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Evaluation of the incidence of peri-stent myocardial infarction and determining predictive risk factors in patients undergoing elective angioplasty referring to heshmat hospital in rasht

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Abstract

Introduction & Objective: Percutaneous Coronary Intervention (PCI) can be associated with a small but significant number of symptoms around procedure such as: myocardial infarction, thrombosis, stroke, broad bleeding or death, that among these symptoms, infarction around the procedure is the most common symptom. Therefore, the aim of this study was assessing the incidence of myocardial infarction around the stent and determining the predictive and preventive factors for this symptom.

Method: 442 patients based on the previous angiography were candidates for elective PCI. Demographic, laboratory, and angiographic variables and their relationship with the peri-procedure infarction were investigated. Previous ck-MB and 8 and 24 hours were measured. Items that had at least three-time increase from the upper normal limit were considered as PMI.

Results: Out of 442 patients with coronary PCI, 40 cases had CK-MB increase three-times more than the increase in URL (9.44%). 149 (33.7%) were female and 293 (66.3%) were male. Patients with a history of hyperlipidemia and low LVEF, low GFR and high Cr, high CRP, high ureic acid, no or low dose of statin, metformin (in diabetics), more stent, longer lesion length, more balloon sessions, were more likely to suffer from PMI.

Conclusion: Caring for renal function and administering adequate doses of statin and minimizing the number of balloon sessions can reduce the risk of post-PCI infarction.

Key words: Myocardial Infarction, Percutaneous Coronary Intervention, Myocardial Infarction peri-Angioplasty.

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Introduction:

Cardiovascular diseases are the most common causes of death in most countries of the world (1). These diseases have killed 16 million people that 82% of them were in developing countries (2). Although the mortality rate of cardiovascular disease in developed countries has been decreasing since the 1960s and 1970s, in developing countries as well as Iran, due to increased life expectancy, the share of cardiovascular disease among the death factors is rising and, according to the World Health Organization (WHO) prediction, it will be the leading cause of death all over the world in 2020 (3).

The pathological diagnosis of myocardial infarction requires evidence of myocyte death due to ischemia. Diagnostic findings include coagulation necrosis and contraction band necrosis along with myocytosis regions beside the infarction region. During the acute phase of myocardial infarction, myocytes die in the infarction area, followed by the inflammation process and then clearness of necrotic and restorative debris lead to the formation of scar tissue.

The clinical diagnosis of myocardial infarction requires clinical evidence of myocardial ischemia combined with

evidence of myocardial necrosis based on the ECG, biochemistry and imaging techniques.

The sensitivity and specificity of clinical instruments for diagnosis of myocardial infarction is clearly different depending on the time they are performed after the onset of an infarction.

Today, experts have proposed new criteria for diagnosing myocardial infarction. New definitions based on the conditions in which myocardial infarction occurs; divide myocardial infarction into five types. Revision of definitions and shifts towards sensitive biomarkers is important not only in patients' clinical care, but also in epidemiological studies, general health and clinical trials.

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Despite the advances in the diagnosis and treatment of myocardial infarction, this is still one of the major health problems in industrialized countries, and is also rising in developing countries. The rate of myocardial infarction increases both in women and in men with increasing age, and occurs more commonly in black men and women regardless of age. In observational studies, the proportion of patients with ACS suffered from STEMI was 29% to 47%. Of course, this estimate does not include an asymptomatic myocardial infarction, as this does not lead to fast admission. Between 1999 and 2008, the proportion of ACS and STEMI patients decreased by 50%.

Coronary artery angiography is the standard diagnostic method for coronary artery disease and, based on its findings, is an appropriate treatment for the diseases, including: medical treatment, treatment through percutaneous coronary intervention (PCI), and coronary artery bypass graft surgery (16, 17). PCI is one of the rising methods in the treatment of coronary artery disease and has increased by 226% in the United States, with increasing medical expertise and improving medical technology. However, PCI can be associated with a small but significant number of complications during and around a procedure such as: myocardial infarction, thrombosis, stroke, broad bleeding or death, among which the complications of infarction around the procedure is the most common procedure. Different studies have suggested different factors as an associated and effective factor in the incidence of PCI-induced infarction. Considering the high number of PCIs in the Heshmat Medical Center and the lack of sufficient study on the incidence of this disorder among patients in this area and also considering the high risk of MACE (cardiovascular major complications such as heart attack and death and stroke) and the cost due to the long-term hospitalization following the incident, we decided to study the PMI and identify the PMI-associated factors in patients with elective angioplasty in this center.

