A very challenging score system for no reflow prediction during primary PCI

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Introduction

- **After acute STEMI, the immediate therapeutic goal is to establish patency of the infarct-related artery.**

- **No-reflow phenomenon is the most striking example of myocardial reperfusion clinical failure. It caused by a lack of adequate blood flow in tissues after successful recanalization of infarct-related artery and is of multifactorial nature.**

- **Patients with «no-reflow» have highly increased risk of complications such as reduced systolic function, heart muscle remodeling, dilatation, cardiac chambers hypertrophy/hyperplasia, left ventricular aneurysm etc.**

- **In addition, «no-reflow» increases the risk of death. Predisposition for «no-reflow» might be associated with a number of local and systemic factors.**


Aim of the Work

The aim of our study was to investigate the clinical factors and angiographic findings to construct a predictive score which will help to predict the risk of developing slow/no-reflow phenomenon during primary PCI in patients with ST segment elevation myocardial infarction.

Patients and methods

Study population

This study was carried out in cardiology department, Zagazig University in Egypt and Mouwasat hospital in Saudi Arabia from June 2015 to July 2017. During this period, emergency cardiac catheterization was performed to 451 patients admitted with acute STEMI.

Inclusion criteria

- Patients who presented with acute myocardial infraction of ≤ 12h duration and patients with STEMI presented after 12 hours of onset of the symptoms with ongoing chest pain.

- Those with age from 25-80 years old in both sex from any nationality were also included in the study .

Exclusion criteria

Patients were excluded if they had:

- End stage renal disease on regular dialysis
- Pre-existing significant valvular heart disease
- Required emergency surgical revascularization
- Patients with malignancy
- Patients with previous CABG

Method

- Complete history taking.
- Complete clinical examination including general and local examination with KILLIP class
- Electrocardiogram.
- Trans-thoracic ehocardiography.

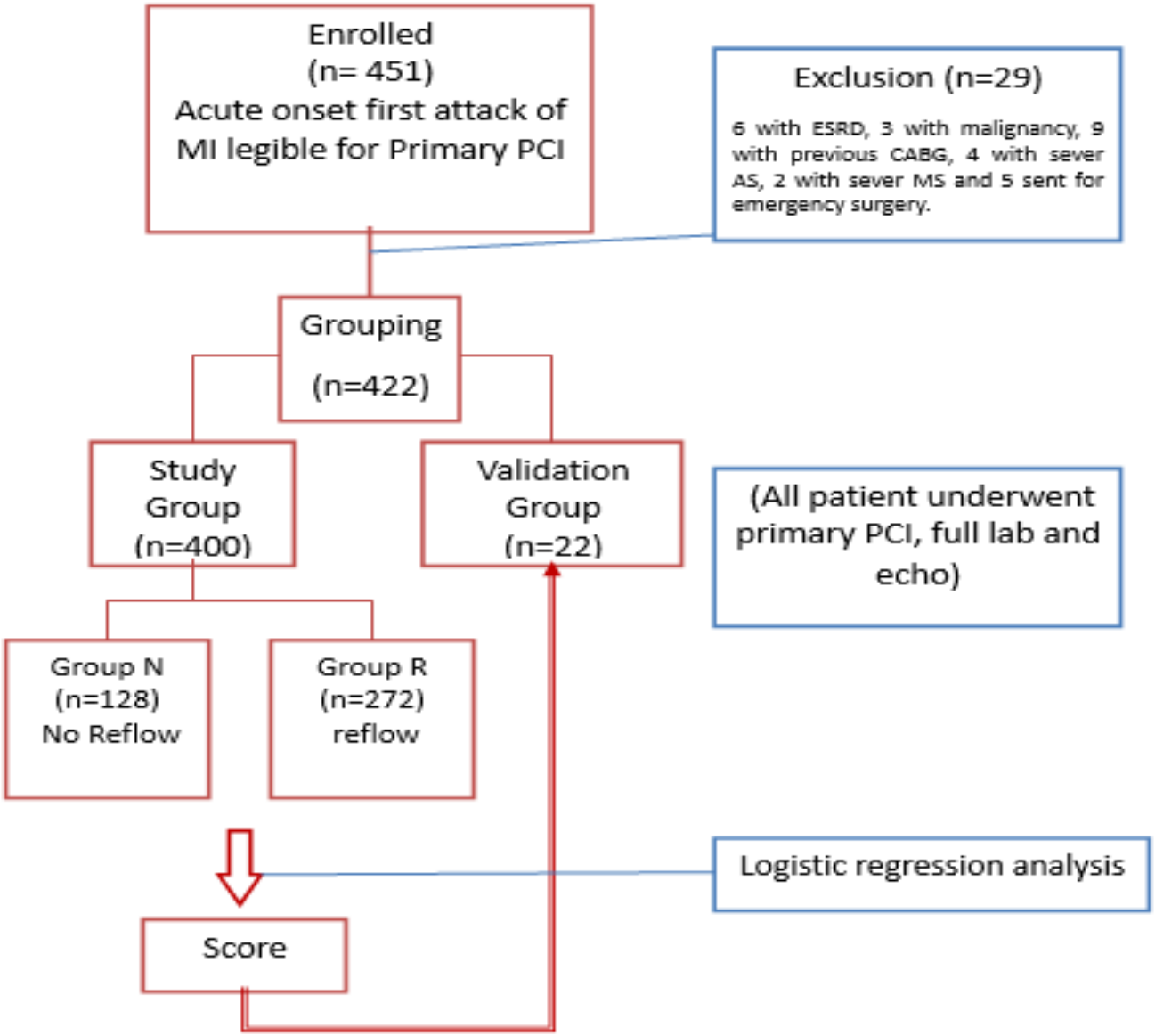
Laboratory investigations

- Cardiac biomarkers (CK-MB)
- Admission blood glucose level
- Creatinine clearance
- Serum albumin
- CRP
- D Dimer
- Neutrophil count
- Mean platelet volume

Angiographical data recorded

- Morphology of the Infract Related Artery (IRA).
- Collateral circulation.
- Presence of multi vessel disease.
- SYNTAX score .
- Initial and final TIMI flow grades,
- Culprit lesion location and degree of stenosis .
- Target lesion length.
- luminal diameter of IRA.
- Method of reperfusion .

