

# Incidence and Outcome of No Flow after Primary Percutaneous Coronary Intervention in Acute Myocardial Infarction

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## Abstract

**Background:** Mechanical revascularization of the infarct-related artery (IRA) is the most effective treatment modality in ST-segment elevation myocardial infarction (STEMI). No flow occurs in ~8.8-10% of cases of primary percutaneous coronary intervention (PCI) in STEMI patients. Our aim was to study actual incidence and outcome of no flow patients.

**Methods:** Five hundred and eighty primary PCI patients were studied over a period of two years i.e. January 2016 to December 2017. Drug eluting stents were used in all cases. Majority of our patients (>90%) came 6 hours after onset of chest pain. There were many patients where there was no flow even after mechanical thrombus aspiration and pharmacological vasodilator therapy. We have studied primary outcome (mortality) of no flow in those patients.

**Results:** There were 44 cases of no flow in our series (7.75%). Left anterior descending artery (LAD) was involved in eighteen patients. Right coronary artery (RCA) was culprit in twenty four cases. Only two cases were seen in LCX territory. One month mortality rate in no flow group was 50% and 6.25% in successful recanalization group. One year mortality was 12.5% in successful recanalization group and 66% in no flow group.

**Conclusion:** Refractory no flow during primary PCI in STEMI is associated with high mortality and morbidity. There is no established strategy to solve this phenomenon.

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## Introduction

**A**cute ST segment elevation myocardial infarction (STEMI) is caused by thrombotic occlusion of a major epicardial coronary artery in the absence of adequate collateral flow from other arteries. Early restoration of normal myocardial perfusion reduces infarct size, preserves left ventricular function and reduces mortality. Mechanical revascularization of the infarct-related artery (IRA) is the most effective treatment modality in ST-segment elevation myocardial infarction (STEMI). No flow occurs in ~8.8-10% of cases of primary percutaneous coronary intervention (PCI) in STEMI and is associated with different risk factors like advanced age, delayed presentation, ectatic coronary artery and huge thrombus burden.<sup>1</sup> The main purpose of the study was mortality outcome of no flow

## Methods

Patients in the age group of 18 to 80 were only considered for our study. No flow was defined by Thrombolysis in myocardial infarction (TIMI) grade zero or TIMI 1 flow. Our centre is a tertiary care university hospital which caters almost five districts of our state. We have studied 580 primary PCI patients done in our hospital over a period of two years i.e. January 2016 to December 2017. Informed consents were taken from all patients and the study protocol conforms to the ethical guidelines of the 1975 Declaration of Helsinki with prior approval by institution's human research committee. Drug eluting stents were used in all cases. Majority of our patients (>90%) came 6 hours after onset of chest pain. Average presentation was 8-12 hrs after onset of chest pain. We have used thrombus aspiration catheter and Gp IIb/IIIa receptor blocker when there is huge thrombus load (TIMI thrombus grade 3 or more). Intracoronary adenosine and nicorandil were used as adjunctive pharmacotherapy to alleviate no flow. There were many patients where there was no flow even after mechanical thrombus aspiration and pharmacological vasodilator therapy. TIMI 3 flow was taken as successful recanalization criteria. Achieving TIMI 3 flow is important because it has a better prognosis. Majority of our procedures (70%) were done by radial route and rest (30%) by femoral route. Manual compression was done

to secure haemostasis.

**Statistical analysis:** Instat 3 software was used for statistical analysis. Fisher exact test was done to evaluate statistical significance between two groups.

## Results

We have experienced 44 cases of no flow in our series. Incidence is around 7.75%. Twenty six patients were suffering from diabetes. Incidence was 60%. Thirty patients were male and fourteen were female patients. Male prevalence was 68% and female prevalence was 32%. Table 1 shows that Twenty four patients were hypertensive. Incidence is about 54%. Thirty two patients were smokers taking more than 10 cigarettes per day. Prevalence is around 72% and it was most common risk factor. Dyslipidaemia was seen only in sixteen patients and incidence was about 36%. No flow was common in elderly patients.

