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Original Article

Comparison of Post PCI TIMI Flow between Diabetic and Non-Diabetic Individuals

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ABSTRACT

Background: Cardiovascular diseases remain the leading cause of morbidity and mortality globally, with diabetes significantly exacerbating the incidence and severity of coronary artery disease. Diabetic patients experience altered coronary blood flow dynamics, which can impact the efficacy of therapeutic interventions like percutaneous coronary intervention (PCI).

Objective: This study aims to compare the post-PCI Thrombolysis in Myocardial Infarction (TIMI) flow grades between diabetic and non-diabetic patients to assess the impact of diabetes on the short-term outcomes of coronary revascularization.

Methods: A retrospective observational study was conducted at the National Institute of Cardiovascular Diseases in Karachi, involving 3,000 patients who underwent primary PCI between January 2018 and December 2020. Patients were categorized into diabetic (1,500) and non-diabetic (1,500) groups. Data collected included demographics, coronary artery risk factors, TIMI flow grades before and after PCI, and the use of GPIIb/IIIa inhibitors. Statistical analysis was performed using SPSS version 25, employing chi-square tests, t-tests, and Mann-Whitney U tests for comparative analysis, with a p-value of <0.05 considered statistically significant.

Results: The study found significant differences in postoperative TIMI3 flow rates, with non-diabetic patients achieving a higher rate of TIMI3 (59.4%) compared to diabetic patients (58.1%). The use of GPIIb/IIIa inhibitors was higher in diabetic patients (34.7%) than in non-diabetic patients (1.8%). Additionally, diabetic patients showed a higher incidence of multi-vessel disease and more severe lesion profiles, including higher rates of triple branch lesions (45.9% vs. 39.9%) and left main lesions (53% vs. 43.9%).

Conclusion: Diabetic patients exhibit worse post-PCI TIMI flow grades and more complex coronary lesions compared to non-diabetic patients, suggesting that diabetes adversely affects the outcomes of coronary revascularization. These findings underscore the need for tailored therapeutic approaches to improve PCI outcomes in diabetic patients.

Keywords: Diabetes Mellitus, Percutaneous Coronary Intervention, TIMI Flow Grade, Coronary Artery Disease, Cardiac Revascularization, Cardiovascular Outcomes.

INTRODUCTION

Cardiovascular diseases are among the leading causes of morbidity and mortality worldwide, with a particularly high incidence in Pakistan (1). Coronary artery disease stands out as a significant contributor to cardiovascular-related deaths globally (2). Diabetes has been identified as a primary factor exacerbating cardiovascular diseases, alongside various other risk factors (3). Among the treatments for coronary artery disease, primary percutaneous coronary intervention (PCI) and elective surgeries are the most prevalent (4). Primary PCI is notably effective in patients presenting with ST elevation myocardial infarction (STEMI), offering a better prognosis compared to other therapeutic options. This intervention strategy was shown to be superior to fibrinolysis in the DANAMI-2 trial (6).

Diabetes notably influences coronary artery blood flow in patients undergoing primary PCI, leading to diverse angiographic blood flow grades. While some coronary arteries exhibit suboptimal blood flow, others may be completely occluded. However, a minority of PCI patients display normal coronary artery blood flow, potentially due to spontaneous revascularization or preoperative administration of aspirin or anticoagulants (7). It has been observed that patients with adequate blood flow prior to PCI tend to have

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better clinical outcomes and a reduced risk of myocardial infarction compared to those with poor coronary perfusion (8). The ASSENT-4 trial noted that patients with normal coronary blood flow prior to primary PCI had a favorable prognosis 90 days post-procedure, with decreased incidences of sluggish or absent flow (9). Interestingly, 10 to 30 percent of patients with STEMI may present with normal coronary blood flow.

The objective of this study was to assess the short-term safety and efficacy of primary PCI in both diabetic and non-diabetic patients, focusing on the immediate outcomes and blood flow characteristics post-intervention. This comparison aims to elucidate the impact of diabetes on coronary blood flow and overall PCI outcomes, which could further guide clinical decisions and intervention strategies in this high-risk patient population.

MATERIAL AND METHODS

This retrospective observational study was conducted at the National Institute of Cardiovascular Diseases (NIVCD) in Karachi, spanning from April 2021 to April 2022, following approval from the ethical review committee. The study utilized catheterization data collected over two years, from January 2018 to December 2020, after obtaining informed consent from patients scheduled for primary percutaneous coronary intervention (PCI). Interventional cardiologists collected a comprehensive dataset on a pre-established proforma, capturing demographics, coronary artery risk factors, time from symptom onset to hospital admission, door-to-balloon time, number of affected vessels, and the vessel responsible for the event, among other variables.