Study design

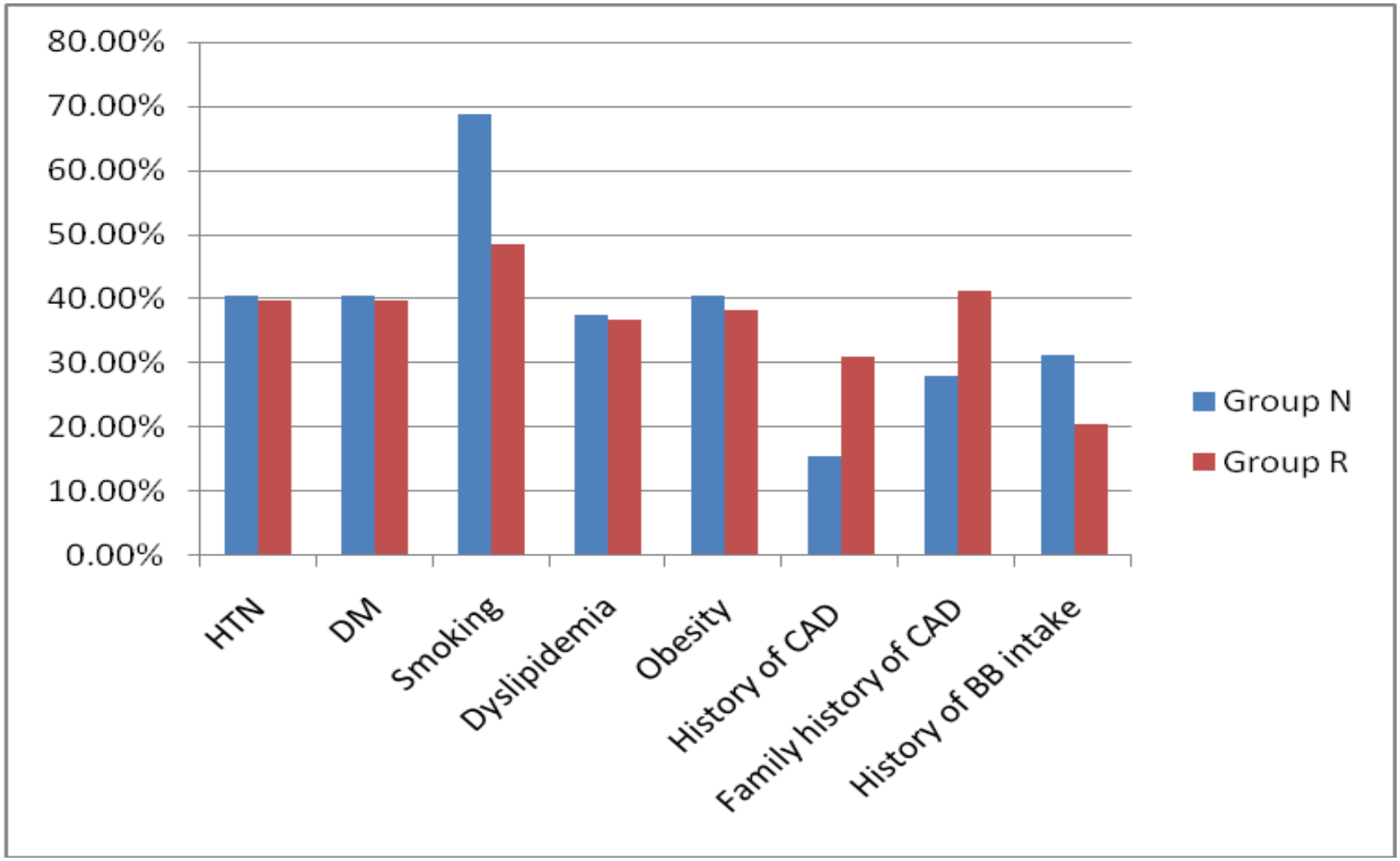



Results

Demographic and clinical data

Variable		Group N (n) = 128		Group R (n) = 272		P-Value
Demographic data		X ±SD		X ±SD		
Age		58.6 ± 9.7		48.9±9.1		0.001**
		N	(%)	N	%	
Gender	Female	20	(15.6%)	28	(10.3%)	0.66 NS
	Male	108	(84.4%)	244	(89.7%)	
HTN		52	(40.6 %)	108	(39.7%)	0.93 NS
DM		40	(31.3%)	108	(39.7%)	0.41 NS
Smoking		88	(68.8 %)	132	(48.5%)	0.057 NS
Dyslipidemia		48	(37.5%)	100	(36.8%)	0.93 NS
Obesity		52	(40.6%)	104	(38.2%)	0.81 NS
History of CAD		20	(15.6%)	84	(30.9%)	0.1 NS
Family history of CAD		36	(28.1%)	112	(41.2%)	0.2 NS
History of BB intake		40	(31.2%)	56	(20.6%)	0.24 NS
Clinical data		X ±SD		X ±SD		
Admission SBP		119.8±28.1		119.7±27.4		0.98 NS
		N	%	N	%	0.2 NS
KILLIP class	I	120	(93.8%)	240	(88.2%)	
	II	4	(3.1%)	16	(5.9 %)	
	III	0	(0.0%)	16	(5.9 %)	
	IV	4	(3.1%)	0	(0.0%)	

The risk factors of both groups



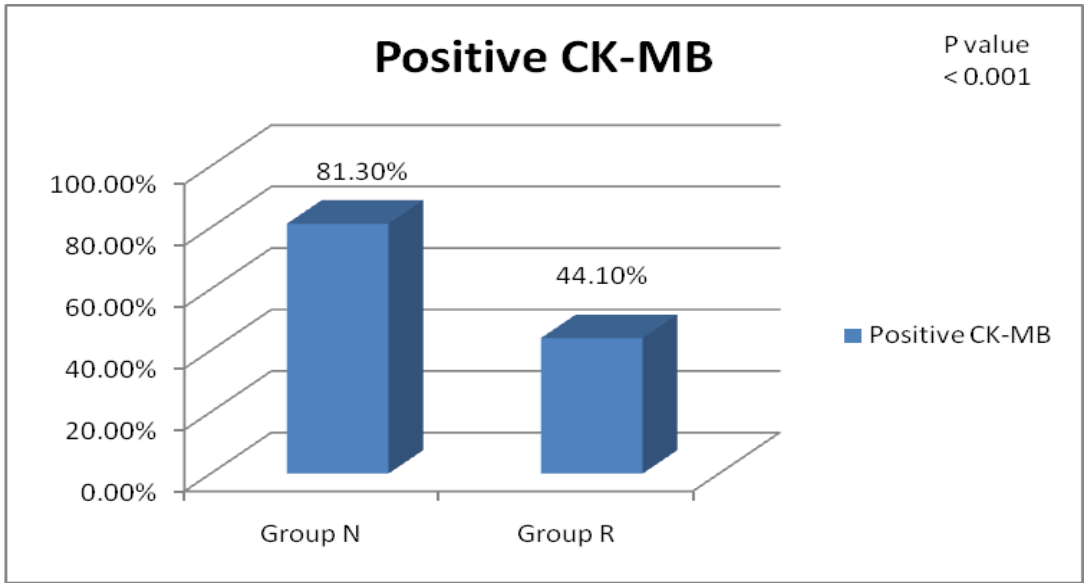
ECG and Echo data of both groups

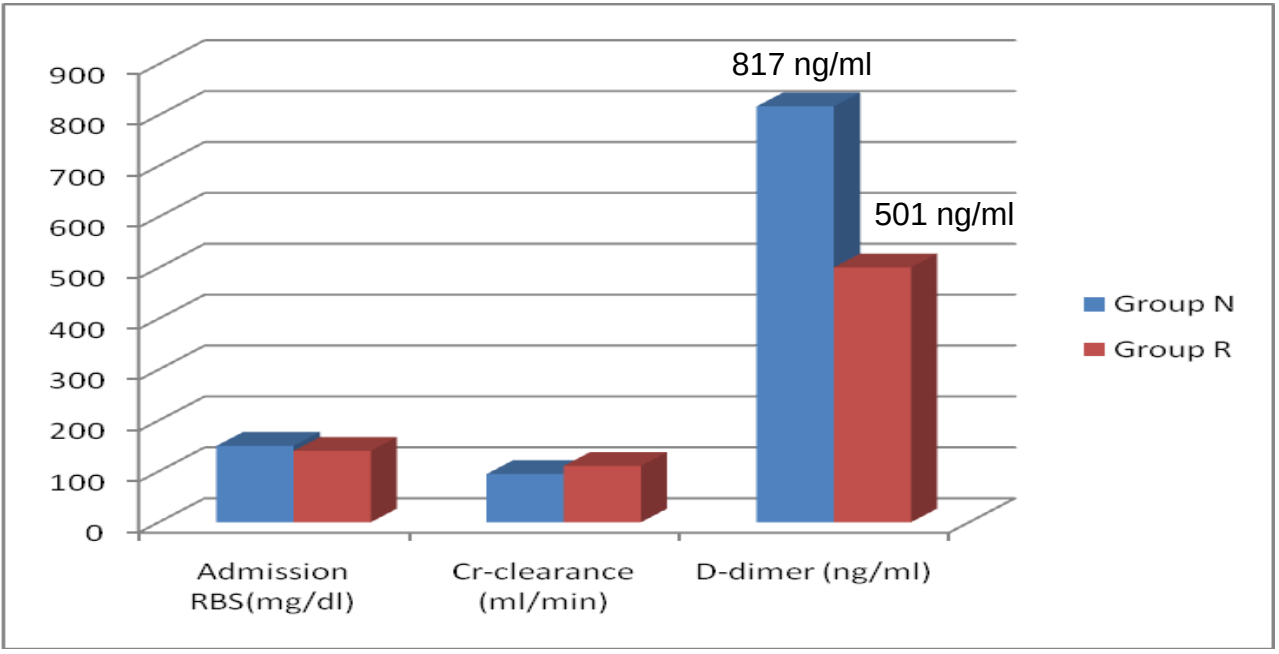
Variable		Group N (n) = 128		Group R (n) = 272		P-Value
		N	%	N	%	
Location of infarction	Anterior	72	(56.3%)	164	(60.3%)	0.4 NS
	Inferior	52	(40.6%)	84	(30.9%)	
	lateral	4	(3.1%)	24	(8.8%)	
LV dysfunction		**80**	**(62.5%)**	**100**	**(36.8%)**	**0.015***

