History of Medicine, 2023, 9(1): 715-721
DOI: 10.17720/2409-5834.v9.1.2023.077

Primary Percutaneous Coronary Interventions Among Acute STEMI Cases: Predictors for No Re-Flow

Hassanain M. S. Abdulameer Almustafa [1], Ali Jaber Aboob Al-Mamoori [2], Ameer Ahmed Aljubawii [3], Hayder Abdul-Amir Makki Al-Hindy [41]*

[1],[2],[3] *College of Medicine, University of Babylon, Babylon, Iraq*
[4] *Ass. Prof., College of Pharmacy, University of Babylon, Babylon, Iraq.*

Corresponding author: Hayder Abdul-Amir Makki Al-Hindy (makihayder68@gmail.com,)

Received: 20 January 2023 **Accepted:** 15 April 2023

Citation: Almustafa H M S A, Mamoori A J A, Aljubawii A A, Al-Hindy H A A M (2023) Primary Percutaneous Coronary Interventions Among Acute STEMI Cases: Predictors for No Re-Flow 9(1): 715-721. https://doi.org/10.17720/2409-5834.v9.1.2023.077

Abstract

Background: no reflow has been recognized as a serious primary percutaneous coronary intervention-associated complication, its incidence is related with poor clinical consequences. The goal of the present research is to evaluate the angiographic and clinical determinants of no-reflow. Methods: The clinical and angiographic characteristics of cases of primary percutaneous coronary intervention for acute ST-segment elevation myocardial infarction at the Shaheedul-Mihrab center between January 2015 and September 2016, were retrospectively evaluated. Results: There were 11.5% no-reflow cases. While diabetes, smoking history, sex category, and infarct location did not affect the probability of no-reflow, a history of hypertension and older age did. A higher syntactic score, a greater thrombus burden, and a low primary TIMI flow were all corelated with no re-flow.

Keywords
re-flow, ST-segment elevation myocardial infarction, PCI, STEMI, percutaneous coronary intervention.

In order to reduce ischemic cardiac injury and maintain left ventricular systolic function, complete recovery of antegrade circulatory flow in the obstructed coronaries is the cornerstone of treating acute ST-segment elevation myocardial infarction (Kirma et al., 2008).

The 2 available strategies for reperfusion are PCI and thrombolytic therapy. Many studies have been demonstrated that a primary PCI is the preferable perfusion option because of the high patency rate of the culprit artery less bleeding risk and lower mortality (Keeley, Boura, & Grines, 2003; Weaver et al., 1997).

Primary (PCI) percutaneous coronary intervention is a gold standard for treating acute ST-segment elevation myocardial infarction or (STEMI), and its preferable when the time to treatment is short and performed by experienced operators (O'gara et al., 2013; Task Force Members et al., 2012).

Angiographically successful PCI is defined as minimal remaining stenosis of less than 10 % for implanted stent and less than 50% for balloon angioplasty in the absence of dissection affecting blood flow, jeopardization of substantial side branch or thrombus (Writing Committee

[1] Copyright: Hassanain M. S. Abdulameer Almustafa, Ali Jaber Aboob Al-Mamoori, Ameer Ahmed Aljubawii, Hayder Abdul-Amir Makki Al-Hindy

Members et al., 2011).

In some patients, primary PCI has achieved coronary reperfusion without myocardial actual reperfusion, this situation is known as no-reflow. Thus no-reflow phenomenon is described as TIMI flow not more than three despite securing patency of the culprit coronary vessel with the exclusion of mechanical obstruction (dissection, obstructive thrombus, or coronary vasospasm) (Harrison et al., 2013).

The issue of no re-flow in case of primary PCI is a major problem. No-reflow is related with greater mortality, and poor LV systolic function, and the treatment of no-reflow is conflicting (Aung Naing et al., 2013; Bolognese et al., 2004), with no single effective treatment strategy (Kloner, Ganote, & Jennings, 1974). The occurrence of no re-flow varies from 5 to 41 % in different clinical reports.

There is a lack of knowledge on the cause of the no-reflow occurrence. In 1974, Kloner et al. described no re-flow as a novel event. They show that no reflow occurs in dogs 90 minutes after coronary ligation (Kloner et al., 1974).