Methodology:

The present study is an analytical cross-sectional study that was conducted on a cohort of people who were diagnosed with coronary artery disease under elective PCI at Heshmat Hospital. In this study, the available sampling was performed from all patients diagnosed with coronary artery disease under elective PCI in Rasht Dr. Heshmat Heart Hospital and normal levels of troponin and

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CKMB before the procedure. Also, those who did not want to participate in the study, those who had a history of recent MI (last 2 weeks), patients with complete chronic obstruction so that the wire could not be crossed, patients with complicated calcification lesions that could not be crossed by the balloon, patients with Distal protection devices and atheroablative, or thrombectomy, are treated with aspiration, patients with left ventricular stenosis of more than 50% with angioplasty alone, patients undergoing hemodialysis, or any death during or after the PCI due to non- MI and diseases other than MI that increase Ck-MB were excluded from the study. Primary demographic information including age, sex, history of diseases (CKD HLP) recorded from patient files, laboratory factors, Plt / lymph, Plt, CK-MB. HDL LDL) CRP. eGFR, MPV, WBC, RDW, TG, CHOL, UricAcid), angiographic factors (Left or right dominant factors, Bifurcation lesion, LAD lesion, Long lesion, DES, Multi vessel disease) procedure factors (Radial or femoral access) was collected by the resident responsible for the project and entered the checklist.

Sampling and number of samples were calculated based on the following formula:

$$n = \frac{z^{2}_{1-\frac{\alpha}{2}} pq}{d^{2}}$$

Proportion: 7.1%, d=0/05, n=317 (1)

Considering 10 probable predictor, 10% was added to the sample size:

N=350

Then, after determining the sample size and selecting the subjects who had entry requirements, PCI was administered to patients in accordance with the standard protocol. For all patients, aspirin, clopidogrel and atorvastatin were prescribed for all patients based on the latest PCI guideline (4).

In the three stages (before, 8 hours and 24 hours after PCI), serum samples were evaluated for CK-MB. The following cases were considered as myocardial infarction in the procedure:

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Chest pain in favor of myocardial infarction with changes in electrocardiogram graphics or CKMB increase is more than 3 times higher than normal maximum.

Data analysis:

All information was entered into SPSS software after qualitative review. Quantitative data were presented as mean and standard deviation; qualitative data were presented as frequency and percentages. The frequency of myocardial infarction in the procedure was investigated based on the underlying factors, previous illnesses and angiographic factors. A logistic regression analysis was used to determine the contribution of each of the risk factors in the occurrence of PPMI.

Results:

The results of this study showed that from a total of 442 patients studied in this study, 149 (33.7%) were female and 293 (66.3%) were male. Of these, a total of 402 patients were in negative cases; 136 (33.8%) were female and 266 (66.2%) were male; 40 patients were positive; 13 (32.5%) were female And 27 (67.5%) were male. According to the results obtained in the analysis, because of the significance levels obtained for all cases were greater than 0.05, there was no significant difference between the CK-MB24H and the gender of the patients.

In addition, according to the findings, negative case patients had mean age of 58.91 ± 10.67 years and positive patients had average age of 61.9 ± 10.44 years, respectively, so that in the negative cases, the lowest age was 30 years and the highest age was 84 years. While for positive cases, the minimum age is 43 and the highest age is 86 years. Also, the mean age of all patients in this study was 59.18 ± 10.67 years. According to the results of statistical analysis, there is no significant relationship between age of patients and CK-MB24h.

The results showed that the mean weight of all patients in this study was 73.87 ± 9.7 kg, and negative case patients' mean weight of 73.93 ± 9.28 kg and patients with positive cases had mean weights of 48.8 ± 28/73 kg. According to the results of the analysis, because the levels of

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significance for all cases were greater than 0.05, there was no significant correlation between weight of patients and CK-MB24h.

