
Number of involved vessels	N	%	N	%
One	75	96.2	3	3.8
Two	60	98.4	1	1.6
Three	31	96.9	1	3.1
P=0.847				

MI, Myocardial infarction

The frequency of periprocedural MI in all the patients (diabetics and nondiabetics) was higher in the patients with 3-vessel involvement (*P*=0.027). In the diabetic patients with periprocedural MI, the type and amount of the contrast agent used in this study were obtained as is illustrated in Table 8.

Table 8. Prevalence of periprocedural MI in the diabetic patients based on the contrast agent

Contrast Agent	MI⁻		MI⁺	
	N	%	N	%
Ultravist	89	97.8	2	2.2
Visipaque	77	96.3	3	3.7

MI, Myocardial infarction

DISCUSSION

PCI is a less invasive procedure than similar modalities. In this method, blocked arteries are opened by sending a balloon. A stent or a small mesh tube is placed into an opened artery after passing the balloon so that the bloodstream can reach the heart muscle. The type of stent is mainly drug-eluting covered by the drug, and the drug is released slowly and constantly and inhibits the re-blocking of the opened artery. [10] The incidence of periprocedural MI in diabetic and nondiabetic patients is 2.9% and 2.5%, respectively, and the difference is not significant. According to various studies conducted in different parts of the world, the incidence of MI in patients undergoing the procedure is between 3% and 11%. [1] Whereas the difference in the incidence of stroke is significant between diabetic and nondiabetic patients in some studies, other investigations have reported the difference as nonsignificant. [9] A previous study reported that the incidence of MI in the diabetic patients undergoing PCI was higher than that in the nondiabetic patients, and the result is in line with our research result. In patients with diabetes, this disease makes almost all segments of the coronary artery involved, rendering patients more susceptible to the risk of MI after the intervention. [11] The reason for nonsignificance in the difference between the 2 groups in terms of the incidence of MI is probably due to the use of a small sample size. Despite the great developments in intervention techniques and PCI, diabetes is an independent predictor factor for complications after the intervention. In a study conducted in 2004, it was found that the mortality rate was high in diabetic patients with CAD undergoing PCI compared to patients undergoing CABG. In fact, diabetic patients are at increased risk of MI after PCI. In terms of the incidence of periprocedural MI, there was no statistical difference between the patients based on blood glucose control or the absence of it. In similar studies in which control blood glucose has been described based on HGA1c levels or fasting blood glucose levels, results consistent with our research results have been obtained. In a study conducted by Giles et al [12] in 2009, it was concluded that good blood glucose control and the Hgba1c level less than or equal to 7 could not prevent the events of MI after PCI, and it was not an important indicator for the prediction of the incidence of coronary events. However, in other studies, a clear difference was found between glycemic control and reduced periprocedural MI. [13] In a study conducted by Corpus et al [14] in 2004, it was found that diabetic patients whose blood glucose was controlled and whose hemoglobin A1c level was less than or equal to 7% when they underwent PCI, the success rates in repairing blood vessels and MI after

PCI were lower. The type of diabetes treatment (insulin or blood glucose-lowering drugs) caused no difference in the incidence of periprocedural MI.

In a study conducted by Armen et al [15] in 2007, it was found that the therapeutic treatment of type II diabetes with pioglitazone was able to reduce the incidence of fatal and nonfatal MI. In contrast, in our study, there was no difference in the incidence of MI, which may have been due to our small sample size. Periprocedural MI showed no significant difference based on vascular lesions between the diabetic and nondiabetic patients. The incidence of periprocedural MI based on the number of vessels involved was significant in all the patients (diabetics and nondiabetics), and in the patients in whom a greater number of vessels were subjected to PCI, MI was seen frequently. However, this rate was not significant in the nondiabetic patients with respect to the number of the vessels involved. This may have been due to our small sample size. Various studies have proved that by increasing the number of the vessels involved in patients undergoing PCI, the incidence of MI increases. [16]

The type and amount of the contrast agent used caused no significant difference in the diabetic and nondiabetic groups in terms of the frequency of the incidence of periprocedural MI. Lack of significant difference between the 2 groups as regards the incidence of periprocedural MI may have been due to the small sample size and a larger sample size is recommended in future studies. In a review study conducted by Tavakol et al [17] in 2012, in clinical trials with large sample sizes, the type of the agent used in angiography had no relation with thrombotic events and the incidence of MI after PCI. The incidence of periprocedural MI in the diabetic patients between the 2 groups (controlled and uncontrolled blood glucose) showed no significant difference, but all the diabetic patients who experienced MI during the intervention were in the group whose blood glucose level was not controlled. In a study conducted in 2007, it was found that lifestyle changes, PCI interventions, and diet could help improve CAD patients and that the control of blood glucose was essential for the prevention of MI following PCI. [18] The absence of statistical significance may have been due to the small sample size and by increasing the number of patients, significant results could be obtained. In the present study, no specific limitation was found. It is recommended that similar studies with larger sample sizes be conducted with a view to performing a better comparison of the results.

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