Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.53555/28bxkf07

PREDICTORS OF SUBOPTIMAL CORONARY BLOOD FLOW DURING PRIMARY PERCUTANEOUS INTERVENTION

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Abstract

Background: Primary percutaneous coronary intervention (PCI) remains the best option for patients presenting with an acute ST-segment elevation myocardial infarction (STEMI). While the success rate in the reopening of the thrombotic occlusion can reach up to 95% , failure to restore optimal blood flow in the infarct-related coronary artery (i.e., less than thrombolysis in myocardial infarction [TIMI]-3 flow has been noted in 5–23% of patients and has been associated with adverse clinical outcomes.

Objective: Predictors of Suboptimal Coronary Blood Flow during Primary Percutaneous Intervention

Methodology: The current retrospective study was done at the department of cardiology Sandeman provincial hospital quetta, Quetta. The current study was carried out from July 2022 to November 2022 after taking approval from the ethical review committee. Patient's physical examination, medical history, different risk factors, vital signs assessment, Killip class, echocardiography, laboratory investigation, and post-procedural ECG were recorded along with PCI data and associated catheterization. Risk factors associated clinical history included age, diabetes, gender, smoking, hypertension, myocardial infarction, hypercholesterolemia, family history of cardiovascular disease, and PCI were recorded. Laboratory findings regarding cardiac catheterization were recorded. ECG (12-lead) were performed in each individual after hospitalization. The data was analyzed using SPSS version 24.

Results: In the current study a total of 200 STEMI patients were enrolled. The male patients were 170 (85%) while female patients were 30 (15%). The mean age (SD) was 55 (±6.11) years. The frequency of suboptimal flow (TIMI flow ≤2) was 50 (25%) and optimal flow (TIMI-3 flow) was 150 (75%). The suboptimal flow independent predictors were Age [OR 1.055/year: p<0.000], total stent length [OR 1.011 per 1 mm], low SBP [OR 1.029 per mm Hg], thrombus burden grade [OR 1.81], and baseline TIMI flow (≤1) [OR 1.86; p=0.001]. The prevalence of in-hospital mortality in suboptimal flow was 22 (11) % and in optimal flow it was 6 (3)%.

Conclusion: The present study found that suboptimal coronary flow after first PCI is substantially associated with higher in-hospital and long- term cardiovascular mortality in STEMI. The most significant predictor of poor coronary flow is predilatation prior to stenting.

Key words: Predictors; Suboptimal Coronary Blood Flow; Primary Percutaneous Intervention

Introduction

Primary percutaneous coronary intervention (PCI) remains the best option for patients presenting with an acute ST-segment elevation myocardial infarction (STEMI) [1]. While the success rate in the reopening of the thrombotic occlusion can reach up to 95% [2, 3], failure to restore optimal blood flow in the infarct-related coronary artery (i.e., less than thrombolysis in myocardial infarction [TIMI]-3 flow [4]) has been noted in 5–23% of patients and has been associated with adverse clinical outcomes [3, 5, 6]. Many mechanisms have been hypothesized to explain this phenomenon, including the obstruction of epicardial coronary vessels (residual stenosis, thrombus, or dissection) and the disturbances at the level of coronary microcirculation and vascular endothelium (distal embolization of thrombotic materials and plaque debris, leukocyte infiltration, and reperfusion injury) [7, 8]. However, there is a lack of contemporary data on predictors and impacts of suboptimal TIMI flow; and there is still a lack of effective management strategies. We therefore looked at the predictors of suboptimal TIMI flow in patients undergoing primary PCI as well as its impact on 30-day clinical outcomes. Patients with acute anterior STEMI were included to minimize the impact of the left anterior descending (LAD) artery as a strong anatomical risk factor for the development of suboptimal coronary blood flow [9,10,11].