Possible mechanisms that contribute to no-reflow include, embolization to the distal microvasculature, reperfusion injury, ischemic injury, individual susceptibility, endothelial dysfunction, in situ distal thrombosis, and release of vasoconstrictor (Reffemann & Kloner, 2004) .

Patients and methods

We retrospectively analyze the database and the angiographic procedures of patients with acute STEMI referred to Shaheedul-Mihrab center in Babylon, Iraq who experienced primary PCI during the interval from January 2015 to September 2016.

Inclusion criteria were STEMI patient with angina pain lasting not more than twelve hrs. before the coronary intervention or 12 to 24 hours after symptoms commencement with persistent chest pain or hemodynamic instability. The exclusion criteria include patients who receive thrombolytic and situations where there has already been a coronary bypass graft.

Patients' demographic details

The medical records of eligible patients were reviewed. Atherosclerotic risk factors include age, sex, history of DM, history of hyperlipidemia, hypertension, tobacco smoking, family history of ischemic heart disease, drug history, prior history of CAD, and previous PCI or cardiac bypass surgery were reported.

Procedures of coronary angiograms and intervention

Two interventional cardiologists evaluated the coronary angiograms. The syntax scores were calculated for all patients using a syntax score calculator, and TIMI flow in the culprit artery was visually evaluated initially during the initial diagnostic angiography and at the conclusion of coronary intervention using TIMI flow grade classification. For a more quantitative evaluation, TIMI flow at the conclusion of the intervention was also evaluated using TIMI frame count. All angiogram films were recorded with 15 frames/second. Coronary angiographic thrombus burden was assessed using TIMI thrombus grade:

Grade zero: no angiographic evidence of thrombosis

Grade one: Probable thrombosis

Grade two: The thrombus' largest diameter is < half the artery width

Grade three: The largest diameter of thrombus is more than half artery diameter and less than 2 artery diameters.

Grade four: Largest diameter of more than 2 artery diameters.

Grade five: total occlusion of the artery due to thrombosis (Sianos & Serruys, 2011)

The coronary intervention procedure is classified as balloon angioplasty, balloon predilatation, and stenting and direct stenting.

Statistical. analysis

With the use of SPSS version 16, statistical studies were carried out. To analyze the association between categorical variables, chi-square was utilized. Categorical parameters were stated as numerical variables, while the continuous parameters were represented by means and standard deviation.

The results

Baseline patient clinical data

Among the 113 patients enrolled in this study, no reflow was detected in 13 patients (11.5%). No significant alteration was found between normal flow and the no re-flow patients concerning sex category, smoking status, presence of diabetes, and location of myocardial infarction. The presence of hypertension and aging were significantly related to the development of the no re-flow phenomenon, (table 1).

Table 1: Clinical characteristics of the studied patients

Variable	No re-flow (n=13)	Normal flow (n=100)	P-value
Age	69+7.621	57+11.039	0.001
Male	9(69.2 %)	54(54 %)	0.2
Diabetes mellitus	7(53.84%)	29(29%)	0.07
Hypertension	8(61.5%)	32(32%)	0.04
Current smoker	8(61.5)	38(38%)	0.9
Location of myocardial infarction			
Anterior	9(69.2%)	62(62%)	0.8
Inferior	3(23%)	23(23%)	
Other	1(7.6%)	15(15)	

Higher syntax score, higher thrombus burden, initial TIMI flow, and predilatation of the lesions of coronary arteries before stenting were significantly associated with the progress of no-reflow, while the culprit lesion and lack or presence of collaterals did not significantly increase the risk of no-reflow. (Table 2)

Table 2: Angiographic features of the no-reflow versus reflow patients

Variable	No re-flow	Normal flow	P-value
Culprit's vessel			
LAD	9	62	0.6
LCX	1	14	
RCA	3	24	
Syntax score	17.9+4.89	12.8+8.56	0.04
Thrombus burden			
0-1	0	45	0.001
2-3	2	32	
4-5	11	23	
Collaterals			
0 -1	12	76	0.3
2	1	4	
3	0	9	
4	0	11	
Method of reperfusion			
Balloon angioplasty	1	2	0.008