Laboratory investigations in the studied subjects

Variable	Group N (n) = 128		Group R (n) = 272		P-Value
	X ±SD		X ±SD		
Admission RBS(mg/dl)	150.3 ± 40.7		140.5± 40.7		0.25 NS
Cr-clearance (ml/min)	**94.8 ± 26.3**		**110.97±28.8**		**< 0.001 ****
D-dimer (ng/ml)	**817.4 ± 384**		**501.0 ± 228**		**< 0.001 ****
Albumin (g/dl)	4.0±0.4		4.0±0.3		0.98 NS
Neutrophil (k/mcl)	6.8 ± 2.7		6.4 ± 1.7		0.32 NS
MPV (fl)	8.8 ± 1.0		8.4 ± 0.9		0.07 NS
	N	%	N	%	
+ve CK-MB	**104**	**(81.3)**	**120**	**(44.1)**	**< 0.001 ****
+ve CRP	96	(75.0)	176	(64.7)	0.3 NS

Laboratory investigations in both groups

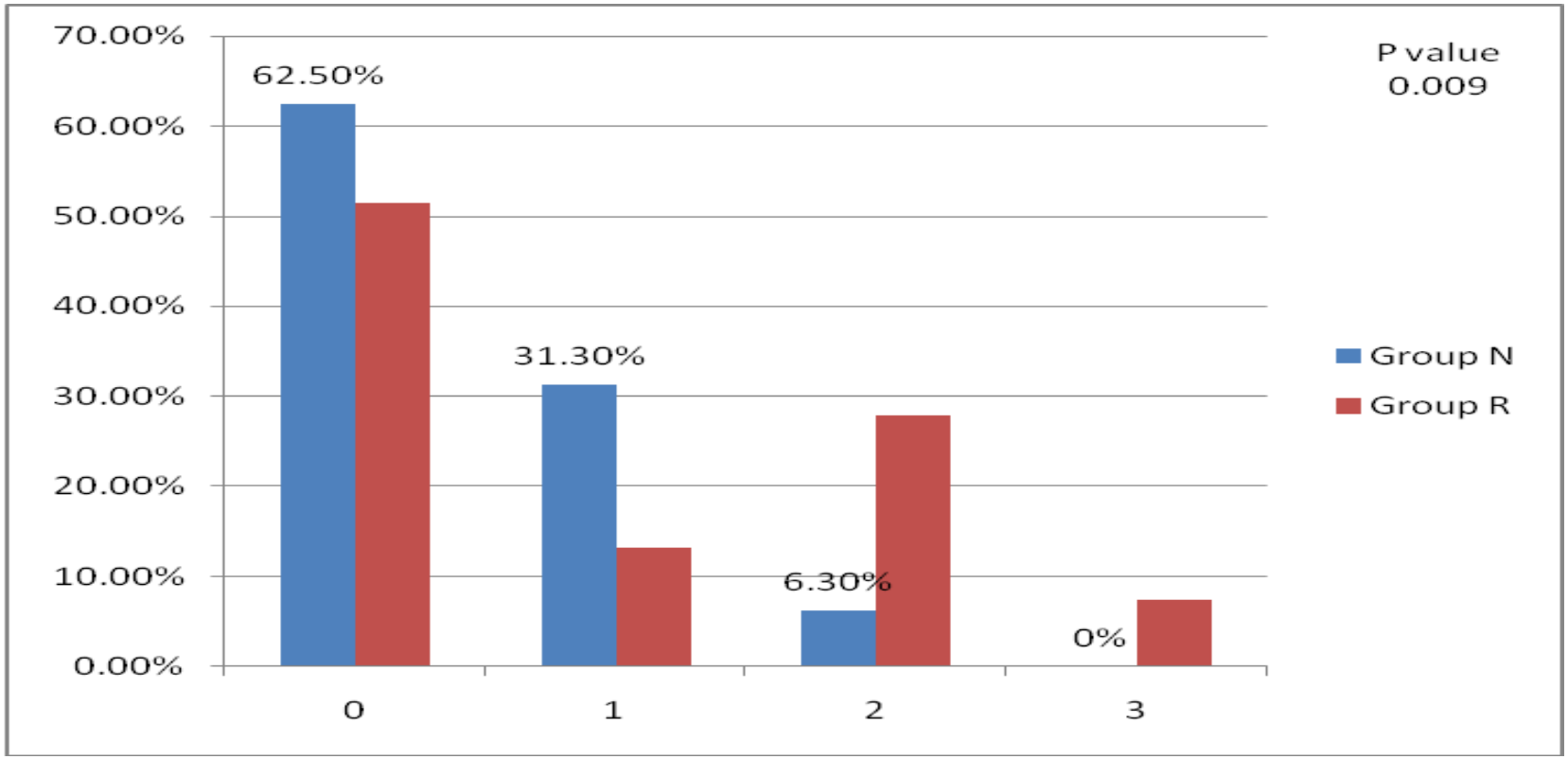




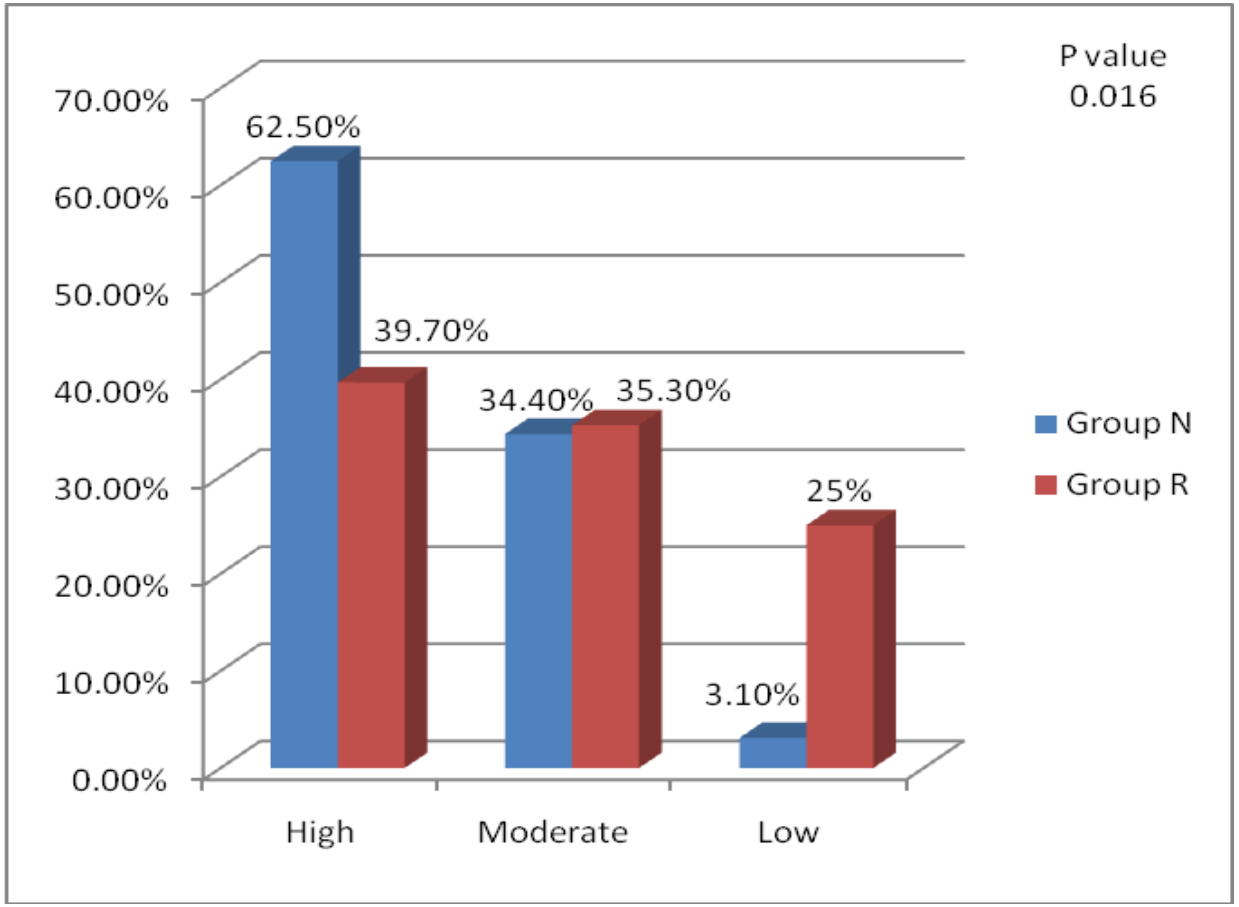
Angiographic and interventional data

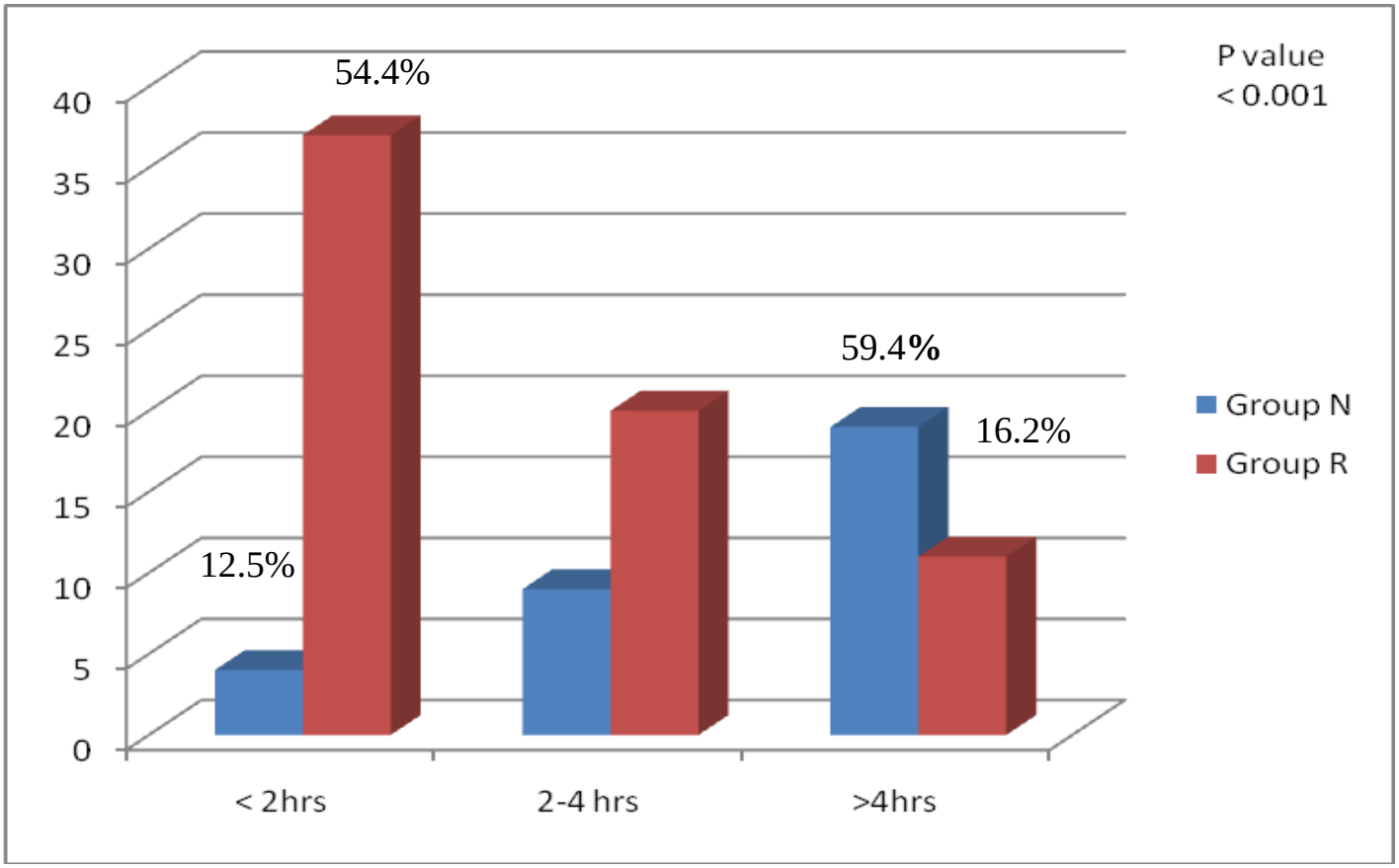
Variables		Group N (n) = 128		Group R (n) = 272		P-Value
		N	%	N	%	
Presence of MVD		76	59.4	132	48.5	0.31 NS