Materials and methods

The current retrospective study was done at the department of cardiology Sandeman provincial hospital quetta, Quetta. The current study was carried out from July 2022 to November 2022 after taking approval from the ethical review committee. Patients (age>20 years) presented with initial percutaneous coronary intervention within 12 hours after onset of symptoms were enrolled. Study protocol was approved by research and ethical committee. Patient's physical examination, medical history, different risk factors, vital signs assessment, Killip class, echocardiography, laboratory investigation, and post-procedural ECG were recorded along with PCI data and associated catheterization. Clinical outcomes included MACE, ischemia-driven target vessel revascularization; re-infection, cardiac mortality, and post- catheterization were assessed. Risk factors associated clinical history included age, diabetes, gender, smoking, hypertension, myocardial infarction, hypercholesterolemia, family history of cardiovascular disease, and PCI were recorded. Duration of chest pain onset-toreperfusion and door-to-balloon were recorded. Laboratory findings regarding cardiac catheterization were recorded. ECG (12-lead) were performed in each individual after hospitalization. Typical ischemic chest pain with electrocardiograph lasted for ≥20 min with elevated cardiac biomarkers were defined as anterior STEMI. Coronary angiography confirmed by LAD and left lesion diagnosis. Total leucocytic count, hemoglobin, blood glucose level, serum creatinine, and platelets were included in laboratory investigation. The data was analyzed using SPSS version 24. Continuous variables were calculated as means and standard deviations. Frequency and percentage were calculated for categorical variables. Predictor power was determined by multiple regression analysis. A p value of less than 0.05 was taken as significant

Results

In the current study a total of 200 STEMI patients were enrolled. The male patients were 170 (85%) while female patients were 30 (15%). (Figure 1) The mean age (SD) was 55 (±6.11) years. The frequency of suboptimal flow (TIMI flow ≤2) was 50 (25%) and optimal flow (TIMI-3 flow) was 150 (75%). (Figure 2) The suboptimal flow independent predictors were Age [OR 1.055/year: p<0.000], total stent length [OR 1.011 per 1 mm], low SBP [OR 1.029 per mm Hg], thrombus burden grade [OR 1.81], and baseline TIMI flow (≤1) [OR 1.86; p=0.001]. (Table 3) Cardiac mortality and MACE were significantly higher after 30-days in suboptimal flow as compared to optimal flow. The prevalence of in-hospital mortality in suboptimal flow was 22 (11) % and in optimal flow it was 6 (3)%. Baseline characteristics are shown in Table-I. Incidences of potential risk factors are shown in Table 2. Multivariate regression analyses of independent risk factors are shown in Table-III.