**Table 1.** Baseline characteristics of no flow patients

Different category of no flow patients	No of Patients	Percentage (%)
Male	30	68
Female	14	32
Diabetes	26	60
Dyslipidaemia	16	36
Hypertension	24	54
Smoker	32	72

Baseline category of normal flow patients	No of Patients	Percentage (%)
Male	426	80
Female	110	20
Diabetes	268	50
Dyslipidaemia	188	35
Hypertension	294	55
Smoker	321	60

Only four patients were below 40 years age group. Twelve patients were in the 40-60 years age group. Figure 1 Twenty patients were in the age group of 60-80. Fourteen patients were in cardiogenic shock requiring pharmacological pressure support mainly noradrenaline, dobutamine and dopamine. We did not use mechanical circulatory support device in any of our patients. Amongst patients with cardiogenic shock ten patients had anterior wall STEMI and four patients had

inferior wall STEMI. Amongst cardiogenic shock cases ten patients were diabetic. Incidence is 70%. Majority of them were having multi vessel disease. Two patients died during hospital stay. They were suffering from anterior wall STEMI. We could not reestablish flow in those patients. They were having persistent cardiogenic shock.

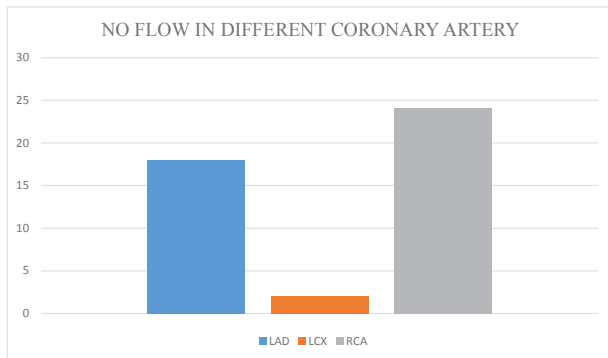


Figure 1. No Flow In Different Coronary Artery

Left anterior descending artery (LAD) was involved in eighteen patients. Right coronary artery (RCA) was culprit in twenty four cases. No flow was most common in RCA territory. Least common was left circumflex (LCX) artery. Figure 2 shows that Only two cases were seen in LCX territory. Average diameter of RCA was greater than LAD. Most RCA were tortuous, dilated and ectatic.

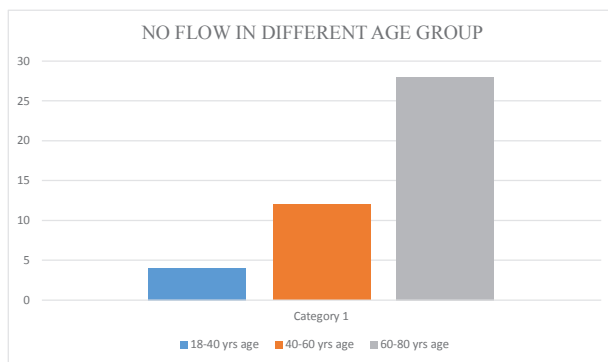


Figure 2. No Flow In Different Age Group

Amongst failure cases two patients died in their hospital stay and they were having persistent cardiogenic shock. Another six patients died during thirty days. Two

died in their home probably because of arrhythmia. Three died due to persistent heart failure later on. Another was admitted with heart failure but died due to incessant ventricular tachycardia refractory to recurrent electrical cardioversion. Thirty five patients died within one month in successful recanalization group. Four more patients died within one year again due to heart failure in no flow group. Seventy six patients died in successful recanalization group. One month mortality rate in no flow group was 50% and 6.25% in successful recanalization group. Table 2 and Figure 3. One year mortality was 12.5% in successful recanalization group and 66% in no flow group. Table 3

**Table 2.** One month mortality rate comparison between successful recanalization and no flow group

	Death	Survived
No Reflow group (44)	8	36
Successful recanalization group(536)	35	501

**Table 3.** One year mortality rate comparison between successful recanalization and no flow group

	Death	Survived
No Reflow group (44)	12	32
Successful recanalization group(536)	76	460

