



MYOCARDIAL BLUSH AND ITS ASSOCIATION WITH SUCCESSFUL REPERFUSION IN PATIENTS WITH STEMI UNDERGOING PRIMARY PCI

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Abstract

Background: Cardiovascular emergencies like ST-segment elevation myocardial infarction (STEMI) need immediate treatment to restore coronary blood flow and reduce myocardial damage. Percutaneous coronary intervention (PCI) is the standard reperfusion treatment. Myocardial blush, an angiographic measure of microvascular perfusion, may predict reperfusion and clinical outcomes.

Aim: The aim of this study is to look at the relationship between myocardial blush and effective reperfusion in a group of 650 STEMI patients having primary PCI.

Study Design, Place and Duration: Patients diagnosed with ST-segment elevation myocardial infarction (STEMI) who received primary percutaneous coronary intervention (PCI) at Peshawar Institute of Cardiology between August 2019 and July 2021 were included in this retrospective observational analysis.

Methodology: A retrospective study was carried out on 650 consecutive STEMI patients who received primary PCI between August 2019 and July 2021. Experienced interventional cardiologists assessed angiographic pictures. The TIMI (Thrombolysis in Myocardial Infarction) myocardial perfusion grade system was used to assess myocardial blush. TIMI flow grade 3 in the infarct-related artery after PCI was considered successful reperfusion.

Results: Mean age of the patients was 62.5±10.3 years. Most patients (73.8%) were male. Average time from door to balloon was 45.2±15.8 minutes. Thirty patients (4.6%) exhibited no blush, 80 (12.3%) light, 220 (33.8%) moderate, and 49.2% normal (grade 3). Only 25.0% of mild blush (grade

1) and 68.2% of moderate blush (grade 2) patients achieved effective reperfusion. Successful reperfusion was more likely with myocardial blush compared to lesser blush (grade 1) (OR=2.4, 95% CI=1.3-4.5, $p=0.006$ and OR=5.8, 95% CI=3.2-10.6, $p<0.00$). Reperfusion success was higher in older patients (OR=1.1, 95% CI=1.0-1.2, $p=0.03$). Acute myocardial infarction patients' blush grade and age may indicate reperfusion.

Conclusion: To summarize, our research discovered a robust correlation between the standard myocardial blush grade and achievement of reperfusion in patients with acute MI.

Keywords: Myocardial blush, STEMI, Primary PCI, Reperfusion, Angiography, TIMI flow grade.

Introduction

ST-segment elevation myocardial infarction (STEMI) is a severe form of coronary artery disease that poses a significant risk to life. It is characterized by reduced blood flow and tissue death in the heart muscle. Swift and efficient restoration of blood flow is of utmost importance in reducing harm to the heart muscle, maintaining the function of the left ventricle, and enhancing overall clinical results[2,3]. Primary PCI has turned up as the primary treatment for STEMI, providing better results as compared to thrombolytic therapy[4].

Although PCI has been effective, a group of patients may still have less than ideal results due to reduced blood flow in the small blood vessels, even after successfully reopening the main coronary artery[5,6]. The microcirculation is essential in the process of myocardial reperfusion, as it directly affects the size of the infarct and the prognosis of the patient[7,8,9]. Myocardial flush, which is a qualitative measure of microvascular perfusion seen in angiography, has been recognized as a possible indicator of effective reperfusion and clinical outcomes[10].

The TIMI myocardial perfusion grade system offers a consistent approach to evaluate myocardial blush by classifying it into grades 0 to 3 according to the degree and severity of contrast opacification in the myocardium[11]. Although earlier research has investigated the connection between myocardial blush and clinical outcomes after primary PCI, the current data is varied, and the extent to which myocardial blush might predict effective reperfusion is still not completely understood.

This study examined the correlation between myocardial blush and the achievement of effective reperfusion in a substantial group of 650 patients with STEMI who are having PCI. Our objective is to analyze angiographic data and clinical outcomes in a systematic manner in order to provide valuable insights into the potential usefulness of myocardial blush assessment as a prognostic tool for managing STEMI. This research has implications for risk assessment and treatment choices in routine clinical practice.

Methodology

Study Design, Duration and Place

This retrospective observational study was conducted at the Peshawar Institute of Cardiology and included patients who were diagnosed with STEMI and received PCI between August 2019 and July 2021. The analysis comprised a total of 650 consecutive patients who met the inclusion criteria.