Infract related artery	LAD	68	53.1	156	57.4	0.1 NS
	LCX	0	0.0	28	10.3	
	RCA	60	46.9	88	32.4	
Initial TIMI	0	**80**	**62.5**	**140**	**51.5**	0.009*
	1	**40**	**31.3**	**36**	**13.2**	
	2	8	6.3	76	27.9	
	3	0	0.0	20	7.4	
Collateral circulation		8	6.3	16	5.9	0.9 NS
Location of lesion	Proximal	64	50.0	112	41.2	0.6 NS
	Mid	56	43.8	148	54.4	
	distal	8	6.3	12	4.4	
Thrombus burden	High	**80**	**62.5**	**108**	**39.7**	**0.016 ***
	Moderate	44	34.4	96	35.3	
	Low	4	3.1	68	25.0	
Time to reperfusion	< 2hrs	16	12.5	148	54.4	**< 0.001 ****
	2-4 hrs	36	28.1	80	29.4	
	>4hrs	76	59.4	44	16.2	
Method of reperfusion	Pre-stent dilatation	84	65.6	164	67.6	0.98 NS
	Direct stent	36	28.1	72	26.5	
	Ballon dilatation	8	6.3	16	5.9	
		X± SD		X± SD		
SYNTAX score		15.6± 6.1		18.8±8.5		0.06 NS
Length of lesion		**27.5±6.4**		**19.4±4.7**		**< 0.001 ****
Luminal diameter		**3.37±0.5**		**2.88±0.4**		**< 0.001 ****

