

## Prediction Of No Reflow Using Syntax II Score in Patients of Acute ST Segment Elevation Myocardial Infarction Undergoing Primary Percutaneous Coronary Intervention

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### ABSTRACT

**Background:** Clinical characteristics are combined with an angiographic grading method to create the SYNTAX Score II, which then compares the results to the SYNTAX II score.

**Objective:** This study aimed to make an early prediction of no reflow in patients receiving primary percutaneous coronary intervention (PPCI) because of an acute ST-segment elevation myocardial infarction (STEMI), the SYNTAX score II was used. **Patients and Methods:** Our cross-sectional trial was conducted on one hundred patients with acute STEMI who underwent primary percutaneous coronary intervention at National Heart Institute, Zagazig University Hospital. Standard coronary angiogram was done to all patients.

**Results:** A statistically significant positive correlation was found between syntax score and age, also with LVESD post treatment, while there was significant negative correlation with both EF pre- and post-treatment and TIMI flow grade. According to the results of the multivariate logistic regression analysis, the most significant risk variables for no reflow were revealed to be the door to balloon time > 2 hours, smoking, syntactic score > 27, EF below 44, and finally, chronic kidney disease.

**Conclusion:** An independent predictor of no-reflow in STEMI patients who are treated with PPCI is the syntax score.

**Keywords:** Syntax II score, Acute ST segment elevation, Myocardial infarction.

### INTRODUCTION

When cardiac biomarkers (preferable troponin) rise or fall over the 99th percentile of the upper reference and one or more indications of ischemia are present, myocardial infarction is considered probable. Novel ST-T modifications include things like aberrant Q waves, new segmental wall motion abnormalities, and the identification of an intra-coronary thrombus through angiography or autopsy<sup>(1)</sup>.

As a strategy to minimize myocardial damage and restore normal blood flow in those affected by an acute ST segment elevation myocardial infarction, treatment is focused on both of these goals. Both fibrinolytic treatment and primary percutaneous coronary intervention can be used to accomplish this goal<sup>(2)</sup>. If high-quality PCI is accessible without significant delay, primary PCI is preferable than fibrinolysis. Door-to-balloon time should be less than 90 minutes. The survival benefit of primary PCI over fibrinolysis appears to be eliminated if the PCI-related delay is more than 60 to 90 minutes<sup>(3)</sup>.

Without evidence of a mechanical obstruction, the "no-reflow phenomenon" is described as a lack of myocardial reperfusion in the coronary circulation<sup>(4)</sup>. Patients with acute ST-segment elevation myocardial infarction who have myocardial no-reflow after the first percutaneous coronary intervention had poorer clinical outcomes and a lower survival rate after the procedure<sup>(5)</sup>. Clinical characteristics are combined with an angiographic grading method to create the SYNTAX Score II, which then compares the results to the SYNTAX I score<sup>(6)</sup>. When calculating the SYNTAX II score during a primary PCI, we can use clinical data and information on patency and area of myocardium at risk supplied by the culprit vascular, as well as lesion complexity and severity. When a high SYNTAX II score is associated with an

increased risk of cardiovascular events, initial PCI failure to achieve sufficient cardiac reperfusion may be a contributing factor<sup>(7)</sup>.

Syntax score II was used as a predictor of no flow in individuals with ST segment elevation myocardial infarction who underwent primary percutaneous coronary intervention.

### PATIENTS AND METHODS

The study was conducted retrospectively on 100 patients admitted to National Heart Institute with acute STEMI subjected to PPCI. They consisted of 78 male and 22 female patients with a mean age of 53.4 years old.

**TIMI flow score was used to split patients into two groups:** Group I (Normal flow group): TIMI flow III: 55 patients with TIMI flow 3 post PCI, and group II: (No reflow group): TIMI flow < III: 45 patients with TIMI flow  $\leq 2$  post intervention

**Inclusion criteria:** All patients with acute STEMI who had: chest pain (lasting more than 30 minutes). ST segment elevation (>1 mm) in two or more contiguous leads or new start LBBB, or ECG abnormalities that imply posterior infarction, and exaggerated chest pain or presentation within 12 hours of the commencement of the symptoms.

**Exclusion criteria:** Patients with acute STEMI more than 12 hours referred for PCI. Patients with previous stenting in the culprit artery. Any contraindication to primary angioplasty. Patients of previous CABG, and retrospective patients with missed or incomplete data records.