Table 1: Overall Indicators of Patients and relationship with peri-Angioplasty Infarction

Variable	**Overall population (n=442)**	**Peri-procedural MI**		***p*-value**
Demographics		**No(n=402)**	**Yes(n=40)**	
Age	59.18±10.67	58.91±10.67	61.9±10.43	**0/154**
Sex				**0/629**
Male	293(66.3%)	266(66.2%)	27(67.5%)	
Female	149(33.7%)	136(33.8%)	13(32.5%)	
Weight(kg)	73.87±9.17	73.93±9.24	73.28±8.48	**0/768**
Clinical characteristics or coexisting conditions, n (%)				
Renal dysfunction (eGFR<60)	95(21.5%)	74(18.4%)	21(52.5%)	**0/005**
LVEF				**0/0001**
>55		174(43.3%)	15(37.5%)	
(60-20%)				
Laboratory characteristics				
Creatinin				
Pre	0.981±0.19	0.98±0.19	1.01±0.22	**0/652**
Post	1.05±0.21	0.19±1.04	0.29±1.14	**0/035**
Uric acid	5.37±1.9	5.24±1.55	6.6±3.84	**0/039**
TG	160.9±75.7	161.2±75.1	158.17±83.04	**0/586**
Chol(total)	160.2±37.1	159±36.5	172.5±41.5	**0/038**
LDL	90.4±29.9	89.2±29.7	102.1±29.6	**0/004**
HDL	40.4±7.1	40.5±7.08	39.5±7.7	**0/390**
CRP				**0/002**

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+	24(5.4%)	12(3%)	12(30%)	
-	418(94.6%)	390(97%)	28(70%)	
WBC	8406±2337	8395±2330	8520±2428	**0/098**
Neut%	59.15±8.67	59.04±8.5	60.2±9.9	**0/105**
Lymph%	34.1±7.42	34.2±7.3	32.7±8.2	**0/086**
Plt	214135±57639	215161±56689	203835±66361	**0/748**
RDW	12.99±0.99	12.98±1	13.15±0.94	**0/154**
Drug Hx.				
Statin(mg), mean	31.11±17.55	33.06±16.87	11.5±11	**0/0001**

Dominancy

Right	380(86%)	343(85.3%)	37(92.5%)	**0/876**
Left	30(6.8%)	28(7%)	2(5%)	**0/548**
Co-dominant	32(7.2%)	31(7.7%)	1(2.5%)	**0/785**
Access				
Femoral	433(98%)	393(97.8%)	40(100%)	**0/514**
Radial	9(2%)	9(2.2%)	0	**0/289**
Angiographic pattern				
SVD	155(% 35/1)	142(% 35/3)	13(32/5%)	
2VD	185(%41.9)	171(% 42/5)	14(%35)	
3VD	101(% 22/9)	89(% 22/1)	12(30%)	
LM+3VD	1(0.2%)	0	1(2.5%)	
Bifurcation	2(0.5%)	1(0.2%)	1(2.5%)	
Multivessel PCI	18(4.1%)	13(3.2%)	5(2.5%)	**0/104**
LM PCI	4(0.9%)	3(0.7%)	1(2.5%)	
Number of stents				**0/0001**
1	268	256	12	
2	138	114	24	

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3	33	30	3	
4	3	2	1	
Total	655			
Balloon inflation(times)				**0/0001**
Total stent length (mm)	41.2+27.3	40.1+26.3	58.4+32.8	**<0/001**

In order to investigate the relationship between history of blood pressure, history of diabetes, history of smoking and CRP in patients with CK-MB24HX3, independent t-test was used as follows:

Table 2: T-test Results of two independent samples about the comparison of CK-MB24H levels of all patients based on history of blood pressure, history of diabetes, history of use of sigmoid CRP

		Frequency	Average	SD	F Levine	F sig. level	t-test	df	Sig.
	Yes	106	36.23	29.86					
CRP	No	418	36.75	30.77	39.087	0.0001	-3.476	23.561	0.002
	Yes	24	81.17	62.17					

findings of the above table show a significant difference with the amount of CK-MB24H. Table 3 shows the results of Pearson correlation coefficient analysis between the variables BS, EGFR, LVEF and CK-MB24H in three different situations.