The percentage of Initial TIMI flow in both groups



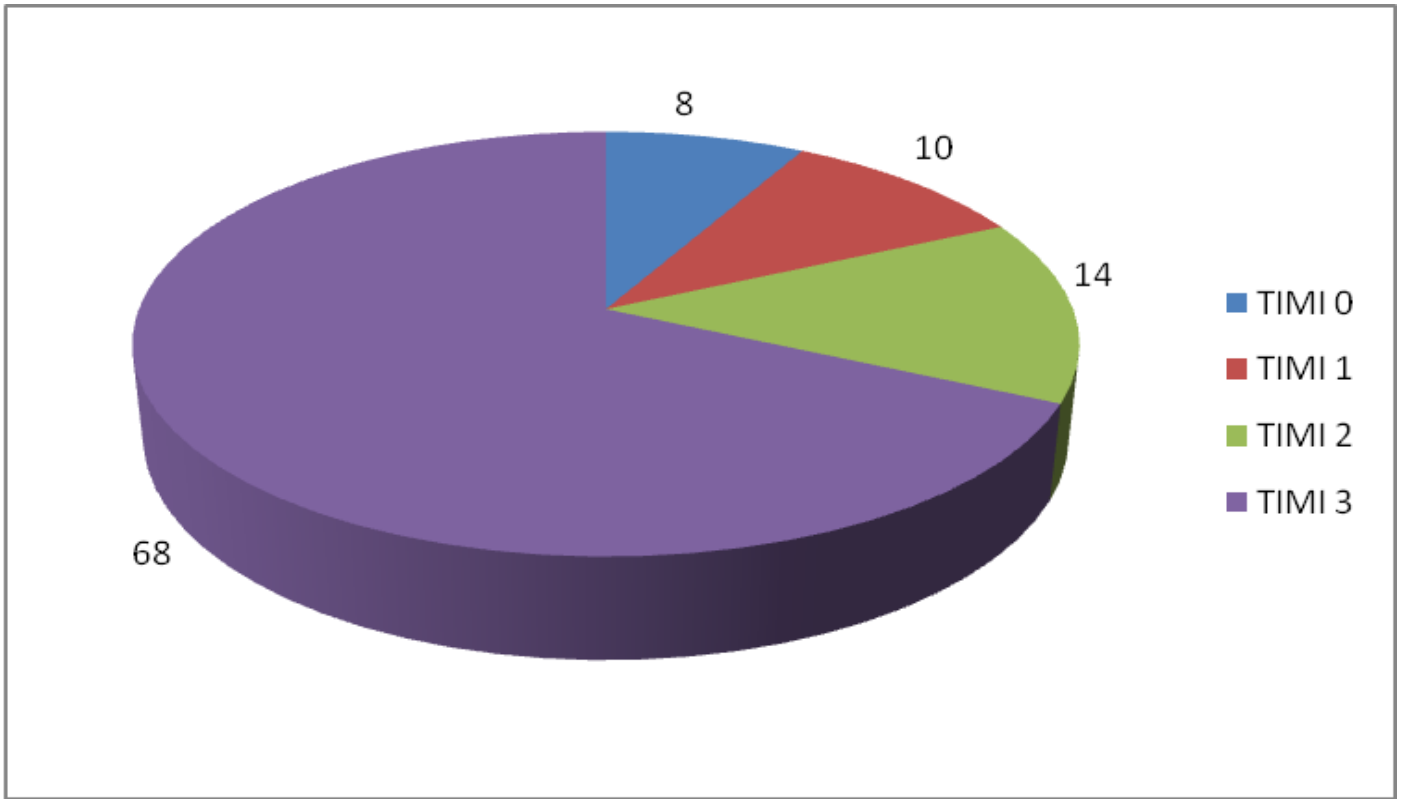
The percentage of thrombus burden in both groups





Time of perfusion of both groups

Final TIMI flow



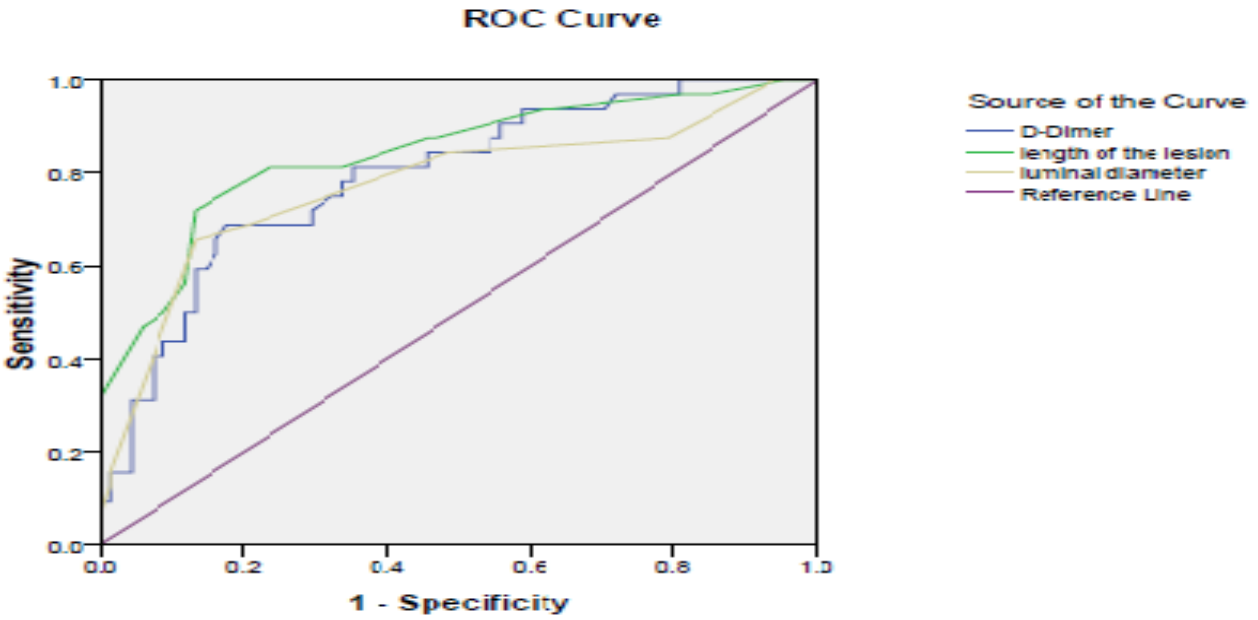
Predictors of no reflow

After multiple regression analysis

Vavriable	OR	95% CI
Age>60	1.4	1.2-1.57
Initial TIMI flow	3.1	2.5-4.9
luminal diameter	2.3	1.56-4.13
Time to reperfusion >4h	2.4	1.15-3.7
Lesion length	4.1	2.1-6.78
High thrombus burden	1.2	1.01-1.5
Positive CK-MB	2.3	1.35-4.57
D-dimer	1.4	1.18-2.12

OR: odd ratio CI : confidence interval

ROC curve of significant quantitative continuous variables.

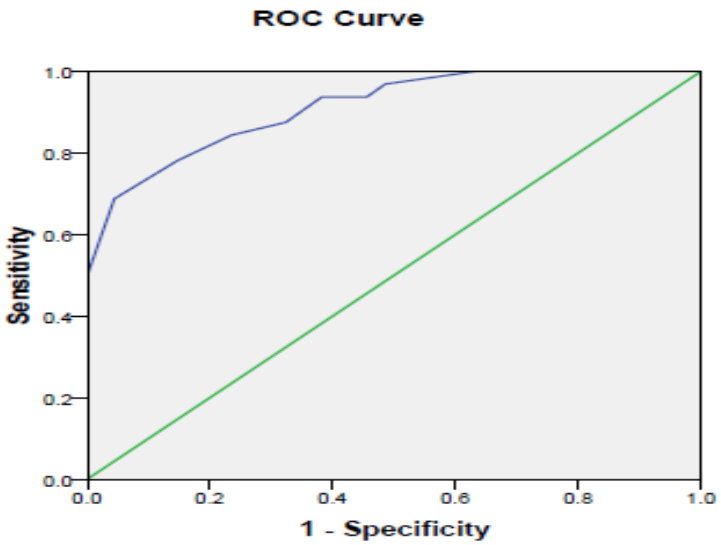


Variable	Cut off point	sensitivity	Specificity
Luminal diameter (mm)	2.8	84%	51.5%
Length of lesion (mm)	20	87%	54.4%
D-Dimer (ng/ml)	500	84.4%	50.0%

The items of the scoring system and their scoring points:

Variable	Score
Age > 60y	1
Time to reperfusion ≥ 4hrs	2
Luminal diameter ≥ 2.8mm	2
Length of lesion ≥ 20mm	4
High thrombus burden	1
D-Dimer ≥ 500ng/ml	1
Initial TIMI ≤ 1	3
+ve CK-MB	2
Total score	16

ROC curve showing the cutoff point of the new scoring system



All patients were scored using the scoring system and a ROC analysis was performed for the scored patients showing that all patients **scoring 10 points** or more are most likely to have no reflow phenomenon, with test sensitivity was 86% , specificity was 73 % and $P < 0.001$.