### All patients underwent the following:

- A complete medical history and demographic data.
- Medical evaluation in-depth at time of admission.

- TIMI risk score assessment of STEMI.
- Standard 12-lead ECG on admission and after PCI.
- Routine laboratory investigations: Random blood sugar. Kidney functions tests (BUN and creatinine) on admission and follow up post PCI. Complete blood count, and cardiac enzymes (CK-MB, Troponin) on admission, 6 hours after PCI and till peaking.
- Echocardiography.
- Cardiac catheterization and primary PCI: Assessment of extent and number of affected coronaries. Location and size of the lesion in the infarct-related artery (IRA) (proximal, mid, distal). SYNTAX II score calculation: Syntax score calculation using the algorithm <sup>(8)</sup>. Monitoring TIMI flow before and after the surgery was completed.
- Patients' medical records, angiograms, and follow-up records were used to gather information.

**Markers of no reflow:** No reflow: TIMI flow < 3 post intervention that cannot be explained by severe dissection or abrupt closure of target lesion <sup>(9)</sup>.

#### **Ethical consent:**

**An approval of the study was obtained from Zagazig University Academic and Ethical Committee. Every patient signed an informed written consent for acceptance of the study. This work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.**

#### **Statistical analysis**

The collected data were coded, processed and analyzed using the SPSS (Statistical Package for Social Sciences) version 22 for Windows® (IBM SPSS Inc., Chicago, IL, USA). Numbers and percentages are used to represent data (percent) or mean  $\pm$  SD. Different qualitative factors were examined using the Chi square ( $X^2$ ) test. Fisher's Exact or Monte Carlo correction, Student t-test, as well as Mann Whitney test were used. If the significant probability was less than 0.05, the threshold for statistical significance, the results were considered statistically significant and highly significant.

#### **RESULTS**

**Table (1)** showed that age ranged between 28 years to 76 years with a mean value of 53.36 years. **Group I:** Age ranged between 34 years to 76 years old with a mean value of  $53.2 \pm 11.5$  years. **Group II:** Age ranged between 28 years to 75 years old with a mean value of  $53.5 \pm 10.4$  years. We didn't find any gender differences between the two groups (P value 0.130). D.M. (P = 0.016), smoking (P = 0.015), and CKD (P = 0.001) all showed statistically significant difference between the two groups, but no other risk factors were.

**Table (2)** showed that there was a statistically significant relation between ejection fraction (EF), left ventricular end diastolic dimension (LVEDD) post PCI and left ventricular end systolic dimension (LVESD) post PCI of the studied group and occurrence of no-reflow.

#### **Echocardiographic findings:**

##### **a) Ejection Fraction:**

**Pre-PCI** ranged between 25 to 60 % with a mean value of  $45.1 \pm 8.17$ . **Group I (Normal flow):** ranged from 28 to 60 with a mean value of  $45.3 \pm 8.04$ . **Group II (No reflow):** ranged from 25 to 60 with a mean value of  $44.9 \pm 8.44$ .

**Post-PCI** ranged between 25 to 70 % with a mean value of  $49.3 \pm 8.75$ . **Group I (Normal flow):** ranged from 30 to 66 with a mean value of  $51.04 \pm 7.16$ . **Group II (No reflow):** ranged from 25 to 70 with a mean value of  $46.93 \pm 10.01$ .

##### **b) LV dimensions:**

**Pre-PCI: LVEDD** ranged from 3.6 to 6.5 with a mean value of  $5.22 \pm 0.68$ . **Group I (Normal flow):** ranged from 3.6 to 6.5 with a mean value of  $5.27 \pm 0.63$ . **Group II (No reflow):** ranged from 3.9 to 6.3 with a mean value of  $5.14 \pm 0.64$ . **LVESD** ranged from 2.2 to 5 with a mean value of  $3.86 \pm 0.61$ .

**Post PCI: LVEDD** ranged from 3.5 to 6.5 with a mean value of  $5.07 \pm 0.62$ . **Group I (Normal flow):** ranged from 4 to 6 with a mean value of  $4.87 \pm 0.58$ . **Group II (No reflow):** ranged from 4 to 6 with a mean value of  $5.2 \pm 0.66$ .