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Table 3: Results of Pearson Correlation Coefficient between Variables and CK-MB24H by different modes

		Overall (n=442)	Negative cases (n=402)	Positive cases (n=40)
BS and CK-MB24H	Pearson Correlation Coefficient	0.111*	0.080	0.180
	Sig. level (p-value)	0.020	0.108	0.265
	Count	442	402	40
CK-MB24H and EGFR	Pearson Correlation Coefficient	-0.218**	0.028	-0.437**
	Sig. level (p-value)	0.0001	0.572	0.005
	Count	442	402	40

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CK-MB24H and LVEF	Pearson Correlation Coefficient	-0.207**	-0.070	-0.359**
	Sig. level (p-value)	0.0001	0.163	0.023
	Count	442	402	40

*: Significant at a level less than 0.05; **: Significant at a level less than 0.001

According to the results of table (3), because the significant levels for positive and negative cases are greater than 0.05, there is no relationship between the level of glucose and CK-MB24H in patients with negative and positive cases, but in general there is a positive and significant correlation between blood sugar levels above 100 and CK-MB24h for all patients. Also, the Pearson correlation coefficient between the two variables EGFR and CK-MB24H in the general condition (for all patients) was -0.281 with a significant level of 0.0001, indicating that the EGFR with CK-MB24H is inverse and meaningful. The results also show that there was no significant relationship between EGFR and CK-MB24H in patients with negative symptoms (p-value <0.05), but for positive cases, the findings indicated a significant and inverse relationship between the two The EGFR variable is CK-MB24H, meaning that patients with high eGFR have decreased their CK-MB24H levels and vice versa, the lower the EGFR, the more CK-MB24H score.

According to the results of table (3), the Pearson correlation coefficient between LVEF and CK-MB24H in the general condition (for all patients) was equal to -0.158, with a significant level of 0.001 and indicating that LVEF CK-MB24H has a reverse and significant relationship, and the results indicate that there was no significant relationship between LVEF and CK-MB24H in patients with negative symptoms (p-value >0.05), but for positive patients, findings showed that

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there is a significant and inverse relationship between the two LVEF variables with CK-MB24H, meaning that in patients with high LVEF, their CK-MB24H levels decrease and vice versa, the lower the LVEF score, the more CK-MB24H score for patients Finds birth.

Table 4 shows the correlation analysis variables between creatinine variables before and 24 hours later, uric acid, triglyceride, cholesterol, HDL cholesterol and LDL cholesterol with CK-MB24H variable in all patients.

Table 4: Results of Pearson correlation coefficient between CR.PRE, CR.POST, URIC ACID, TG, CHOL, HDL and LDL with CK-MB24H among all patients (n = 442)

	CR.PRE	CR.POST	URIC ACID	TG	CHOL	HDL	LDL
Pearson Correlation Coefficient	0.021	0.101*	0.086	-0.026	0.099*	-0.041	0.137**
Sig. level (p-value)	0.652	0.035	0.071	0.586	0.038	0.390	0.004
Count	442	441	442	442	442	442	442

*: Significant at a level less than 0.05; **: Significant at a level less than 0.001

The results showed that between the creatinine variables studied after procedure, there is a positive and significant relationship between total cholesterol and LDL cholesterol with the CK-MB24H variable (P-value -0.05). This means that in patients with creatinine after treatment is total cholesterol and LDL cholesterol, their CK-MB24H levels have also increased, and vice versa.

Table 5 shows the results of correlation matrix analysis of the number of balloon number and stent number with CK-MB24H among all patients.

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Table 5: Results of Pearson correlation coefficient between balloon number and stent number with CK-MB24H among all patients (n = 442)

	Balloon count	Stent count
Pearson Correlation Coefficient	0.356**	0.174**
Sig. level (p-value)	0.0001	0.0001
Count	442	442

*: Significant at a level less than 0.05; **: Significant at a level less than 0.001

The results of the findings indicated that the significant relationship between the number of balloon and number of stents with CK-MB24H can be investigated (P-value ≤0.05).

Table 6 shows the results of correlation matrix analysis of statin consumption variables and metformin consumption with CK-MB24H among all patients.

Table 6: Results of Pearson correlation coefficient between variables of statin consumption and metformin consumption with CK-MB24H among all patients (n = 442)

	Statin consumption	Metformin consumption
Pearson Correlation Coefficient	-0.336**	-0.159**
Sig. level (p-value)	0.0001	0.001

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Count	442	442

*: Significant at a level less than 0.05; **: Significant at a level less than 0.001

The results of this study indicated a reverse and significant relationship between statin consumption and metformin consumption with CK-MB24H in patients (P-value ≤0.05).

Discussion and Conclusion

This study was conducted on 442 patients with elective coronary angioplasty. All patients received adequate dose of aspirin and clopidogrel prior to performing PCI according to standard protocol conforming to guideline.

