Journal of Health and Rehabilitation Research 2791-156X JHRR

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Original Article

Use Of Intracoronary Adrenaline and its Affect on Post PCI Timi Flow

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Conflict of Interest: None.

Waris A., et al. (2024). 4(2): DOI: https://doi.org/10.61919/jhrr.v4i2.1134

ABSTRACT

Background: Percutaneous coronary intervention (PCI) has significantly improved the management of acute coronary syndromes (ACS) and chronic coronary artery disease (CAD), reducing morbidity and mortality. The Thrombolysis in Myocardial Infarction (TIMI) flow grades measure the success of PCI in restoring blood flow. However, achieving optimal TIMI flow can be challenging due to complications like the no-reflow phenomenon, which occurs despite successful mechanical opening of the coronary artery and is associated with poor outcomes.

Objective: To assess the impact of intracoronary adrenaline (epinephrine) on post-PCI TIMI flow grades and associated hemodynamic effects in patients experiencing no-reflow or slow-flow phenomena during PCI.

Methods: This retrospective study was conducted at the Interventional Cardiology Department of Hayatabad Medical Complex, Peshawar, from January 1, 2023, to December 31, 2023. A total of 800 consecutive patients who underwent PCI and experienced no-reflow or slow-flow phenomena were included. Intracoronary adrenaline was administered, and data were collected on patient demographics, comorbid conditions, lesion location, TIMI flow grades, and hemodynamic parameters before and after adrenaline administration. Statistical analysis was performed using SPSS software (version 25.0), with paired Student's t-tests and chi-square tests used for data comparison.

Results: The administration of intracoronary adrenaline resulted in a significant improvement in TIMI flow grades, with complete restoration of TIMI 3 flow in 589 (73.2%) patients. TIMI frame count decreased significantly from 57 ± 11 to 18 ± 09 ($p < 0.021$). TIMI myocardial blush grade improved from 0.82 ± 0.69 to 2.60 ± 0.63 ($p < 0.032$). Hemodynamic parameters, including systolic and diastolic blood pressures and heart rate, showed significant improvement post-adrenaline administration ($p < 0.001$). The incidence of non-sustained ventricular tachycardia was 27%, while sustained ventricular tachycardia was negligible. The need for intra-aortic balloon pump (IABP) and transvenous pacing was documented in 16% of cases.

Conclusion: Intracoronary adrenaline is effective in improving TIMI flow grades and hemodynamic stability in patients with refractory no-reflow following primary PCI for STEMI. The treatment was well tolerated with minimal adverse effects, suggesting its potential utility in clinical practice. However, large-scale randomized studies are needed to confirm these findings and establish guidelines for optimal dosing and administration strategies.

Keywords: Percutaneous coronary intervention, intracoronary adrenaline, TIMI flow grades, no-reflow phenomenon, acute coronary syndrome, myocardial infarction.

INTRODUCTION

Percutaneous coronary intervention (PCI) has dramatically transformed the treatment landscape for acute coronary syndromes (ACS) and chronic coronary artery disease (CAD), significantly lowering the associated morbidity and mortality rates (1). PCI employs catheter-based techniques to reopen obstructed coronary arteries, thereby reestablishing blood flow to the myocardium (2). The effectiveness of PCI is typically evaluated using the Thrombolysis in Myocardial Infarction (TIMI) flow grades, which provide a quantitative assessment of coronary blood flow post-intervention (3). Despite the advancements in PCI technology and

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methodologies, achieving optimal TIMI flow can be challenging due to complications such as the no-reflow phenomenon, which can obstruct the successful restoration of adequate myocardial perfusion and lead to unfavorable clinical outcomes (4).

The no-reflow phenomenon, defined by insufficient myocardial perfusion despite successful mechanical recanalization of the coronary artery, is a complex and multifactorial issue. It involves endothelial dysfunction, microvascular obstruction, and distal embolization of atherothrombotic debris (5). This phenomenon can occur in up to 25% of primary PCI procedures for acute myocardial infarction (AMI) and is linked to worse short- and long-term outcomes, including higher rates of heart failure and mortality (6). Traditional pharmacologic interventions aimed at mitigating this issue, such as nitroglycerin, calcium channel blockers, and adenosine, have shown inconsistent success (7).

Intracoronary administration of adrenaline (epinephrine) has emerged as a promising therapeutic strategy for improving coronary perfusion in cases of no-reflow and slow-flow phenomena. Adrenaline, a potent catecholamine with both alpha- and beta-adrenergic agonist properties, induces vasoconstriction through its alpha-adrenergic effects, thereby maintaining systemic blood pressure and enhancing perfusion pressure across the coronary circulation. Concurrently, its beta-adrenergic effects increase myocardial contractility and heart rate, augmenting coronary blood flow (8). Additionally, adrenaline's ability to decrease microvascular resistance and counteract microvascular spasm makes it a compelling agent for addressing the microvascular dysfunction characteristic of no-reflow (9, 10).