Balloon angioplasty and stenting	10	38	
Direct stenting	2	60	
Initial TIMI flow			
0	11	23	0.001
1	0	5	
2	2	36	
3	0	36	

Discussion

Early diagnosis is essential in treating of individuals with assumed or confirmed AMI because it is the most prevalent cause of debility and mortality worldwide (Al-Shamma, Alkhafaji, & Al-Hindy, 2022; Shaker et al., 2020). In the contemporary era, an intense considerate of the pathophysiology of coronary arteriosclerosis as the basic mechanism of acute myocardial infarction has conducted studies toward detailed microvascular dynamic changes as possible diagnostic means for the clinical setting (Al-Saad et al., 2020; Alhaideri et al., 2022; Ghazi, Al-Taee, & Al-Hindy, 2020; Kazaili et al., 2021; Mousa, Al Saffar, & Al-Hindy, 2020). In this study, the no-reflow phenomenon was detected in 13 cases (11%), this result was comparable to the international data, which report a no-reflow phenomenon rate of 5 to 41% (Niccoli et al., 2009).

The exact cause of no-reflow is not so clear, possible etiologies include coronary artery spasm, dysfunction of the coronary microvasculature, distal embolization, ischemic injury, reperfusion injury, and increased platelet activity, the release of vasoconstrictors and endothelial dysfunction (Galasso et al., 2014). Advancing age was associated significantly with no re-flow phenomenon. As well, comorbidities, delayed hospitalization, heavy calcification of coronary artery, more complex coronary lesions, and dysfunction of microvasculature are more common in an elderly patient and can explain the less successful primary PCI in this age category (Yang et al., 2020).

The risk of no re-flow in this study was not significantly associated with smoking habits and diabetes, though smoking and diabetes are well-known risk factors for atherosclerosis, endothelial dysfunction, and microvascular dysfunction (Messner & Bernhard, 2014). We cannot explain theoretically this result, possibly a small sample size can attribute to this controversy. Meanwhile, hypertensive patients were at greater risk for a no-reflow phenomenon, which is similar to several articles.

In this study, the location of myocardial infarction and the culprit's vessel does not affect the chance of no-reflow. Large recent meta-analysis of 27 prospective and retrospective studies show also no correlation between no-reflow and the anatomical location of infarction (Fajar, Heriansyah, & Rohman, 2018).

In our investigation, there was a statistically significant correlation between initial TIMI flow, thrombus burden, modality of reperfusion, and no re-flow in terms of angiographic parameters. While the risk of the no-reflow event, was unaffected by the existence or lack of collaterals. In patients undergoing primary PCI, De Luca et al. demonstrated that early TIMI flow is a robust predictor of successful intervention and accomplishment of normal TIMI flow, myocardial blush grade two or three, and minimal myocardial damage (De Luca et al., 2004). A high initial thrombus burden was an independent predictor for no re-flow and possibly related to the higher risk of distal embolization (Chen et al., 2012).

Finally, direct stenting without predilatation has been correlated with a lower risk of no-reflow in

the current study. Direct stenting without predilatation is a possible interventional approach that has been used successfully during primary percutaneous coronary intervention (Antoniucci et al., 2001). However, Balloon predilatation before stent implantation during the primary PCI can lead to manipulation thrombus, dislodgment, distal embolization, and subsequently no-reflow. In some clinical situations, balloon predilatation is unavoidable especially if the distal stent landing zone is not visible. In our study, the choice of direct stenting versus balloon predilatation and stenting was the decision of the operator.

Conclusion

No re-flow occurring in patients with a primary PCI was 11.5%, which was more likely to occur in elderly and hypertensive patients. There was a high syntax score, low initial TIMI flow, and higher thrombus burden among the patients.