The score was applied on another 22 patients (The validation group) , The outcome predicted by the score was compared with the study group.

		Score predicted			
		No reflow	Reflow	Total	P value
Outcome	No reflow	8 (100%)	3 (21%)	11 (50%)	0.002
	Reflow	0 (0.0%)	11 (79%)	11 (50%)	
Total		8 (100%)	14(100%)	32(100%)	

Cross table showing the real outcome versus the score predicted outcome (the data was expressed as number of patients and %)


Conclusion

Conclusion

We can conclude that the current score has a sensitivity, specificity, accuracy, positive predictive value and negative predictive value of 73%, 100%, 86%, 100% and 79% respectively, in detecting no reflow during primary PCI in patients presented by acute STEMI.

In particular, patients with advanced age, delayed reperfusion , low initial TIMI flow , high thrombus burden on baseline angiography and patients who had a long target lesion with large luminal diameter were at increased risk for no-reflow development.


Limitation

- We did not use IVUS to quantitatively evaluate thrombus burden and plaque content.

- We did not evaluate microvascular no-reflow using myocardial contrast echocardiography or nuclear scintigraphy.

Case demonstration

- *History:*

A 76 years old male, HTN and DM.

Presented to the emergency department with retrosternal chest pain for 6 hours duration that was associated with nusea and sweating.

- *Physical examination:*

✓ BP 110/80

✓ Pulse 75 bpm

✓ O2 saturation 98% on room air

✓ Normal JVP

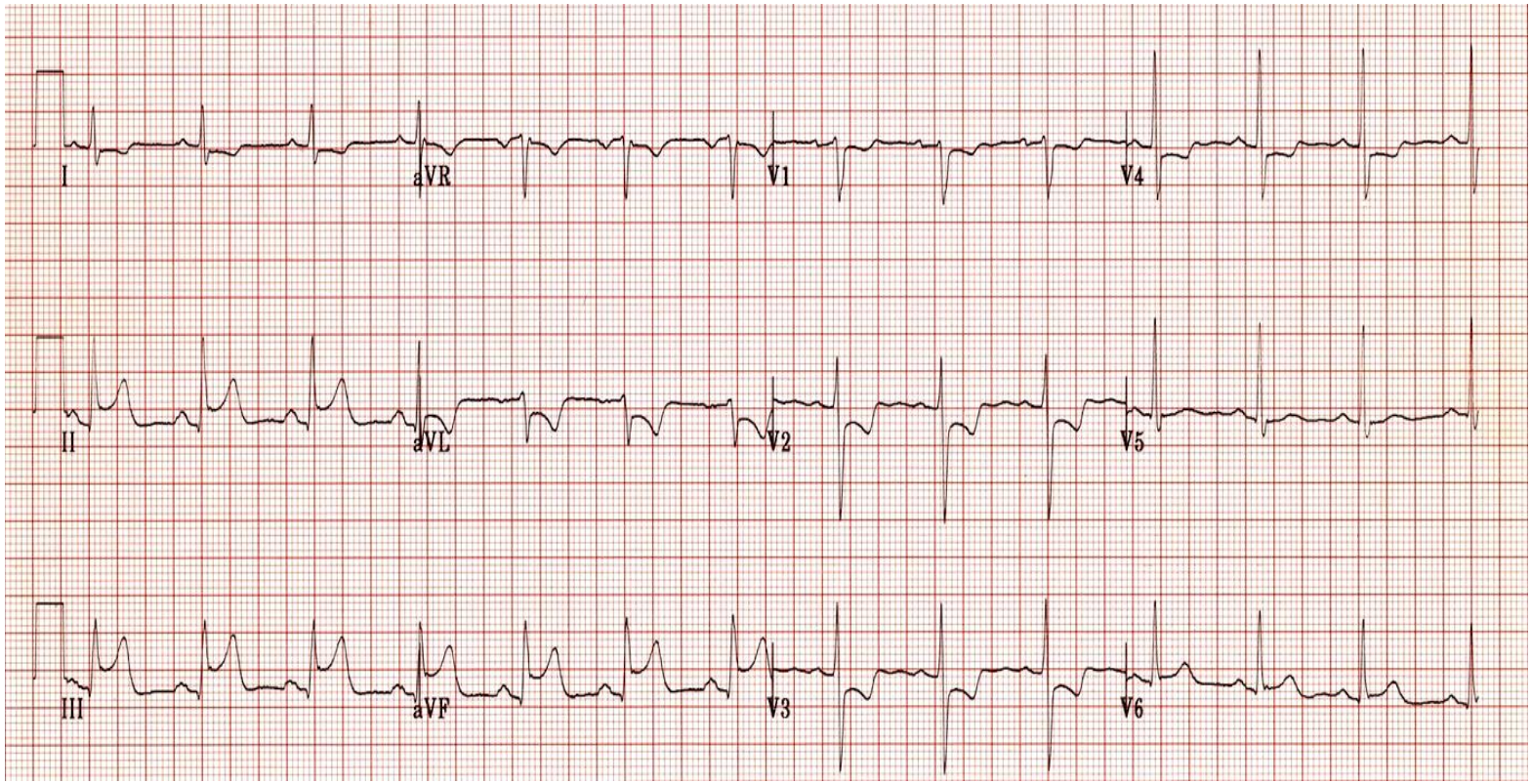
✓ Temperature 36.7 c

✓ Heart : s1 s2

✓ Chest : clear

✓ KILLIP class 1

✓ No lower limb edema



- *ECG at presentation:*

It showed ST- segment elevation in the inferior leads with ST segment depression in lateral and right precordial leads that confirms the diagnosis of acute inferior STEMI with extension to posterior wall.