**LVESD** ranged from 1.5 to 5 with a mean value of  $3.73 \pm 0.65$ . **Group I (Normal flow):** ranged from 2 – 5 with a mean value of  $3.65 \pm 0.65$ . **Group II (No reflow):** ranged from 3 – 5 with a mean value of  $3.93 \pm 0.69$ .

**Valvular heart disease:** Only one patient in the study group had VHD (1%).

**Table (3)** showed that MVD represented a significant predictor for occurrence of no re-flow among studied group.

**Table (4)** showed that there was a high statistically significant increase in syntax II score among the studied group with no-reflow.

**Table (5)** showed that sensitivity of syntax score as a predictor of no-reflow was 82.2% with ability to exclude 60% of truly negative cases and 70% test accuracy in diagnosis.

**Table (6)** showed that there was a statistically significant positive correlation between syntax score and age and LVESD post treatment. While, there was significant negative correlation with both EF pre- and post-treatment and TIMI flow grade.

**Table (7)** showed that univariate logistic regression analysis revealed that there was statistically significant association found between no reflow and all the previous parameters. Also the multivariate logistic regression analysis showed that the most important factors associated with no reflow were door to balloon > 2 hrs with p-value 0.004 and OR (95% CI) of 21.541 (2.675 – 173.445), smoking with p-value 0.009 and OR (95% CI) of 14.125 (1.941 – 102.788), syntax score > 27 with p-value 0.011 and OR (95% CI) of 8.133 (1.614 – 40.966), EF post  $\leq$  44 with p-value 0.012 and OR (95% CI) of 23.736 (2.019 – 279.114), and lastly CKD with p-value = 0.036 and OR (95% CI) of 8.535 (1.148 – 63.440).

**Table (1):** Distribution of the studied patients according to demographic, comorbidities data

		Group I: Normal flow		Group II: No-reflow		P value
Age\ years Mean ± SD		53.5 ±10.4		53.2 ± 11.5		0.901 NS
		Group I: Normal flow		Group II: No-reflow		
		Count	%	Count	%	
Age	Male	46	83.6	32	71.1	0.130 NS
	Female	9	10.4	13	28.9	
		With no-reflow N=45		With normal flow N=55		
		N	%	N	%	
DM		20	44.4	12	21.8	<b>0.016 S</b>
Hypertension		22	48.9	22	40	0.340 NS
Smoking		39	86.7	36	65.5	<b>0.015 S</b>
Dyslipidemia		17	37.8	24	43.6	0.550 NS
COPD		12	26.7	10	18.2	0.308 NS
PVD		11	24.4	8	14.5	0.209 NS
CKD		20	44.4	4	7.3	<b>&lt;0.001 HS</b>

**Table (2):** Comparison of Echo parameters among the two groups

	With no-reflow N=45 Mean ± SD	With reflow N=55 Mean ± SD	t-test	P value
EF pre-	44.9 ± 8.44	45.3 ± 8.04	0.19	0.85 NS
EF post-	46.93 ± 10.01	51.04 ± 7.16	2.385	<b>0.019 S</b>
LVEDD pre-	5.14 ± 0.64	5.27 ± 0.63	1.13	0.26 NS
LVEDD post-	5.20 ± 0.66	4.87 ± 0.58	2.639	<b>0.01 S</b>
LVESD pre-	3.78 ± 0.63	3.92 ± 0.61	1.09	0.28 NS
LVESD post-	3.93 ± 0.69	3.65 ± 0.65	2.088	<b>0.039 S</b>
Valvular heart disease, N (%)	0 (0.0%)	1 (1.8%)	Fisher	0.55 NS

**Table (3):** Relation between no-reflow and no. of vessels affected among both studied groups

Affected vessel n (%)	With no-reflow N=45	With reflow N=55	X <sup>2</sup>	P value
Single vessel	20 (44.4%)	34 (61.8%)	3.008	0.082 NS
Two vessels	12 (26.7%)	14 (25.5%)	0.019	0.890 NS
Multi vessel disease	13 (28.9%)	7 (12.7%)	4.04	<b>0.040 S</b>

**Table (4):** Relation between no-reflow and Syntax II score among both studied groups

Syntax II score	With no-reflow N=45	With reflow N=55	X <sup>2</sup> MW*	P value
Mean ± SD	33.3 ± 10.3	25.9 ± 9.4	3.61*	<b>&lt;0.001 HS</b>
Median	30.7	24.6		
(Range)	(18.6 – 69.4)	(0.19 – 51)		