Reference

Al-Saad RZ, Shaker AK, Dleikh FS, & Al-Hindy HA-AM (2020) Is There Any Association Between Highly Sensitive Creactive Protein and Dental-status in Ischemic Heart Diseases? A Comparative Study. Biochemical & Cellular Archives 20 (2): 6069-6075. URL: https://www.researchgate.net/profile/Hayder-Maki/publication/347318185

Al-Shamma YMH, Alkhafaji AAA, & Al-Hindy HA-A (2022) Caries burden is associated with serum uric acid and CRP in patients treated for acute coronary syndrome. HIV Nursing 12 (2): 050-056. DOI: http://dx.doi.org/10.31838/hiv23.02.9

Alhaideri AF, Al-Agam A, Alzughaibi M, Al-Hindy H, & Mousa M (2022) Hypovitaminosis D is a biological vulnerability for depressive symptoms in major depression at the era of COVID-19 outbreak. Clinical Schizophrenia & Related Psychoses 5

Antoniucci D, Valenti R, Migliorini A, Moschi G, Bolognese L et al. (2001) Direct infarct artery stenting without predilation and no-reflow in patients with acute myocardial infarction. American heart journal 142 (4): 684-690. DOI: https://doi.org/10.1067/mhj.2001.117778

Aung Naing K, Li L, Su Q, & Wu T (2013) Adenosine and verapamil for no-reflow during primary percutaneous coronary intervention in people with acute myocardial infarction. Cochrane Database Syst Rev (6): Cd009503. DOI: https://doi.org/10.1002/14651858.CD009503.pub2

Bolognese L, Carrabba N, Parodi G, Santoro GM, Buonamici P et al. (2004) Impact of microvascular dysfunction on left ventricular remodeling and long-term clinical outcome after primary coronary angioplasty for acute myocardial infarction. Circulation 109 (9): 1121-1126. DOI: https://doi.org/10.1161/01.CIR.0000118496.44135.A7

Chen Y, Wang C, Yang X, Wang L, Sun Z et al. (2012) Independent no-reflow predictors in female patients with ST-elevation acute myocardial infarction treated with primary percutaneous coronary intervention. Heart and vessels 27: 243-249. DOI: https://doi.org/10.1007/s00380-011-0144-2

De Luca G, Ernst N, Zijlstra F, Van't Hof AW, Hoorntje JC et al. (2004) Preprocedural TIMI flow and mortality in patients with acute myocardial infarction treated by primary angioplasty. Journal of the American College of Cardiology 43 (8): 1363-1367. URL: https://www.jacc.org/doi/abs/10.1016/j.jacc.2003.11.042

Fajar JK, Heriansyah T, & Rohman MS (2018) The predictors of no reflow phenomenon after percutaneous coronary intervention in patients with ST elevation myocardial

infarction: A meta-analysis. Indian Heart Journal 70: S406-S418. DOI: https://doi.org/10.1016/j.ihj.2018.01.032

Galasso G, Schiekofer S, D'Anna C, Gioia GD, Piccolo R et al. (2014) No-reflow phenomenon: pathophysiology, diagnosis, prevention, and treatment. A review of the current literature and future perspectives. Angiology 65 (3): 180-189. DOI: https://doi.org/10.1177/0003319712474336

Ghazi HAA-M, Al-Taee RAM, & Al-Hindy HA-AM (2020) Immunophenotypic characterization of malignant lymphoma in Iraqi patients using immunohistochemical CD-marker study. Systematic Reviews in Pharmacy 11 (11): 412-417. DOI: http://dx.doi.org/10.31838/srp.2020.11.61

Harrison RW, Aggarwal A, Ou F-s, Klein LW, Rumsfeld JS et al. (2013) Incidence and outcomes of no-reflow phenomenon during percutaneous coronary intervention among patients with acute myocardial infarction. The American journal of cardiology 111 (2): 178-184. DOI: https://doi.org/10.1016/j.amjcard.2012.09.015

Kazaili A, Abdul-Amir Al-Hindy H, Madine J, & Akhtar R (2021) Nano-scale stiffness and collagen fibril deterioration: Probing the cornea following enzymatic degradation using peakforce-qnm afm. Sensors 21 (5): 1629. DOI: https://doi.org/10.3390/s21051629

Keeley EC, Boura JA, & Grines CL (2003) Primary angioplasty versus intravenous thrombolytic therapy for acute myocardial infarction: a quantitative review of 23 randomised trials. The lancet 361 (9351): 13-20. DOI: https://doi.org/10.1016/S0140-6736(03)12113-7