Cardiac factors

The CK-MB biomarker, as the chosen diagnostic criterion, was measured three times before, 8 hours and 24 hours after the procedure. Patients who had at least three-fold increase in CK-MB in 8 or 24 hours after the procedure were considered as positive cases. A total of 40 patients from 442 (9.4%) patients were positive in this study.

The results of this study showed that 149 (33.7%) were female and 293 (66.3%) were male. Patients with a history of hyperlipidemia and low LVEF and low GFR and high Cr and high CRP and high ureic acid and no or low dose of statin and more stent and longer lesion length and more balloon sessions suffered from PMI.

In a study conducted by DUK woo et al. in 2013, with three-time ck-MB, 7.1 percent of patients suffered from PP-MB (5).

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The mean CK-MB level of patients after 24 hours was 29.48%, while for positive patients; it was reported to be 13.6% after 24 hours. In the negative cases, the lowest CK-MB after 24 hours is 13 and the highest is 77; on the other hand, for positive PMI, the minimum CK-MB after 24 hours is 88 (at least three times the URL) and the highest is 258 (Up to 9 times the URL). The mean CK-MB after 24 hours for all patients in this study is 38.31.

The results of this study showed that for 40 (9.5%) people in the total respondents CK-MB after 24 hours was above 84 and the rest 402 (equivalent to 90.95%) have CK-MB less than 84, based on this finding, 40 people who have won the CK-MB of over 84 are positive cases and those below 84 are considered negative in the present study. The latest definition of PCI-induced MI in 2012 involves an increase of more than 5 times cTnI or three times the CK-MB after the procedure (4.6).

According to a study published by Hannan Idris et al. in 2014, there was no significant correlation between BMI and PMI according to the global definition of MI (p-value = 0.104) (6).

A meta-analysis from 11 studies of PCI-PPMI (PCI-PPMI) in 2013 by Duk Woo Park and colleagues found that the incidence of myocardial infarction (MI) was about 7% among patients undergoing PCI and most cases were with obstruction. Independent prognostic factors for infarction during the procedure included older age, female gender, which no relationship was reported between age and gender.

According to the results of the analysis, for positive patients, the findings indicate a reverse and significant relationship between LVEF and CK-MB24H, meaning that in patients with high LVEF their CK-MB24H levels decrease and vice versa. Whenever LVEF is lower, the CK-MB24H score for patients increases. Inverse to the present study Duk Woo Park's meta-analysis in 2013 did not show any significant correlation between PPI and left ventricular ejection fraction (p - value = 0/89) (5).

In a study conducted by Ae-Young Her in 2017, there was no relationship between LVEF and PPMI (7). However, in a study by Dr. Mohsen Madani and his colleagues at Tehran's Shahid Rajaee Heart Center, the left ventricular drainage fraction also was introduced as one of the

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important predictors of the increase in CKMB level after the procedure (8), our finding, in contrast to other studies (5.8), is consistent with the study of Dr. Madani on the effect of LVEF on the incidence of PMI.

Renal factors

Also, the results indicate that there is no significant relationship between EGFR and CK-MB24H in patients with negative cases, while for positive patients, the findings indicate a reverse and significant relationship between the two variables of EGFR with CK-MB24H, that is, in patients with high eGFR, their CK-MB24H levels decrease and vice versa, the lower the EGFR, the CK-MB24H score increases.

In a 2012 study by Soichiro Kumagai, a correlation between renal function and myocardial infarction (PPMI) in patients undergoing elective PCI was investigated. The results of this study showed that glomerular filtration index (GFR) has a strong correlation with PPMI occurrence, and as a result, GFR is a powerful and convenient predictor for measuring and estimating the risk of PPMI (9). It is also observed that the mean renal creatinine (24 hours after procedure) of negative patients is 1.04, while for positive patients it is equal to 1.14. In the negative cases, the lowest level of renal creatinine (24 hours after the procedure) was equal to 0.60 and the highest was equal to 1.88; on the other hand, for positive positive kidney creatinine (24 hours after procedure), 0.70 and the highest is equal to 2.37. The mean renal creatinine (24 hours after the procedure) of all patients in this study is 1.05. In other words, the creatinine level of the kidney (24 hours after the procedure) is for all patients in the range of 0.6 to 2.37 and for positive cases in the range of 0.70-2.37. Based on the stated averages, it can be said that the renal creatinine level (24 hours after the procedure) is higher in positive cases. The analysis showed that creatinine has a positive and significant relationship with the CK-MB24H variable after the procedure. This means that in patients with creatinine after the procedure, their CK-MB24H levels also increased, and vice versa. These findings also confirmed the association of CK-MB with GFR decline, which is evident in these studies

