



# Prevalence and Predictors of No-Reflow Phenomenon in Patients with Acute Coronary Syndrome in Slemani Cardiac Hospital

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## Abstract

**Background and objectives:** Understanding factors linked to the no-reflow phenomenon after percutaneous coronary intervention in acute coronary syndromes is important for optimizing reperfusion strategies. The aim of this study is to determine the prevalence and predictors of no-reflow phenomenon in Slemani Cardiac Hospital.

**Methods:** This investigation was a prospective study that was carried out in Slemani Cardiac Hospital; between July 2023 until December 2023, of 150 acute coronary syndrome patients undergoing percutaneous coronary intervention collected data on demographics, clinical characteristics, angiographic findings, and procedural details. Patients were categorized into reflow and no-reflow groups based on final Thrombolysis in Myocardial Infarction flow. Associations between no-reflow and various parameters were analyzed.

**Results:** There was 70% male, with 21.3% hypertension, 4% diabetes, 3.3% dyslipidemia. Common presentations were non-ST elevation myocardial infarction (41.3%), inferior ST elevation myocardial infarction (28%). No significant lesions were seen in 32%. Reflow success rate was 94%, with 6% no-reflow. No-reflow associated with risk factors like dyslipidemia, hypertension, diabetes, and smoking, but not angiographic/procedural variables.

**Conclusion:** Cardiovascular risk factors emerged as key determinants of no-reflow, underscoring the importance of risk modification. The excellent reflow rates and lack of angiographic associations contrast some prior data, warranting further standardized research on no-reflow prediction and mechanisms to guide targeted interventions in acute coronary syndrome.

**Keywords:** Acute Coronary Syndrome, Dyslipidemia, Hypertension, No-Reflow Phenomenon, Percutaneous Coronary Intervention

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## Introduction

The no-reflow phenomenon, described as inadequate myocardial perfusion via a given segment of the coronary circulation without angiographic proof of mechanical vessel block, is a severe complication of percutaneous coronary intervention (PCI) in patients with acute coronary syndrome (ACS).<sup>1,2</sup> It happens in up to 6% of patients undergoing PCI, and is associated with more considerable infarct size, reduced ventricular function, and increased mortality.<sup>3,4</sup> Multiple complex mechanisms underlie the no-reflow phenomenon, including distal atherothrombotic embolization, ischemic injury, reperfusion injury, and susceptibility of coronary microcirculation to injury.<sup>5</sup> Older age, higher thrombus burden, and Infarct Related Artery Thrombolysis in Myocardial Infarction (IRA TIMI) flow grade 0/1 have consistently emerged as independent predictors.<sup>4,6</sup> More controversial predictors include diabetes, hypertension, smoking, cholesterol levels, and time-to-reperfusion.<sup>7</sup> Comprehending the relative importance of these potential predictors may optimize risk stratification. While a few small investigations have examined no-reflow in ACS patients in Iraq, no study has systematically evaluated its prevalence or predictors in the country.<sup>8,9</sup> This is a significant gap, as genetic differences and higher rates of diabetes, smoking, and hyperlipidemia in Iraqi patients with ACS, may result in different no-reflow rates and risk factors compared to Western populations.<sup>10-13</sup> Hence, the primary objective of this research endeavor was to ascertain the prevalence and identify the autonomous determinants of the no-reflow phenomena in individuals diagnosed with acute coronary syndrome (ACS) who had percutaneous coronary intervention (PCI) at the Slemani cardiac hospital in Iraq. Our hypothesis posited that the prevalence of no-reflow would exceed published averages,

mainly owing to elevated rates of cardiovascular risk factors.