Kirma C, Izgi A, Dundar C, Tanalp AC, Oduncu V et al. (2008) Clinical and procedural predictors of no-reflow phenomenon after primary percutaneous coronary interventions Experience at a Single Center. Circulation Journal 72 (5): 716-721. DOI: https://doi.org/10.1253/circj.72.716

Kloner RA, Ganote CE, & Jennings RB (1974) The "no-reflow" phenomenon after temporary coronary occlusion in the dog. The Journal of clinical investigation 54 (6): 1496-1508. DOI: https://doi.org/10.1172/JCI107898

Messner B, & Bernhard D (2014) Smoking and cardiovascular disease: mechanisms of endothelial dysfunction and early atherogenesis. Arteriosclerosis, thrombosis, and vascular biology 34 (3): 509-515. DOI: https://doi.org/10.1161/ATVBAHA.113.300156

Mousa MJ, Al Saffar HS, & Al-Hindy H (2020) Low Level Laser (Biophotomodulation) Therapy for the Treatment of Diabetic Foot Ulcers with 532 nm KTP Laser Induces Wound Healing, Fibroblast Proliferation and Over-expression of TGF-β. Systematic Reviews in Pharmacy 11 (6): 396-403. DOI: https://doi.org/10.31838/srp.2020.6.63

Niccoli G, Burzotta F, Galiuto L, & Crea F (2009) Myocardial no-reflow in humans. Journal of the American College of Cardiology 54 (4): 281-292. URL: https://www.jacc.org/doi/abs/10.1016/j.jacc.2009.03.054

O'gara PT, Kushner FG, Ascheim DD, Casey Jr DE, Chung MK et al. (2013) 2013 ACCF/AHA guideline for the management of ST-elevation myocardial infarction: executive summary: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines. Circulation 127 (4): 529-555. DOI: https://doi.org/10.1161/CIR.0b013e3182742c84

Reffemann T, & Kloner RA (2004) Microvascular alterations after temporary coronary artery occlusion: the no-reflow phenomenon. Journal of cardiovascular pharmacology and therapeutics 9 (3): 163-172. DOI:

https://doi.org/10.1177/107424840400900303

Shaker AK, Al-Saad R, Jasim R, & Al-Hindy HA-AM (2020) Biochemical Significance of Cystatin-C and High-Sensitive CRP in Patients with Acute Coronary Syndrome; any Clinical Correlation with Diagnosis and Ejection Fraction. Systematic Reviews in Pharmacy 11 (3): 301-308. DOI: http://dx.doi.org/10.5530/srp.2019.2.04

Sianos G, & Serruys PW (2011) Angiographic thrombus burden classification in patients with ST-segment elevation myocardial infarction treated with percutaneous coronary intervention. Journal of Invasive Cardiology 22 (10): 6B-14B. URL: http://hdl.handle.net/1765/84854

Task Force Members, Steg PG, James SK, Atar D, Badano LP et al. (2012) ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation: The Task Force on the management of ST-segment elevation acute myocardial infarction of the European Society of Cardiology (ESC). European heart journal 33 (20): 2569-2619. DOI: https://doi.org/10.1093/eurheartj/ehs215

Weaver WD, Simes RJ, Betriu A, Grines CL, Zijlstra F et al. (1997) Comparison of primary coronary angioplasty and intravenous thrombolytic therapy for acute myocardial infarction: a quantitative review. Jama 278 (23): 2093-2098. DOI: https://doi.org/10.1001/jama.1997.03550230069040

Writing Committee Members, Levine GN, Bates ER, Blankenship JC, Bailey SR et al. (2011) 2011 ACCF/AHA/SCAI guideline for percutaneous coronary intervention: executive summary: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines and the Society for Cardiovascular Angiography and Interventions. Circulation 124 (23): 2574-2609. DOI: https://doi.org/10.1161/CIR.0b013e31823a5596

Yang L, Cong H, Lu Y, Chen X, & Liu Y (2020) Prediction of no-reflow phenomenon in patients treated with primary percutaneous coronary intervention for ST-segment elevation myocardial infarction. Medicine 99 (26). DOI: https://doi.org/10.1097/MD.0000000000020152