- ***Lab results:***

✓ 1st set CK-MB: positive 55ng/ml

✓ Admission random blood sugar: 224 mg/dl

✓ Creatinine clearance: 44 ml/min

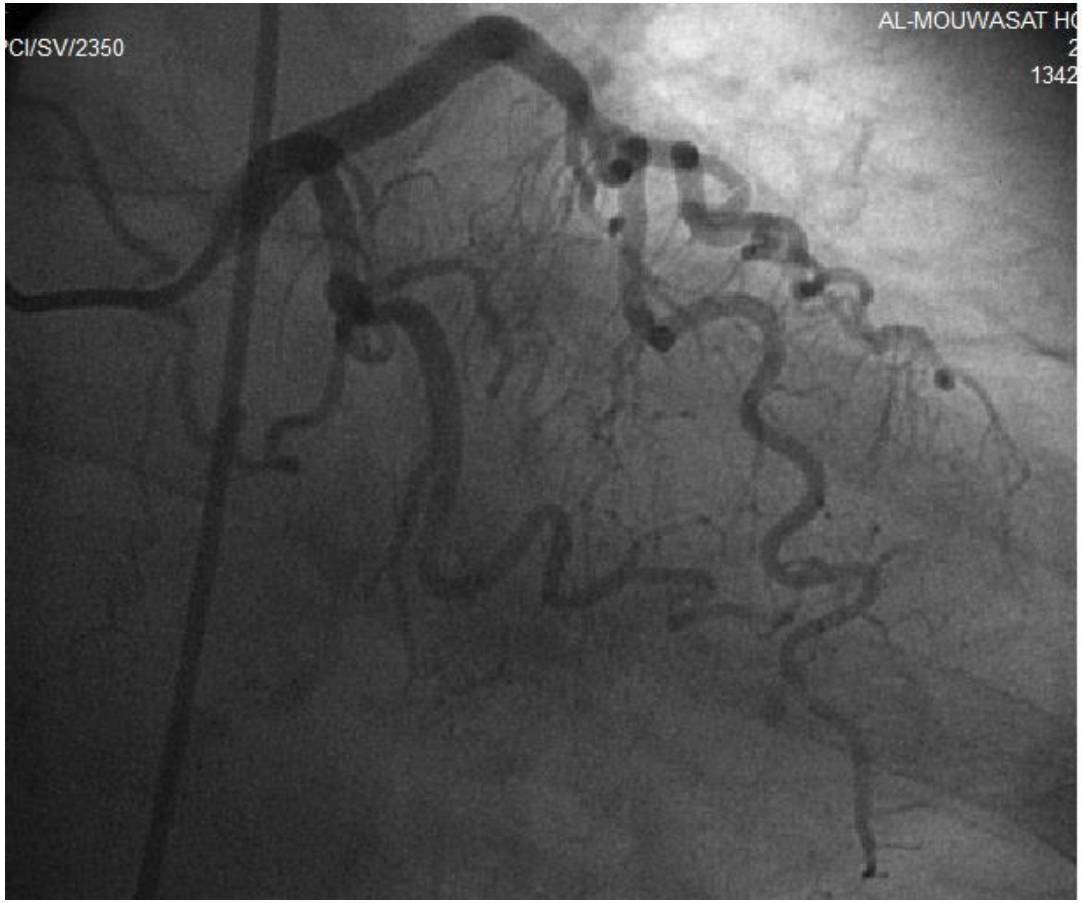
✓ D dimer: 866 ng/l

✓ C-reative protein: positive

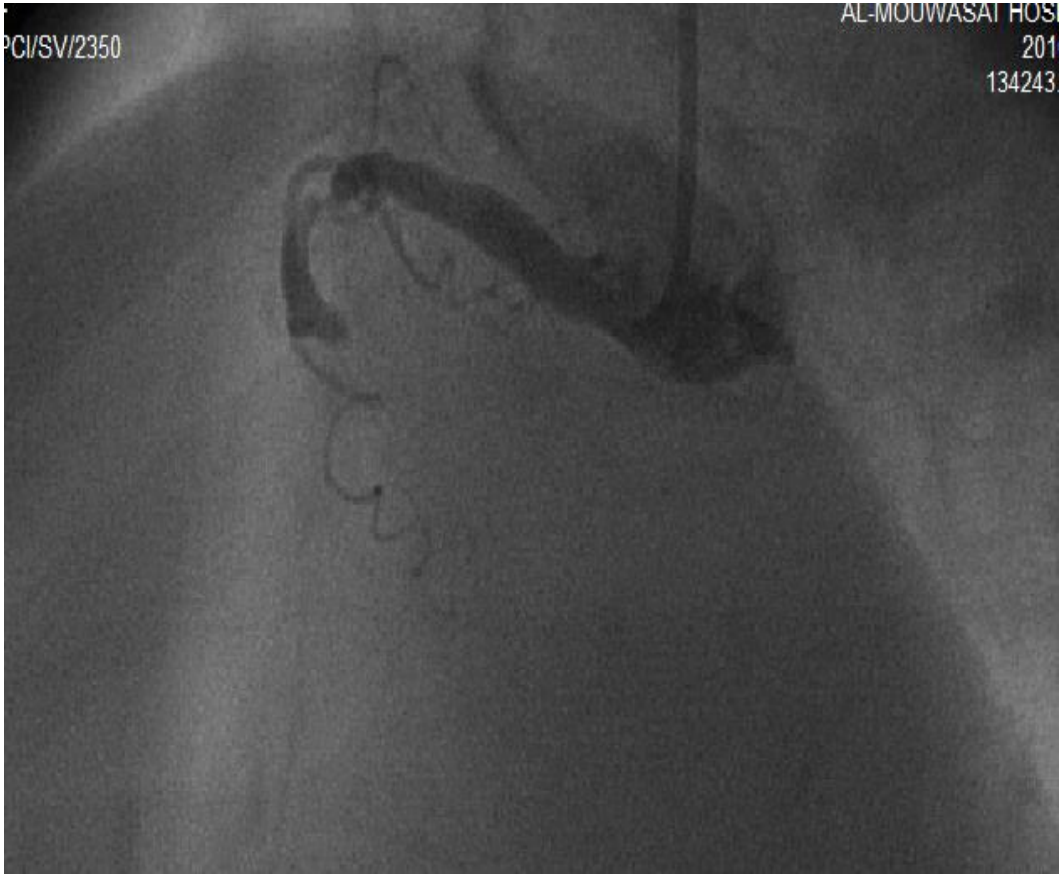
✓ Serum albumin: 4g/dl

✓ Neutrophil count: 6.5 x 10^9/L

✓ Mean platelet volume: 8.1 fl



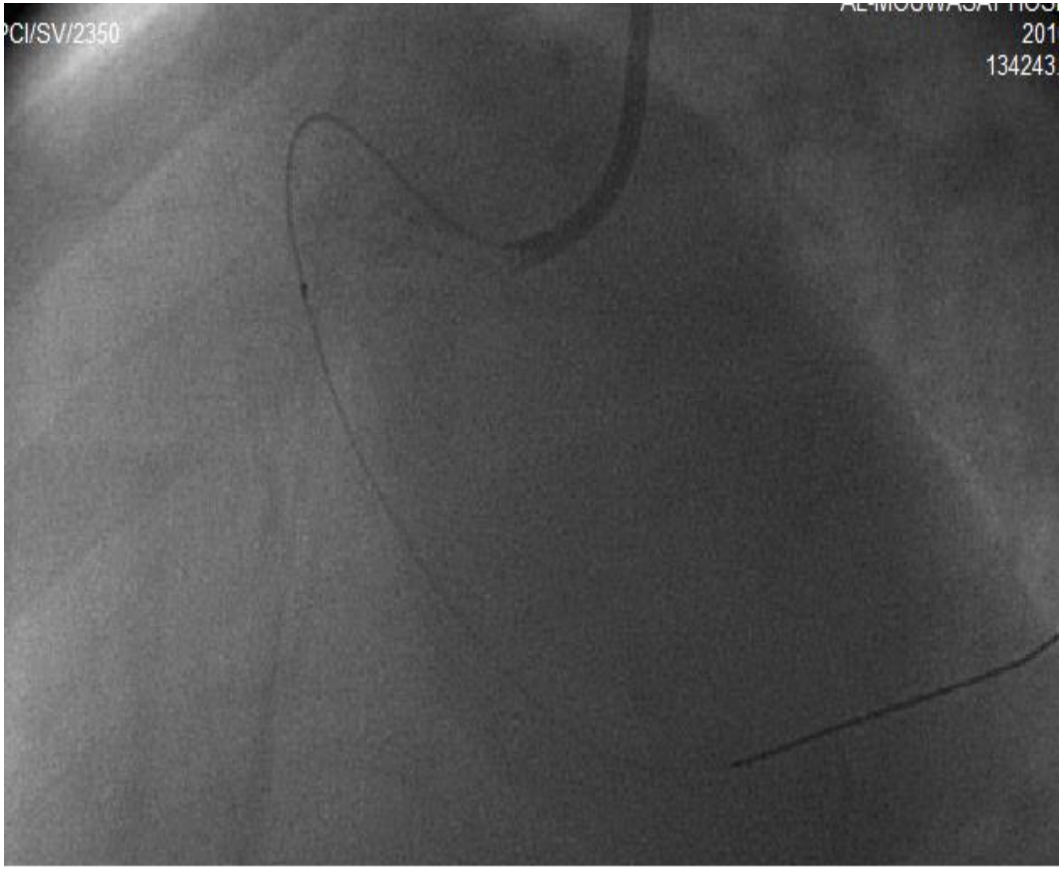
Coronary angiography of the left coronary system in the RAO caudal projection that showed calcific proximal LAD with tortuosity of both LAD and the LCX without significant lesion.



Coronary angiography of the RCA in the LAO projection that showed proximal lesion then total mid occlusion with initial TIMI 0 and high thrombus burden.