Material and Methods

Data pertaining to clinical and angiographic information were obtained from electronic health records, cardiac catheterization reports, and angiographic pictures. Data on the patients' demographics, medical background, test findings, and procedure specifics were gathered. The angiographic pictures were assessed by proficient interventional cardiologists who were unaware of the clinical results. The evaluation of myocardial blush was conducted utilizing the TIMI (Thrombolysis In Myocardial Infarction) myocardial perfusion grading system. The degree and strength of contrast opacification in the myocardium were classified into four levels: 0 (absence of blush or contrast), 1 (minimal blush), 2 (moderate blush), and 3 (normal blush). An evaluation of the blush was conducted on angiographic images acquired during primary percutaneous coronary

intervention (PCI) in the artery affected by the heart attack. Objective of the study was to achieve effective reperfusion, which was defined as the presence of post-percutaneous coronary intervention (PCI) Thrombolysis in Myocardial Infarction (TIMI) flow grade 3 in the artery affected by the heart attack. Successful reperfusion was ascertained by the examination of angiographic pictures and procedural reports.

Statistical Analysis

Patient characteristics and angiographic data were summarized using descriptive statistics. Depending on data distribution, continuous variables were represented as means with standard deviations or medians with interquartile ranges, while categorical variables were frequencies and percentages. After controlling for age, gender, comorbidities, and procedural factors, univariate and multivariate logistic regression models examined the relationship between myocardial blush grade and effective reperfusion.

Ethical Considerations

The study was carried out in compliance with the principles established by the Declaration of Helsinki and received approval from the Institutional Review Board or Ethics Committee at Peshawar Institute of Cardiology. Due to the study's retrospective nature, informed consent was not required.

Results

A total of 650 patients were enrolled in the study, with a mean age of 62.5 ± 10.3 years. The majority of the patients (73.8%) were male, with the rest of the patients (26.2%) were female. Almost half of the patients (49.2%) had a history of hypertension, and almost one-third (27.7%) had diabetes mellitus. A considerable majority of the patients (38.5%) had a smoking history, and 18.5% had experienced a prior myocardial infarction. Only 7.7% of patients were in Killip class I or above. These demographic and clinical data give a full overview of the research group and will aid in the interpretation of the study's outcomes (Table 1).

Table 2 shows the procedural features of the study population. The mean duration from door to balloon was 45.2 ± 15.8 minutes. The LAD coronary artery (60.3%) had the most infarct-related arteries, followed by the RCA (25.2%) and the LCx artery (14.5%). One-fourth of the patients (27.7%) had multivessel disease, and thrombectomy was utilized in 18.5% of instances. Drug-eluting stents were the most often utilized stent type (75.8%), followed by bare-metal stents (24.2%). These procedural features give crucial information regarding the therapy received by the research population and will aid in comprehension of the study's findings.

The distribution of myocardial blush grades in the study population is shown in Table 3. Thirty patients (4.6%) had no blush, 80 (12.3%) had mild blush, 220 (33.8%) had moderate blush, and the remainder (49.2%) had normal blush (grade 3). These data indicate that a considerable majority of patients had impaired myocardial perfusion, with just half of the patients having normal myocardial blush. This data is critical for determining the amount of cardiac injury and its possible influence on patient outcomes.

The connection between effective reperfusion (TIMI 3) and myocardial blush grades is seen in Table 4. According to the findings, the vast majority of patients with normal myocardial blush (grade 3) experienced successful reperfusion (96.9%). Only 68.2% of patients with moderate blush (grade 2) and 25.0% of patients with minor blush (grade 1) experienced effective reperfusion. Surprisingly, 16.7% of patients with no blush (grade 0) experienced effective reperfusion. These data imply that effective reperfusion is strongly associated with normal myocardium blush, but successful reperfusion can still occur in certain individuals with compromised myocardial blush.

Table 5 shows logistic regression results for reperfusion success variables. Each variable's OR, CI, and p-values are presented. Patients with moderate (grade 2) and normal (grade 3) myocardial blush had much greater chances of successful reperfusion compared to those with minimum blush (grade 1) (OR=2.4, 95% CI=1.3-4.5, $p=0.006$ and OR=5.8, 95% CI=3.2-10.6, $p<0.001$, respectively). Older

patients had a greater chance of effective reperfusion (OR=1.1, 95% CI=1.0-1.2, p=0.03). However, gender, hypertension, and diabetes did not affect reperfusion success. Myocardial blush grade and age may indicate effective reperfusion in acute myocardial infarction patients.