**Table (5):** Validity data of syntax score as a predictor of no-reflow among studied cases

	Syntax score
Cut off	25.9
AUC (95% CI)	0.722 (0.623 – 0.831)
Sensitivity	82.2%
Specificity	60%
PVP	62.7%
PVN	80.5%
Accuracy	70%
P- value	<b>&lt;0.001 HS</b>

**Table (6):** Correlation between syntax score and other clinical data of the studied patients

	Syntax score	
	R	P value
Age	0.547	<0.001 HS
EF pre	-0.482	<0.001 HS
EF post	-0.431	<0.001 HS
LVEDD pre	0.07	0.514 NS
LVEDD post	0.03	0.804 NS
LVESD pre	0.184	0.06 NS
LVESD post	0.239	0.02 S
TIMI	-0.580	<0.001 HS

**Table (7):** Multivariate analysis of significant predictors of no-reflow among studied patients

	Univariate				Multivariate			
	P-value	Odds ratio (OR)	95% C.I. for OR		P-value	Odds ratio (OR)	95% C.I. for OR	
			Lower	Upper			Lower	Upper
Smoking	<b>0.018</b>	3.431	1.233	9.547	<b>0.009</b>	14.125	1.941	102.788
DM	<b>0.018</b>	2.867	1.202	6.836	0.675	0.681	0.113	4.111
CKD	<b>0.000</b>	10.200	3.149	33.040	<b>0.036</b>	8.535	1.148	63.440
EF post ≤ 44	<b>0.001</b>	5.444	1.931	15.350	<b>0.012</b>	23.736	2.019	279.114
LVEDD post > 5	<b>0.009</b>	4.083	1.429	11.670	0.392	2.444	0.316	18.882
LVESD post > 4	<b>0.020</b>	6.625	1.352	32.474	0.612	1.803	0.185	17.602
Onset of chest pain > 4hrs.	<b>0.009</b>	3.048	1.324	7.015	0.137	3.737	0.658	21.218
Door to balloon > 2 hrs.	<b>0.000</b>	11.433	3.602	36.292	<b>0.004</b>	21.541	2.675	173.445
MVD	<b>0.049</b>	2.786	1.003	7.740	0.284	2.841	0.420	19.214
Pre-dilatation	<b>0.001</b>	5.444	1.931	15.350	0.069	7.946	0.852	74.092
Post-dilatation	<b>0.005</b>	3.378	1.438	7.931	0.663	1.478	0.254	8.589
Syntax score > 27	<b>0.000</b>	5.856	2.434	14.093	<b>0.011</b>	8.133	1.614	40.966

**DISCUSSION**

Primary percutaneous coronary intervention (PCI) has proven to be the most effective treatment method, increasing patient survival and enhancing their prognosis and quality of life (10). After a heart attack, restoring blood flow to the heart's vulnerable myocardium has become a critical aspect of treatment. Even with an open IRA, the infarct zone's blood flow can be significantly reduced by the breakdown of blockage to the coronary microvasculature. This phenomena is linked to infarct size, short- and long-term mortality, and useful prognostic information (11). Myocardial infarction size, poorer left ventricular ejection fraction, unfavorable left ventricular remodeling, mechanical problems, heart failure, and death have all been linked to coronary no-reflow despite effective epicardial coronary flow restoration (12).

In terms of gender distribution, men outnumbered women (78% to 22%) in this study, which included participants ranging in age from 28 to 76 years old. 44% of our patients had high blood pressure, 32% had diabetes, 41% had dyslipidemia, and 75.3% were smokers. COPD (22%) and PVD (19%) were also prevalent. 24% of the individuals in our study had chronic kidney disease (CKD).

In this study, no-reflow was observed in 46% of the participants. Niccoli *et al.* (13) found in different

populations and with different methodologies that the prevalence ranged anywhere from 5% to 50%, according to the findings. Bouleti *et al.* (12), Henriques *et al.* (14), Hamada *et al.* (15) and Wu *et al.* (16) reported that NR has been seen in up to 60% of patients with excellent coronary artery reperfusion following a STEMI.