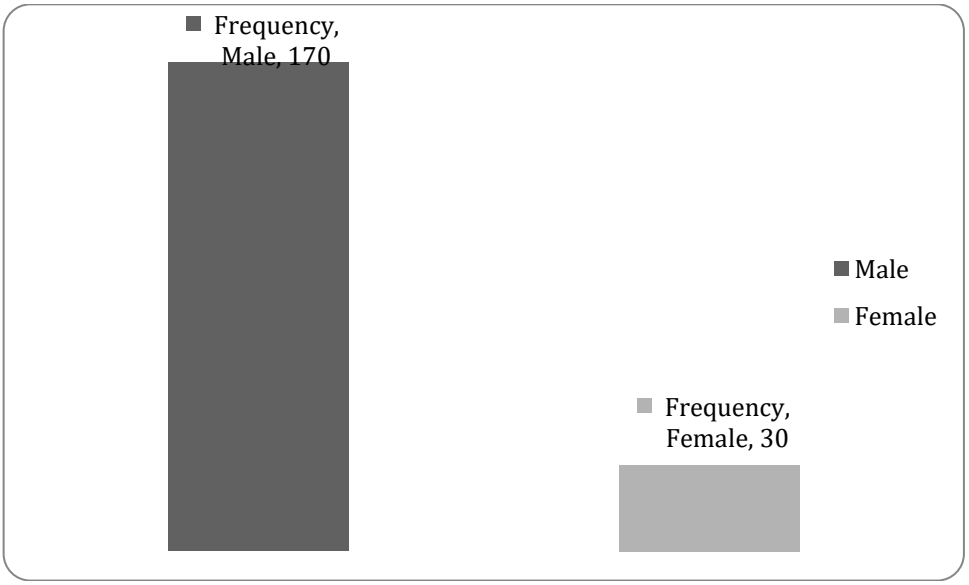

Figure 1: Gender wise distribution of patients

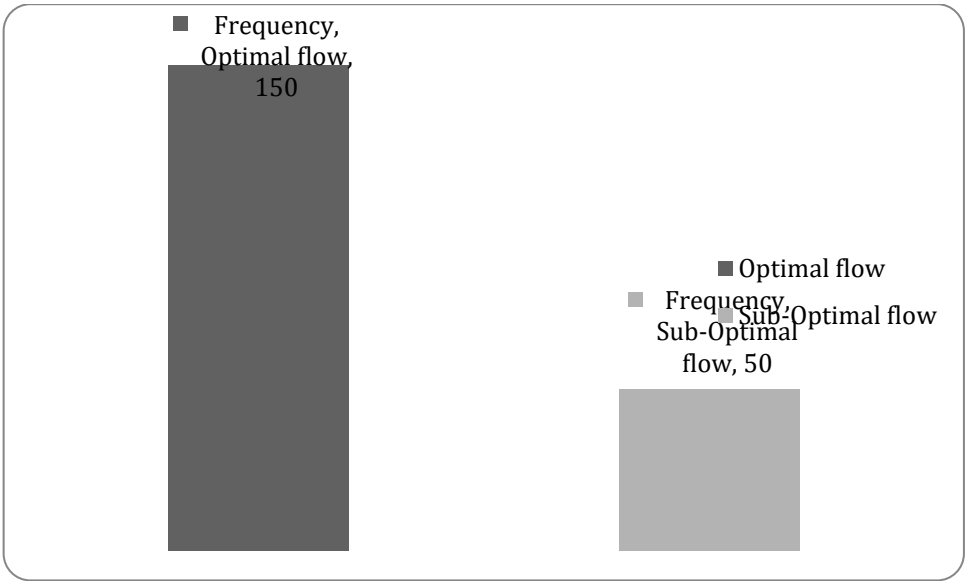

Figure 2: Frequency of optimal and suboptimal flow

Table 1: Baseline characteristics of the enrolled patients

Parameters	Suboptimal flow	Optimal flow	P-value
Mean age in years	54.99± 5.11	55.01± 4.38	0.003
Mean weight in Kg	66.11± 9.36	68± 9	0.122
Total ischemic time	4.2 (2.7–8)	4.8 (2.3–7.6)	0.232
Mean systolic blood pressure, mm Hg	123.9 ± 18.25	135 ± 16.16	0.003
Mean diastolic blood pressure, mm Hg	81 ± 9	85 ± 9	0.002
Killip class > 1, n (%)	15 (30)	30 (20)	0.003
Mean serum Creatinine, umol/L	69 ± 12.32	65 ± 11.9	0.022
Mean HDL cholesterol, mmol/L	1.05 ± 0.11	1.07 ± 0.31	0.221
Mean LDL cholesterol, mmol/L	2.71 ± 0.11	2.67 ± 0.81	0.371

Table 2: primary PCI procedure and angiographic data

Parameters	Suboptimal flow	Optimal flow	P-value
Left main involvement N (%)	8 (16)	19 (12.67)	0.003

LAD lesion location N (%) Proximal Mid Distal	 40 (80) 8 (16) 2 (4)	 108 (72) 39 (26) 3 (2)	0.729
Approach n (%) Radial Femoral	 47 (94) 3 (6)	 146 (97.33) 4 (2.67)	0.221
Stents, n (%) PTCA One Two Three	 2 (4) 24 (48) 16 (32) 8 (16)	 3 (2) 108 (72) 39 (26) 00 (00)	0.004
Thrombus Aspiration, n (%)	16 (32)	39 (26)	0.001