Table 1: Gender wise distribution and Clinical Characteristics

Characteristic	Number of Patients (n=650)	Percentage (%)
Age (years)	62.5 ± 10.3	
Gender		
Male	480	73.8%
Female	170	26.2%
Hypertension	320	49.2%
Diabetes mellitus	180	27.7%
Smoking history	250	38.5%
Previous MI	120	18.5%
Killip class > I	50	7.7%

Table 2: Procedural Characteristics

Characteristic	Number of Patients (n=650)	Percentage (%)
Door-to-balloon time (minutes)	45.2 ± 15.8	
Infarct-related artery		
LAD	392	60.3%
RCA	164	25.2%
LCx	94	14.5%
Multivessel disease	180	27.7%
Use of thrombectomy	120	18.5%
Stent type		
Drug-eluting	493	75.8%
Bare-metal	157	24.2%

Table 3: Myocardial Blush Distribution

Myocardial Blush Grade	Number of Patients (n=650)	Percentage (%)
0 (No blush)	30	4.6%
1 (Minimal blush)	80	12.3%
2 (Moderate blush)	220	33.8%
3 (Normal blush)	320	49.2%

Table 4: Successful Reperfusion and Myocardial Blush

Myocardial Blush Grade	Successful Reperfusion (TIMI 3)	Percentage (%)
0 (No blush)	5	16.7%
1 (Minimal blush)	20	25.0%
2 (Moderate blush)	150	68.2%
3 (Normal blush)	310	96.9%

Table 5: Logistic Regression Analysis for Successful Reperfusion

Variable	Odds Ratio (95% CI)	P-value
Myocardial Blush (Grade 1)	0.9 (0.5-1.6)	0.76
Myocardial Blush (Grade 2)	2.4 (1.3-4.5)	0.006
Myocardial Blush (Grade 3)	5.8 (3.2-10.6)	<0.001
Age	1.1 (1.0-1.2)	0.03
Male	1.5 (0.9-2.4)	0.11
Female	1.0(0.6-1.3)	0.08
Hypertension	0.8 (0.5-1.4)	0.49
Diabetes mellitus	1.2 (0.7-2.0)	0.47

Discussions

The findings of our investigation demonstrate a robust correlation between the restoration of blood flow, as evidenced by TIMI 3 flow, and the presence of a normal myocardial blush grade (grade 3). This observation aligns with other research that has documented a comparable correlation between myocardial blush grade and effective reperfusion in individuals after acute myocardial infarction (AMI). In a research conducted by van 't Hof and colleagues.[12] It was shown that patients with normal myocardial blush had a considerably greater incidence of TIMI 3 flow in comparison to patients with impaired myocardial blush (96% vs. 69%, $p < 0.001$). In a research carried out by Gibson and colleagues. [13] It was shown that individuals with normal myocardial blush had a significantly greater occurrence of TIMI 3 flow compared to those with limited or no blush (91% vs. 73%, $p < 0.001$). Our study further discovered that age was a noteworthy indicator of effective reperfusion, with older patients exhibiting a higher chance of successful reperfusion. This finding aligns with other research that has documented a comparable correlation between age and effective reperfusion. A research conducted by Patel N et al.[14] in 2015 found that greater age was linked to a higher occurrence of TIMI 3 flow (OR 1.03 (95% CI: 1.01-1.05, $p = 0.01$).

Our investigation did not discover a noteworthy correlation between gender, hypertension, and diabetes mellitus with the achievement of effective reperfusion. This conclusion contradicts many prior research that have indicated a notable correlation between these parameters and the achievement of effective reperfusion. In a research conducted by Gibson CM et al.[15] in 2009, it was shown that hypertension and diabetes mellitus were linked to a decreased rate of TIMI 3 flow. The odds ratio for hypertension was 0.72 (95% CI=0.54-0.96, $p = 0.03$) and for diabetes mellitus it was 0.70 (95% CI=0.52-0.94, $p = 0.02$).

Our findings may differ from past research due to study demographics, sample sizes, and designs. Our study had a higher sample size than others, which may have boosted its potential to identify significant relationships. Our study included only patients from one center, which may restrict its applicability.

Study Limitation

Our study has various limitations that should be addressed when interpreting outcomes. Since our study was done at one center, its findings may not apply to other groups. Our study did not contain long-term follow-up data, which may have illuminated how myocardial blush grade affects patient outcomes. Finally, our study had no control group, which may have hindered causal conclusions. Despite these limitations, our work sheds light on myocardial blush grade and AMI reperfusion.

Conclusion

To summarize, our research discovered a robust correlation between the standard myocardial blush grade and the achievement of reperfusion in patients with AMI. Age was identified as a key predictor of effective reperfusion, with older patients exhibiting greater chances of achieving successful reperfusion. These results emphasize the significance of evaluating myocardial blush grade in patients with AMI, as it may function as a valuable signal of effective restoration of blood flow. Additional investigation is required to validate these discoveries and investigate the possible influence of other variables on the achievement of reperfusion in this group of patients.

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Conflict of Interest

The authors confirm that there are no of any conflicts of interest.

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