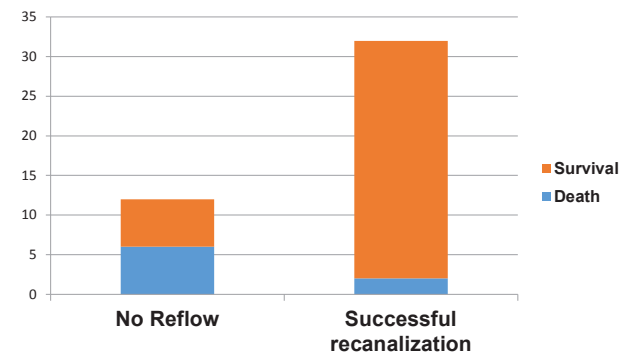


Figure 3. One month mortality comparison

One month mortality rate in no flow group was 50% and 6.25% in successful recanalization group. Relative risk of dying within one month in no-reflow group as compared to successful recanalization group is highly significant (RR is 8.00; 95% Confidence interval 1.864 to 34.333; with a p-value of <0.001). One year mortality rate comparison between successful recanalization

and no-reflow group: Relative risk of dying within one year in no-reflow group as compared to successful recanalization group is statistically significant (RR is 5.333; 95% Confidence interval 1.961 to 14.504; with a p-value of <0.001)

## Discussion

No flow is seen around 8.8-10% patients of primary percutaneous intervention (PCI) in ST elevation myocardial infarction (STEMI) patients. No flow is associated with increased morbidity and mortality. No flow can result in poor healing of the infarct and adverse left ventricular remodeling, increasing the risk for major adverse cardiac events, including congestive heart failure and death. Despite considerable insight regarding who is at risk for no flow and how management strategies work, no specific therapies have been devised yet. No flow is accompanied by chest pain, electrical instability and possible hemodynamic compromise. The mechanisms of no flow are thrombus-plaque embolisation, platelet activation, release of vasoconstrictors and vasospasm. Thirty day mortality of refractory no flow is 32%.<sup>3</sup> No flow is directly proportional to thrombus burden. Lot of STEMI patients have huge thrombus burden. After stent deployment or balloon dilatation thrombus may fragment and migrate distally in coronary artery. Routine use of aspiration catheter and Gp IIb/IIIa receptor blocker in primary PCI is not recommended now. TASTE trial has proven that routine use of aspiration catheter is not beneficial and it increases incidence of stroke.

Rezkalla et al had studied 347 STEMI patients treated with primary PCI and found no-reflow phenomenon in 32% of patients. Patients with no-reflow who received pharmacological therapy in the form of intracoronary nitroprusside, nicardipine, or verapamil had an improvement in coronary flow and better prognosis, demonstrating the importance of recognition and appropriate<sup>4</sup> management of this condition. Patient-specific features known to be related to high risk of no-reflow in patients with STEMI include delayed presentation to the catheterization laboratory, hyperglycemia, and hypercholesterolemia. More recent evidence suggests that no-reflow is more frequently encountered in association with female sex, hypertension, mild-to-moderate renal insufficiency, and

elevated inflammatory markers.<sup>5</sup> There are also lesion-specific features that may influence the risk of no-reflow, such as plaque composition and thrombus burden as detected by intravascular ultrasound.<sup>6</sup> In patients with diabetes, optimal blood sugar control before the procedure can reduce the occurrence of no-reflow.<sup>7</sup> In individuals with hyperlipidemia, intensive statin therapy before PCI is beneficial in reducing no flow.<sup>8</sup> Prevention strategies should include primary stenting, avoidance of high pressure stent deployment, and thrombectomy before the intervention if there is huge thrombus load.<sup>9</sup> Incidence of no flow was around 7.75% in our study. Right coronary artery was most commonly involved and least common was left circumflex artery. Thrombus burden and vesselectasia were two important predisposing factors for no flow. There was statistically significant effect on mortality in no flow patients. Relative risk of dying within one month in no flow group as compared to successful recanalization group is highly significant (RR is 8.00; 95% Confidence interval 1.864 to 34.333; with a p-value of <0.001). Relative risk of dying within one year in no flow group as compared to successful recanalization group is statistically significant (RR is 5.333; 95% Confidence interval 1.961 to 14.504; with a p-value of 0.0009). Primary PCI is associated with high rates of distal embolization due to high thrombus burden. The sequelae of distal embolization results in reduced myocardial perfusion and increased myocyte damage. Macroscopic distal embolization may be seen in up to 16% of patients undergoing primary PCI and suboptimal tissue perfusion may be seen in 20% to 40% of patients despite restoration of TIMI 3 epicardial flow in the catheterization laboratory.<sup>10</sup> A number of vasodilator agents have been shown to improve TIMI flow rate, corrected TIMI frame counts, and wall motion score index. Such vasodilator agents include adenosine, verapamil, nicorandil, norepinephrine and sodium nitroprusside.<sup>11</sup>