Table 3: Frequency of potential risk factors

Risk factors	**Frequency (%)**
Hypertension	100 (50%)
Diabetes	48 (24%)
Smoking	92 (46%)
Previous IHD	20 (10%)
Previous CVD	8 (4%)

Table 4: Multivariate regression analysis of independent risk factors

Independent risk factors	**Odd Ratio (OR), 95% CI**	**P-value**
Age	1.055/year	0.000
Total stent length	1.011 per 1 mm	0.031
Low SBP	1.029 per mm Hg	0.031
Thrombus burden grade	1.81	0.001
Baseline TIMI flow (≤1)	1.86	0.001

Discussion

The present study mainly focused on potential risk factors and predictor of coronary blood flow during primary percutaneous intervention and reported that suboptimal coronary flow after first PCI is substantially associated with higher in-hospital and long- term cardiovascular mortality in STEMI. The most significant predictor of poor coronary flow is predilatation prior to stenting. Regardless of PCI modalities development, normal TIMI flow through interventional devices are difficult to achieve in anterior STEMI patients and significantly related with specific factors such as lower SBP and age and angiographic factors like heavy thrombus, baseline TIMI flow (≤1), and total stent length. A higher cardiac mortality was found in suboptimal flow as compared to optimal flow. Additionally, cardiogenic shock, increased CK, malignant arrhythmias, and heart failure were significantly associated with MACE and cardiac mortality. Numerous studies carried out on 1st generation DES included in STEMI patients in the bare metal stent era extended up to 24 hours [12, 13]. The suboptimal flow higher rate (25%) was observed as compared to previously reported 5% to 23% [14, 15]. Various studies demonstrated an association between increased incidence of suboptimal flow and larger infarct size [16]. The largest myocardial infarction has been accounted for typical proximal LAD in IRA lesion [17]. Previous few studies reported that increased heart rate, advance age, lower SBP, and LVEF <50% were TIMI flow suboptimal predictors and higher in-hospital mortality [18, 19]. Following primary PCI, coronary blood flow sub optimality is independently predicted by thrombus burden. In contrast, another study by McNamara et al [20] reported that STEMI patients with minimal thrombus burden could be happened in suboptimal coronary flow and prolong reperfusion times. Suboptimal flow could developed by microvascular circulation caused by adverse

effected prolong ischemia [21]. No significant association has been correlated between TIMI flow and ischemic time that resembles with previous studies [22, 23]. The present study found that means total stent length was 32.9 mm that was longer than previous studies [24, 25]. Moreover, it is possible to achieve optimal expansion and angiographic results following stent deployment by routine balloon predilation and NC balloon postdilation. PCI strategy has been increasingly used for suboptimal flow higher incidence in contemporary exercise. The pre- and post-dilatation lengths and the stent length increase the opportunity for mechanical fragmentation of the plaque and subsequent dislodgement of the thrombus [26]. The adverse outcomes could be mainly indicated after primary PCI leading to suboptimal coronary blood flow as reported in the present study. Early identification, effective management, and risk factors control in suboptimal TIMI flow are necessary [27]. Low systolic blood pressure, baseline TIMI flow ≤1, heavy thrombus burden, and longer stent use were significant and independent risk factors for suboptimal flow in the current study. Suboptimal flow was mostly experienced in cardiogenic shock and hypertension in patients. Patients with hypertension who have appropriate vasopressors and other hemodynamic devices may aid to maintain myocardial perfusion pressure and microvascular permeability to enhance primary PCI results and distal TIMI flow [28, 29]. IRA restoring patency is significantly associated with better outcomes [30]. Suboptimal flow effective treatment is not currently available and suboptimal flow development is still avoided. Heart attack increase awareness symptoms and immediate medical care seeking measures should be implied. Additionally, interventional techniques must be followed for prevention of abnormalities and minimizing the door-to-ballooon time.

Conclusion

The present study found that suboptimal coronary flow after first PCI is substantially associated with higher in-hospital and long- term cardiovascular mortality in STEMI. The most significant predictor of poor coronary flow is predilatation prior to stenting."

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