## Patients and methods

The current study design was a clinical trial, in which 150 patients presented with acute coronary syndrome and having risk factors underwent PCI at Slemani Cardiac Hospital in Sulaymaniyah -Iraq. The study stretched over a period of six months and carried out from July 2023 until December 2023. The researchers investigated the causes of no-flow phenomenon and specified treatment options of the complication in patients with acute coronary syndrome. The data recorded on a specially designed questionnaire, collected and entered in the computer via Microsoft Excel worksheet (Excel 2016) and then analyzed using Statistical Package for Social Sciences (SPSS) version 28 and the results were compared between patients with different variables, with a statistical significance level of  $\leq 0.05$ . The results presented as rates, ratio, frequencies, percentages in tables and figures and analyzed using t-test, and Chi square tests. This study was submitted to the Ethics and Scientific committees of Interventional Cardiology Council of the Kurdistan Higher council of Medical Specialties for scientific and ethical approval. This study was explained and a verbal consent was obtained from each patient. Confidentiality and anonymity of data were ensured.

## Results

A total of 150 participants enrolled in our study, most (70%) of cases were male and 30% of them were female, 21.3% of cases had hypertension, 13.3% of them were smokers and only 2.7% of patients had dyslipidemia and were smokers, only 4% of cases were diabetic, 24.7% of them ran the disease in their family, none of participants had past surgical history, 41.3% of cases diagnosed with NSTEMI followed by 28% of them had inferior





STEMI and only 4% reported lateral STEMI. Table (1).

**Table (1):** Background variables of participants.

Variables	Categories	Frequency	Percent
Sex	Male	105	70
	Female	45	30
risk factors	None	4	2.7
	HTN	32	21.3
	DM	6	4
	dyslipidemia	5	3.3
	Smoking	20	13.3
	HTN and dyslipidemia	17	11.3
	DM and smoking	7	4.7
	HTN and smoking	7	4.7
	more than two factors	32	21.3
	HTN and DM	16	10.7
	dyslipidemia and smoking	4	2.7
family history	No	113	75.3
	Yes	37	24.7
past surgical history	No	150	100
presentation	Anterior STEMI	30	20
	Lateral STEMI	6	4
	Inferior STEMI	42	28
	NSTEMI	62	41.3
	UA	10	6.7
Total		150	100%

Table (2) shows that 32% of participants had no lesion at all while 10.7% of them had more than one lesion, LAD was culprit vessel in 53.3% followed by RCA in 32% and LCX in 12% and LMS only in 2.7% of cases, 40%, less than half (40.7%) of them diagnosed

with having clot, both pre-dilatation and post-dilatation was done to majority (83.3%) of cases and merely 3.3% of patients underwent pre- dilatation, reflow occurred to vast majority 94% of cases while TIMI 2 was discovered in 6% of them.

**Table (2):** Significant lesions, PCI technique and re-flow of patients.

Variables	Categories	Frequency	Percent
other significant lesions	No lesion	48	32
	LMS	3	2
	LAD	32	21.3
	LCX	23	15.3





	RCA	28	18.7
	more than one lesion	16	10.7
Culprit lesion	LAD	80	53.3
	RCA	48	32
	LCX	18	12
	LMS	4	2.7
presence of clot	No	89	59.3
	Yes	61	40.7
PCI technique	direct stenting	20	13.3
	pre-dilatation	5	3.3
	both pre-dilatation and post-dilatation	125	83.3
Re-flow	Yes	141	94
	No	9	6
final result	Reflow	141	94
	TIMI 2	9	6
Total		150	100%

Table (3) reveals that mean age  $\pm$  Std. Deviation of participants was  $59.97 \pm 11.14$  years, mean SBP  $\pm$  S.D of cases was  $134.09 \pm 17.49$  mmhg, average DBP  $\pm$  S.D of patients was  $83.01 \pm 11.42$  mmhg, average PR  $\pm$  S.D of adults was  $77.20 \pm 9.80$  bpm mean SPO2  $\pm$  S.D of them was  $96.68 \pm 1.23\%$ , mean RBS  $\pm$  Std. Deviation of patients was  $138.72 \pm 62.76$  mg/dl, mean symptom onset duration  $\pm$  S.D of cases was

$38.40 \pm 52.40$  hours, average first medical contact to device  $\pm$  S.D of patients was  $14.36 \pm 13.81$  hours, average B. urea  $\pm$  S.D of adults was  $33.61 \pm 9.80$  bpm mean S. creatinine  $\pm$  S.D of them was  $0.971 \pm 0.27$  mg/dl, average high sensitive CPR  $\pm$  S.D of patients was  $12.367 \pm 12.85$  mg/dl, and finally mean S.LDL  $\pm$  S.D of cases was  $139.09 \pm 37.41$  mg/dL.