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The analysis showed that uric acid had a positive and significant correlation with CK-MB24H (P-value≤0.05). That is, in patients with high uric acid, their CK-MB24H levels also increased, and vice versa. While a study published in 2014 by Monica Verodia and colleagues about the role of ureic acid on the occurrence of PPMI in elective PCI patients showed that despite high uric acid with higher risk of thrombosis and more inflammation, there was no association with increased PPMI risk (10) that proved to be contrary to our study.

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Number of stent

According to the findings, of 402 patients in negative cases; for a total of 256 patients, one stent was used, two stents were used for 114 patients, three stents were used for 30 patients, and four stents were used for 2 patients; therefore, in the negative cases, 582 stents have been used.

Of the 40 patients in positive cases, one stent were used for 12 patients, two stents were used for 24 patients, 3 stents were used for 3 patients and 4 stents were used for 1 patient, so in positive cases, 73 stent were used and it can be said that from 442 patients studied in this study 268 cases were present that one stent was used for them, for 138 patient two stents were used, for 33 cases, three stents and for 3 cases, four stents have been used, so in this study, a total of 655 stents have been used. The results of the findings indicate that there is a positive and significant relationship between the number of balloons and the number of CK-MB24H stent in the patients under study (stent number greater than or equal to 2, and pre-post score of more than 5 times pre-post have significant relationship with PMI). In the study of Duk Woo Park (5), LAD lesions and lesion lengths of more than 20 and stents were related to PMI, which our study is consistent with, but the effect of the number of balloons on PMI in our study is new findings.

In a study published by Ae-Young Her and his colleagues in 2017, Paclitaxel Balloon and DES were compared for PMI in de novo coronary damages. For 104 patients: 52 DES and 52 PCBs were used. In patients receiving DES, there was a significant increase in the CK- MB Ventroponin

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T biomarker was observed (23.1% for drug stents compared to 1.9% for PCBs). Complete blockage of the lateral branch was seen in two DES cases, if not seen on the PCB (7).

Statin consumption

Finally, the results of this study indicated a significant and inverse correlation between statin consumption with CK-MB24H in patients under study (P-value ≤0.05). In a study by Briguori et al. in 2009 it was found that a single high dose of atorvastatin (80 mg) administered over 24 hours reduced the risk of pre-PCI prior to periprocedural MI (11).

In a study by Chuan Nan Zhai et al. in 2015 it was found that high doses of statin prior to elective PCI, regardless of their history of use, prevented PPMI and should be implemented for all PCI candidates (12).

In the studies above the emphasize is on the high dose of atorvastatin (80) at 24 hours prior to PCI to prevent PMI, while in our study, patients with a history of at least a moderate dose (40) were immune to this condition. Also, in our study, along with the study by Li and colleagues who mentioned that metformin was taken one week ago, it has been shown that diabetic patients taking metformin (in our study above 1,000 mg) were immune to PMI.

Our findings have been consistent with other studies in line with the preventive role of statin and metformin also using specific dosage of statin previously and pre-consumption of more than 1,000 mg of metformin were new findings in our study in our study.

Conclusion

This study was the first study to investigate the PMI that was performed in Heshmat center due to the high PCI volume. In accordance with other studies, the history of hyperlipidemia and low LVEF, low GFR, high Cr and high CRP, the use of statin and more stents and longer lesion lengths increase the risk of PMI.

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Contrary to other studies, there was no significant relationship between PMI and PCI multivessel age and sex. A new finding in this study was the relationship between high uric acid and the frequency of non-pharmacological balloon use with PMI. Also, the association between atorvastatin minimum dosage of 40 mg in the prophylaxis of PMI was demonstrated in this study. (In other studies, one single dose of statin acetamin 80 mg was obtained weekly without indication of dose). Considering the findings of this study and other studies it is recommended to control and care kidney function in patients with CKD, as well as controlling and treating uric acid before PCI. It is also recommended to take atorvastatin with a minimum dose of 40 mg in all patients prior to PCI to reduce PMI symptoms. Also, the findings of this study support the use of less frequent non-drug balloons.

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