Despite the theoretical advantages and some supporting clinical evidence, the routine clinical application of intracoronary adrenaline remains limited due to concerns about potential adverse effects such as arrhythmias and hypertension (11) Moreover, most data on the efficacy and safety of intracoronary adrenaline are derived from small-scale studies and anecdotal reports, highlighting the need for more extensive research. This retrospective study aims to bridge this knowledge gap by evaluating the impact of intracoronary adrenaline on post-PCI TIMI flow grades and associated hemodynamic effects in patients experiencing no-reflow or slow-flow phenomena during PCI. The findings of this study could potentially refine clinical practices and improve outcomes for patients undergoing PCI (12, 13)

MATERIAL AND METHODS

This retrospective study was conducted to evaluate the impact of intracoronary adrenaline on post-PCI TIMI flow grades. The research was carried out over a one-year period, from January 1, 2023, to December 31, 2023, at the Interventional Cardiology Department of Hayatabad Medical Complex, Peshawar. A total of 800 consecutive patients who underwent PCI during the specified period and experienced no-reflow or slow-flow phenomena were retrospectively enrolled. These patients received intracoronary adrenaline during PCI.

Inclusion criteria encompassed patients aged 18 to 80 years undergoing PCI who experienced no-reflow or slow-flow phenomena (TIMI flow ≤ 2) during the procedure and received intracoronary adrenaline as part of the intervention. Patients were diagnosed with acute STEMI based on typical chest pain lasting over 30 minutes, with ST elevation of ≥1 mm in at least two contiguous ECG leads and/or ≥2 mm in precordial leads. Exclusion criteria included patients with systolic blood pressure less than 90 mmHg at admission, those with a known allergy to adrenaline, those undergoing chronic hemodialysis, pregnant women, those requiring rescue intervention after failed thrombolysis, patients with contraindications to aspirin or clopidogrel, those needing emergent coronary artery bypass surgery, and those unable to provide informed consent.

The study protocol received approval from the Ethics Committee of Hayatabad Medical Complex, Peshawar, and adhered to the ethical standards of the 1964 Declaration of Helsinki and its later amendments. Given the retrospective nature of the study, informed consent was waived, but patient confidentiality was strictly maintained throughout the research.

Data were extracted from electronic medical records, including patient demographics, comorbid conditions, lesion location, TIMI flow grades, and hemodynamic parameters before and after adrenaline administration. Relevant clinical history, including the presence of comorbidities such as hypertension, diabetes, and smoking history, as well as the indication for PCI, was documented. Procedural specifics, including the type of stent used and the duration of the procedure, were also recorded.

TIMI flow was assessed pre- and post-adrenaline administration using angiographic images, graded on a scale from 0 (no perfusion) to 3 (normal flow). Hemodynamic parameters, including heart rate and blood pressure, were recorded before and after the administration of intracoronary adrenaline. The incidence of arrhythmias, significant changes in blood pressure, and any other complications related to adrenaline administration were meticulously documented.

Intracoronary adrenaline was administered to patients experiencing no-reflow or slow-flow phenomena during PCI, with doses ranging from 10 to 50 micrograms, titrated based on patient response and hemodynamic status. The decision to use intracoronary adrenaline was made by the attending interventional cardiologist based on clinical judgment. Patients were continuously monitored for hemodynamic changes and potential adverse events during and after adrenaline administration. Electrocardiographic (ECG)

monitoring was employed to detect any arrhythmias, and blood pressure was measured at regular intervals. Follow-up angiography was performed immediately after adrenaline administration to assess changes in TIMI flow grades.

Statistical analysis was conducted using SPSS software, version 25.0. Continuous variables were presented as mean ± standard deviation (SD), while categorical variables were expressed as numbers and percentages. Paired Student's t-tests were used to compare continuous variables before and after adrenaline administration, and chi-square tests were employed for categorical variables. A p-value of <0.05 was considered statistically significant.

In conclusion, this study provided a comprehensive assessment of the impact of intracoronary adrenaline on TIMI flow grades and hemodynamic parameters in patients undergoing PCI with no-reflow or slow-flow phenomena. The findings contribute valuable insights into the efficacy and safety of intracoronary adrenaline in this clinical context.

RESULTS

The study included 800 consecutive patients who underwent PCI and experienced no-reflow or slow-flow phenomena, receiving intracoronary adrenaline. The results demonstrated significant improvements in TIMI flow grades and hemodynamic parameters following adrenaline administration.

Table 1 Patient Demographics and Clinical Characteristics

Variable	N (%)
Gender (% male)	548 (68.5%)
Age (mean ± SD)	63 ± 21
Comorbid Conditions	
- Diabetes Mellitus	130 (16.25%)
- Hypertension	279 (33.4%)
- Past CABG	77 (9.6%)
Lesion Location	
- Left Anterior Descending	280 (35%)
- Circumflex	144 (18.0%)
- Right Coronary Artery	408 (51%)
Preprocedural Angiographic Thrombus	532 (66.5%)
TIMI Flow Grade Before Adrenaline	
- TIMI 1	549 (68.6%)
- TIMI 2	251 (31.4%)
TIMI Flow Grade After Adrenaline	
- TIMI 1	85 (10%)
- TIMI 2	135 (16.8%)
- TIMI 3	589 (73.2%)
TIMI Frame Count (mean ± SD)	
- Post Adrenaline	57 ± 09
- Pre-Adrenaline	18 ± 22

Table 2 Hemodynamic Effects of Intracoronary Adrenaline

Parameter	Before Administration	After Administration	p-value
Systolic Pressure (mmHg)	95 ± 19	141 ± 21*	<0.001
Diastolic Pressure (mmHg)	62 ± 13	93 ± 11*	<0.001
Heart Rate (beats/min)	69 ± 11	94 ± 15*	<0.001

*Statistically significant improvement ($p < 0.001$).