Patients who sought treatment within three hours of the onset of their first symptoms were equally likely to receive thrombolytic treatment or primary PCI, which may have contributed to the study's high no-reflow rate. Many of these patients were treated with thrombolytics at our facility and were therefore unable to participate in the trial. As a result, patients with a higher risk of embolization and a longer time from door to balloon in our facility had primary PCI. The size of the sample, the demographics of the population investigated, and the availability of certain gadgets could also be factors.

In this study, those in the no-reflow group had significantly higher levels of CKD, smoking, and diabetes mellitus than those in the control group. While there was no significant difference in age, gender, HTN, dyslipidemia, COPD, and PVD.

Regarding age this is concordant to that demonstrated by Chen *et al.* (11) who found that there was no significant difference regarding age between the

two studied groups. The Sex distribution was not statistically different between reflow and no-reflow patients. This is concordant to that demonstrated by Mazhar *et al.* <sup>(17)</sup>. Also, in agreement with our study, Ndrepepa *et al.* <sup>(5)</sup> showed that however, there were substantial differences in HTN and dyslipidemia, as well as smoking habits.

The no-reflow group in this study showed a statistically significant rise in syntax II scores. This comes in agreement with Şahin *et al.* <sup>(18)</sup> who found (compared to normal flow group) that the mean of SYNTAX score (SS) of the no-reflow group was higher (19.26.8/12.96.1,  $p < 0.001$ ).

There are many ways to describe the connection between SS and no-reflow. It is possible that a lowered resistance index in the microcirculatory system can be a sign of disseminated disease <sup>(19)</sup>. Myocardial plaques release bioactive chemicals that may aggravate coronary artery dysfunction <sup>(20)</sup>. There is a possibility that microcirculatory resistance could affect coronary flow in the epicardium. Assuming that the donor artery is also diseased, inadequate collateral circulation will be provided to the microvasculature. When coronary artery disease is more advanced, the level of oxidative stress increases, which reduces the nitric oxide, adenosine, and prostacyclin vasodilatory actions in the coronary vessels <sup>(21)</sup>.

In the current study, sensitivity of syntax score as a predictor of no-reflow was 82.2% with ability to exclude 60% of truly negative cases and 70% test accuracy in diagnosis. This comes in agreement with Şahin *et al.* <sup>(18)</sup> who discovered that the ROC curve analysis cutoff value for SS for predicting no-reflow was 19.75 (sensitivity: 70.6% and specificity: 69.4%). Also, Magro *et al.* <sup>(22)</sup> showed that a patient's SS is a reliable indicator of whether or not they will experience no-reflow after a STEMI.

Patients with STEMI who develop the no-reflow phenomena following PPCI are at an increased risk of death, as has long been suspected <sup>(18)</sup>. Patients with high SS, according to our findings, require strong protective treatment to avoid the development of no-reflow syndrome.

According to the univariate factor analysis of our study, there was a significant P-Value for the incidence of no-reflow in patients who had a history of smoking, diabetes mellitus (DM), kidney disease (CKD), and an enlarged heart (EF) after age 44, as well as those who had LVEDD post > 5, LVESD post > 4, onset of chest pain was greater than 4 hours, and a time from door to balloon greater than 2 hours. Multivariate analysis indicated significant P-values for the occurrence of no-reflow in door to balloon > 2 hrs, smoking, syntactic score > 27, EF post ≤ 44, and CKD. Şahin *et al.* <sup>(18)</sup> reported that on multivariate logistic regression analysis, SS, diabetes, anterior myocardial infarction and thrombus grade after wiring, were independent predictors of no-reflow. In a study, which was just

published and included 153 patients who underwent primary PCI within 24 hours of experiencing their first symptoms. Normal flow (n=124) and slow/no reflow (n=29) groups were based on cine angiograms obtained during the course of PCI. SI 0.66, thrombus load, and plasma glucose upon entry were all revealed to be independent predictors of coronary sluggishness or no-reflow <sup>(23)</sup>.

## CONCLUSION

In the present study, no-reflow occurred in 45% of STEMI patients underwent primary PCI and was more likely to be related to door to balloon > 2 hrs, smoking, syntax score > 27, EF post ≤ 44, and lastly CKD. Patients with STEMI treated with PPCI, and a high syntax score had a higher risk of having no reflow. Patients with STEMI might benefit from having their syntactic score evaluated during diagnostic coronary angiography and from receiving treatment aimed at preventing the no-reflow phenomena.

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