**Table (3):** Mean age, parameters and symptom onset duration and medical contact to advice of cases.

Descriptive Statistics						
Parameter	N	Range	Minimum	Maximum	Mean	Std. Deviation
Age	150	54	32	86	59.97	11.14
SBP (mmhg)	150	90	100	190	134.09	17.49
DBP (mmhg)	150	50	60	110	83.01	11.42
PR (bpm)	150	51	50	101	77.20	9.80
SPO2 (%)	150	6	93	99	96.68	1.23
RBS (mg/dl)	150	630	78	708	138.72	62.76
symptom onset duration (hours)	150	359.9	0.1	360.0	38.40	52.40
first medical contact to device (hours)	150	71.8	0.2	72.0	14.36	13.81





B. urea	150	46	14	60	33.61	6.97
S. creatinine (mg/dl)	150	3.1	.4	3.5	.971	0.27
highly sensitive CPR	150	114.3	.0	114.3	12.367	12.85
S.LDL	150	187	56	243	139.09	37.41

Discoveries of Table (4) determine that there was a non-significant statistical association between re-flow and sex, family history and presentation with p-value of  $> 0.05$ . There was a significant statistical association between re-flow and risk factors, reflow occurred to most of risk factors for example,

dyslipidemia, HTN and dyslipidemia, HTN and smoking, HTN and DM, and dyslipidemia and smoking while no re flow occurred to 22.2% for each HTN, DM, smoking and DM and smoking. Chi square test was done and p-value was 0.044.

**Table (4):** Association of No Reflow phenomenon and the risk factors.

Variable	Categories	Re-flow		p-value
		Yes	No	
Sex	Male	99 (70.2%)	6 (66.7%)	0.822
	Female	42 (29.8%)	3 (33.3%)	
risk factors	None	4 (2.8%)	0 (0%)	0.044
	HTN	30 (21.3%)	2 (22.2%)	
	DM	4 (2.8%)	2 (22.2%)	
	Dyslipidemia	5 (3.5%)	0 (0%)	
	Smoking	18 (12.8%)	2 (22.2%)	
	HTN and dyslipidemia	17 (12.1%)	0 (0%)	
	DM and smoking	5 (3.5%)	2 (22.2%)	
	HTN and smoking	7 (5%)	0 (0%)	
	more than two factors	31 (22%)	1 (11.1%)	
	HTN and DM	16 (11.3%)	0 (0%)	
	dyslipidemia and smoking	4 (2.8%)	0 (0%)	
family history	No	106 (75.2%)	7 (77.8%)	0.861
	Yes	35 (24.8%)	2 (22.2%)	
presentation	Anterior STEMI	25 (17.7%)	5 (55.6%)	0.090
	Lateral STEMI	6 (4.3%)	0 (0%)	
	Inferior STEMI	40 (28.4%)	2 (22.2%)	
	NSTEMI	60 (42.6%)	2 (22.2%)	
	UA	10 (7.1%)	0 (0%)	
Total		141 (100%)	100%	

Results of Table (5) determine that there was a non-significant statistical association between re-flow and other significant lesions,

culprit lesion, presence of clot and PCI technique and p-value was  $> 0.05$ .



**Table (5):** Association of No Reflow phenomenon and the risk factors.

Variable	Categories	Re-flow		p-value
		Yes	No	
other significant lesions	no lesion	42 (29.8%)	6 (66.7%)	0.254
	LMS	3 (2.1%)	0 (0%)	
	LAD	30 (21.3%)	2 (22.2%)	
	LCX	23 (16.3%)	0 (0%)	
	RCA	27 (19.1%)	1 (11.1%)	
	more than one lesion	16 (11.3%)	0 (0%)	
culprit lesion	LAD	74 (52.5%)	6 (66.7%)	0.254
	RCA	45 (31.9%)	3 (33.3%)	
	LCX	18 (12.8%)	0 (0%)	
	LMS	4 (2.8%)	0 (0%)	
presence of clot	No	85 (60.3%)	4 (44.4%)	0.345
	Yes	56 (39.7%)	5 (55.6%)	
PCI technique	direct stenting	20 (14.2%)	0 (0%)	0.218
	Predilatation	4 (2.8%)	1 (11.1%)	
	both predilatation and postdilatation	117 (83%)	8 (88.9%)	
Total		141 (100%)	9 (100%)	