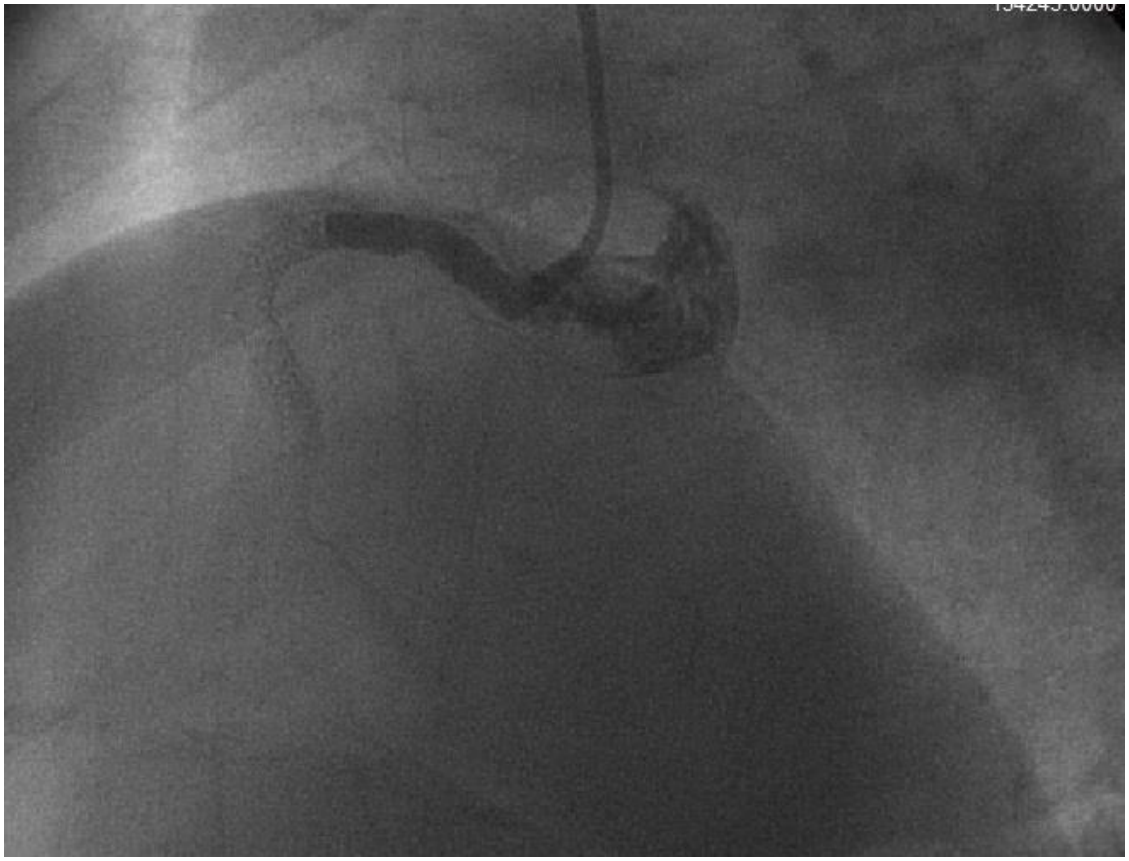
Variable	Score
Age =76 y	1
Time to reperfusion ≥ 4hrs	2
Luminal diameter =3.5 mm	2
Length of lesion = 24mm	4
High thrombus burden	1
D-Dimer = 866ng/ml	1
Initial TIMI = 0	3
+ve CK-MB	2
Total score	16

Items of the scoring system and their scoring points

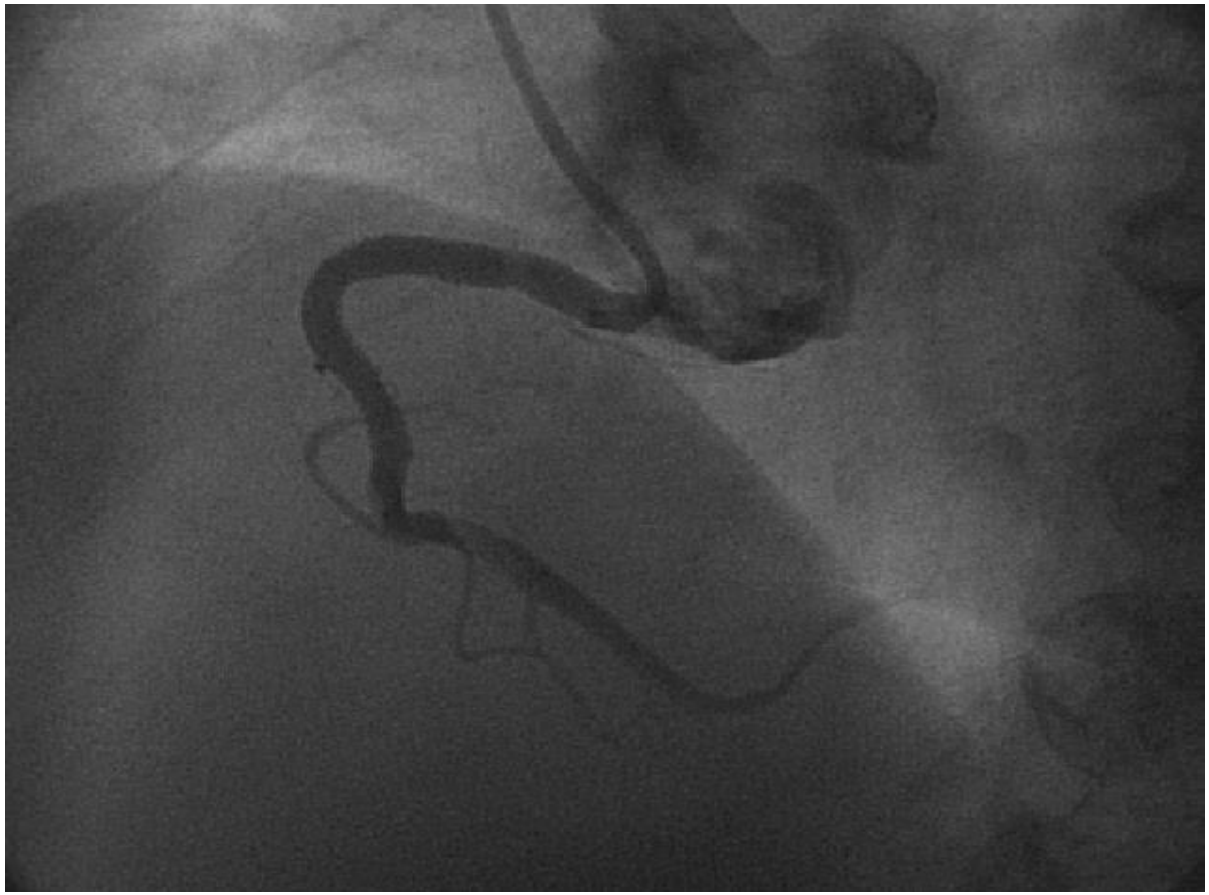


Thrombectomy with the Export catheter as the first interventional step.

repeated balloon dilatation by using Sapphire 1.5/15mm balloon, after balloon dilatation RCA shows two critical proximal lesions which is covered by Xience 3.5/28mm stent reaching 16 atmospheric pressure for 30 sec and followed by stenting of proximal RCA by Xience 4.0/18mm stent reaching 16 atmospheric pressure for 30 sec.



After stenting , no reflow occured which was treated by intra coronary Injection of nitroglycerin and repeated balloon inflation



Successful reperfusion with good final result , patient shifted to CCU on tirofiban infusion with good condition


Recommendations

- The current study suggested a weighted scoring system, to predict the development of no-reflow phenomenon during primary PCI in patients acute STEMI .

- The confirmation of these findings in prospective studies might allow the implementation of strategies to prevent this phenomenon and eventually improve the long term clinical outcomes.


THANK YOU FOR YOUR ATTENTION.
HAVE A GREAT DAY!