## Conclusion

Refractory no flow during primary PCI in STEMI is associated with high mortality and morbidity. There is no established strategy for this phenomenon, future research should be directed to prevent this condition.

## Conflict of Interest

None.

## References

1. Sandhir Prasad, Ian. T. Meredith. Current approach to slow flow and no Reflow. *Cardiac Interventions Today*: 2008 :43-49 .
2. Triantafyllou K, Metaxopoulos P, Babalis D. Primary percutaneous coronary intervention of an unprotected left main using mini-crush drug-eluting stents facilitated by intracoronary reteplase. *Catheterisation and cardiovascular intervention*. 2011 March. Vol 77: 515-521
4. Rezkalla S.H., Dharmashankar K.C., Abdalrahman I.B., Kloner R.A. No-reflow phenomenon following percutaneous coronary intervention for acute myocardial infarction: incidence, outcome, and effect of pharmacologic therapy. *Journal of Interventional Cardiology* .2010;23:429–436
5. Wang H.J., Lo P.H., Lin J.J., Lee H, Hung S.. Treatment of slow/no-reflow phenomenon with intracoronary nitroprusside injection in primary coronary intervention for acute myocardial infarction. *Catheter Cardiovascular Intervention*. 2004;63:171–176
6. Amano H, Ikeda T, Toda M, Okubo R, Yabe T, Watanabe I, Saito D. Plaque composition and no-reflow phenomenon during percutaneous coronary intervention of low-echoic structures in grayscale intravascular ultrasound. *International Heart Journal*.2016: 57:285–291.
7. Katsuomi Iwakura, Hiroshi Ito, Masashi Ikushima, Shigeo Kawano, Atsushi Okamura, Katsuaki Asano .Association between hyperglycemia and the no-reflow phenomenon in patients with acute myocardial infarction. *Journal of American College of Cardiology* .2003;41:1–7
8. LI, Xiang-dong; YANG, Yue-jin; HAO, Yong-chen; YANG, Ying; ZHAO, Jing-lin; DOU, Ke-fei; GU, Dong-feng. Effects of pre-procedural statin therapy on myocardial no-reflow following percutaneous coronary intervention: a meta analysis. *Chinese Medical Journal* .2013: 126:1755–1760
9. Grygier M., Araszkiwicz A., Lesiak M., Grajek S. Role of adenosine as an adjunct therapy in the prevention and treatment of no-reflow phenomenon in acute myocardial infarction with ST segment elevation: review of the current data. *Kardiologia Poloska*.2013: 71:115–120
10. Higashi H, Inaba S, Nishimura K, Hamagami T, Fujita Y, Okayama H, Okayama H, Higaki J. Usefulness of Adjunctive Pulse Infusion Thrombolysis After Failed Aspiration for Massive Intracoronary Thrombus. *Canadian journal of Cardiology*. 2011. Nov :Vol 27. 869- 869.
11. Shereif H. Rezkalla, Rachel V. Stankowski, Jennifer Hanna, Robert A. Kloner. Management of No-Reflow Phenomenon in the Catheterization Laboratory. *JACC: Cardiovascular Interventions*.2017 Feb. Vol.10:215-223