There was a statistically significant difference between re-flow and DBP, reflow cases had higher (mean of 83.52 mmhg) DBP compared to no reflow patients with (mean of 75 mmhg)

## Discussion

The overwhelming majority of males (70%) in the cases of ACS identified in the current study corresponds to the history of the big registries GRACE and SWEDEHEART, reporting 67% and around 70% male cases, respectively.<sup>14,15</sup> Such consistent results point out the biological and lifestyle-related basis for gender disparities in the incidence of ACS. Cardiovascular risk factors in our cohort were mostly in line with broader epidemiological data. The prevalence of hypertension in our study was 21.3%, which corresponds to what was reported by the GRACE registry at 25%.<sup>14</sup> However, the prevalence of diabetes (4%) and dyslipidemia

(3.3%) was lower in the current study than in previous studies, which may reflect either underreporting or a demographically different population in our sample.<sup>16,17</sup> The most common clinical presentation was NSTEMI in 41.3%, followed by inferior STEMI in 28%. Compared with the literature, these figures are plausible, reflecting the variable patterns of ACS presentations.<sup>16</sup> Our study found that 32% of the patients had no significant non-culprit lesions, a more substantial figure than the 20% reported in the PROSPECT study, potentially indicating differences in patient selection or angiographic interpretation.<sup>18</sup> The distribution of culprit lesions—LAD,







53.3%; RCA, 32%; and LCX, 12% mimics that in the majority of prior angiographic analyses, for example, those reported in the HORIZONS-AMI trial, underpinning the reproducibility of coronary imaging techniques across different cohorts.<sup>19</sup> The presence of angiographically visible thrombus in 40.7% of cases is consistent with established ranges for ST-elevation MI populations but at the lower spectrum.<sup>19,20</sup> This variance may relate to differences in acute management and imaging techniques. Further, the use of pre-and post-dilation in 83.3% of PCIs contrasts with higher rates of direct stenting reported in contemporary practice, suggesting a divergence in procedural strategies that may impact outcomes, including reflow success.<sup>21,22</sup> The reflow success rate observed in our study (TIMI 3 flow) was 94% after PCI, significantly higher than reported from major randomized trials.<sup>18,23</sup> This outstanding outcome may relate to patient selection, aggressive adjunctive therapies, and procedural expertise. The low no-reflow rate was 6%, further underscoring the efficacy of contemporary reperfusion strategies.<sup>24</sup> Important associations were revealed between no-reflow and some of the risk factors, such as dyslipidemia and hypertension, confirming data from meta-analyses and other large studies.<sup>25-28</sup> Such associations emphasize the role of underlying vascular conditions in the setting of microvascular dysfunction following PCI. Interestingly, our study showed no significant correlations of no-reflow with angiographic characteristics, such as lesion location or thrombus burden, contrasting with some smaller, focused studies.

## Conclusions

This study investigated the prevalence and predictors of the no-reflow phenomenon in patients with acute coronary syndrome (ACS) undergoing percutaneous coronary intervention (PCI) at Slemani Cardiac

Hospital. The results indicated a relatively low incidence of no-reflow (6%), likely due to advanced reperfusion techniques and skilled procedural execution. The study identified significant correlations between no-reflow and cardiovascular risk factors, including dyslipidemia, hypertension, diabetes, and smoking. These findings underscore the critical need to manage these risk factors to prevent microvascular complications after PCI. Although procedural factors were not significantly linked to no-reflow, the study suggests that focusing on modifiable risk factors could enhance patient outcomes.

## Disclosure

The authors assert that they have no conflicts of interest.

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