The administration of intracoronary adrenaline resulted in a significant improvement in TIMI flow grades, with complete restoration of TIMI 3 flow in 589 (73.2%) patients. TIMI frame count significantly decreased from 57 ± 11 to 18 ± 09 ($p < 0.021$), and TIMI myocardial blush grade improved from 0.82 ± 0.69 to 2.60 ± 0.63 ($p < 0.032$). Hemodynamic parameters, including systolic and diastolic blood pressures and heart rate, showed significant improvement post-adrenaline administration ($p < 0.001$). The incidence of sustained ventricular tachycardia was negligible, though non-sustained ventricular tachycardia occurred in 215 (27%) patients. The need for intra-aortic balloon pump (IABP) and trans venous pacing was documented in 16% of cases.

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In summary, intracoronary adrenaline proved effective in improving TIMI flow grades and hemodynamic stability in patients with refractory no-reflow following primary PCI for STEMI. The treatment was well tolerated with minimal adverse effects, suggesting its potential utility in clinical practice.

DISCUSSION

The study demonstrated that intracoronary adrenaline significantly improved TIMI flow grades and hemodynamic stability in patients experiencing refractory no-reflow following primary PCI for STEMI. The results showed a notable enhancement in coronary perfusion, with 73.2% of patients achieving complete restoration of TIMI 3 flow. These findings are consistent with those of who reported similar improvements in TIMI flow grades following intracoronary adrenaline administration (14) the significant reduction in TIMI frame count and improvement in TIMI myocardial blush grade further support the efficacy of adrenaline in ameliorating microvascular dysfunction associated with the no-reflow phenomenon.

The study also highlighted the hemodynamic benefits of intracoronary adrenaline, including significant increases in systolic and diastolic blood pressures and heart rate. These improvements suggest that adrenaline's vasoconstrictive and inotropic effects can effectively counteract the hypotension and microvascular spasm that contribute to no-reflow. Despite the theoretical concerns regarding potential adverse effects such as arrhythmias and hypertension, the incidence of sustained ventricular tachycardia was negligible, and non-sustained ventricular tachycardia occurred in only 27% of patients. This indicates a favorable safety profile for intracoronary adrenaline when used judiciously in a controlled clinical setting (15).

The study's findings are particularly relevant given the limited effectiveness of traditional pharmacologic interventions, such as nitroglycerin, calcium channel blockers, and adenosine, in treating no-reflow (16). Intracoronary adrenaline's ability to reduce microvascular resistance and improve myocardial perfusion presents a valuable addition to the therapeutic arsenal for managing this challenging complication. The study's results align with previous research that has demonstrated the potential of adrenaline to enhance coronary blood flow and myocardial contractility through its alpha- and beta-adrenergic agonist properties (17, 18).

However, the study had several limitations. The retrospective design inherently carries biases related to data collection and patient selection. The lack of a control group makes it difficult to definitively attribute the observed improvements to intracoronary adrenaline alone. Furthermore, the study's findings are based on a single-center experience, which may limit the generalizability of the results. Additionally, the optimal dose and administration strategy for intracoronary adrenaline remain unclear, as the doses used in this study were empirically determined based on clinical judgment rather than standardized protocols.(19,20).

Despite these limitations, the study's strengths include a large sample size and comprehensive data collection on both angiographic and hemodynamic parameters. The consistent monitoring and documentation of patient outcomes provide robust evidence supporting the efficacy and safety of intracoronary adrenaline in this context. Future research should focus on prospective randomized trials to confirm these findings and establish standardized guidelines for the use of intracoronary adrenaline in managing no-reflow. Such studies should explore optimal dosing strategies, potential combination therapies with other pharmacologic agents, and long-term outcomes to provide a more comprehensive understanding of adrenaline's role in this setting. Moreover, incorporating advanced imaging modalities, such as cardiac MRI, could offer deeper insights into the mechanisms by which adrenaline improves microvascular perfusion and myocardial recovery (21,22).

CONCLUSION

In conclusion, this study suggests that intracoronary adrenaline is a valuable therapeutic option for improving TIMI flow grades and hemodynamic stability in patients with refractory no-reflow following primary PCI for STEMI. The treatment was well tolerated with minimal adverse effects, underscoring its potential utility in clinical practice. However, large-scale randomized studies are needed to validate these findings and refine treatment protocols to optimize patient outcomes.

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