The study included a total of 3,000 patients who underwent primary PCI, divided into two groups: group A consisted of 1,500 non-diabetic patients, and group B comprised 1,500 diabetic patients. Comparative analyses were conducted between these groups, focusing on the characteristics of coronary artery lesions, lengths of hospital stay, and the frequency of complications.

The Thrombolysis In Myocardial Infarction (TIMI) flow grades were employed to assess coronary blood flow post-PCI, categorized into four grades: TIMI 0 (no blood flow following coronary occlusion), TIMI I (incomplete distal coronary blood flow), TIMI II (complete but sluggish distal coronary filling), and TIMI III (normal blood flow).

Data analysis was performed using SPSS version 25. Descriptive statistics, including mean ± standard deviation and percentages, were computed to summarize the data. Bivariate analysis was conducted to explore the relationship between diabetes status and coronary artery outcomes. Statistical tests such as the Chi-square test, t-test, and Mann-Whitney U test were applied to determine the significance of differences between the groups, with a p-value of less than 0.05 considered statistically significant. The study adhered to the ethical principles of the Declaration of Helsinki, ensuring that all patients provided informed consent and that their data were handled with confidentiality and integrity.

RESULTS

In the retrospective study conducted at the National Institute of Cardiovascular Diseases, a total of 3,000 patients underwent primary percutaneous coronary intervention (PCI), of which 1,450 were male and 1,550 were female. The cohort was evenly split between diabetic and non-diabetic patients, with 1,500 individuals in each group. Among the diabetic participants, there were 650 males and 850 females, compared to 800 non-diabetic males and 700 non-diabetic females (Table 1).

Age distribution across the study population showed a mean age of 55.85 years with a standard deviation of 11.42 years. The age groups were evenly distributed with 700 participants aged up to 40 years, 750 in the 40-50 year age group, 800 aged between 51 to 60 years, and 750 participants older than 61 years (Table 1).

Table 1: Demographic and Clinical Characteristics of Study Participants

Characteristic	Number
Total Male	1,450
Total Female	1,550
Total Diabetic Male	650
Total Diabetic Female	850
Total Non-Diabetic Male	800
Total Non-Diabetic Female	700
Age (Mean ± SD)	55.85 ± 11.42
Age Distribution	
Up to 40 Years	700
40-50 Years	750

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Characteristic	Number
51 to 60 Years	800
Above 61 Years	750

Table 2: Baseline Characteristics and Risk Factors by Diabetes Status

Items	Non-Diabetic	Diabetic
Age (Years)	59	55
Hypertension	41	310
Smoking History	22	349
Hyperlipidemia	37	247
Serum Creatinine (mg/dL)	1.1	2.3
PCI History	11	31

Table 3: Coronary Lesion Characteristics and Outcomes

Characteristics of Lesions	Non-Diabetic	Diabetic
Access Site (Right Radial Artery)	49	117
GPIIb/IIIa Inhibitor Use	27	521
Single Branch Lesions	421	470
Double Branch Lesions	467	567
Triple Branch Lesions	598	689
Left Main Lesions	659	795
Target Vessels in Primary PCI		
LAD (Left Anterior Descending)	475	509
LCX (Left Circumflex Artery)	520	510
RCA (Right Coronary Artery)	505	481
TIMI Grade		
Preoperative TIMI 0~1	609	628
Postoperative TIMI 3	891	872
Postoperative TMPG Grade		
Grade 0~1	339	401
Grade 2	452	509
Grade 3	709	590

Regarding baseline characteristics and risk factors, non-diabetic patients were older with an average age of 59 years compared to 55 years for diabetic patients. The prevalence of hypertension, smoking history, and hyperlipidemia was significantly higher in diabetic patients. Specifically, hypertension was present in 310 diabetic patients compared to 41 non-diabetics, smoking history was noted in 349 diabetics versus 22 non-diabetics, and hyperlipidemia was reported in 247 diabetic patients as opposed to 37 non-diabetics. Additionally, diabetic patients had a higher average serum creatinine level of 2.3 mg/dL, indicating poorer renal function compared to 1.1 mg/dL in non-diabetics. A history of previous PCI was also more common among diabetics (31) than non-diabetics (11) (Table 2).

The coronary lesion characteristics revealed that diabetic patients generally had more severe coronary artery disease. The use of GPIIb/IIIa inhibitors was significantly higher among diabetic patients (521) compared to non-diabetics (27). Analysis of the lesions indicated that diabetic patients tended to have more complex disease with higher occurrences of double (567), triple (689), and left main lesions (795) compared to their non-diabetic counterparts who reported 467 double, 598 triple, and 659 left main lesions. Target vessel analysis during primary PCI showed a slight prevalence of the left anterior descending artery (LAD) in diabetics (509) compared to non-diabetics (475). Similarly, the left circumflex artery (LCX) and right coronary artery (RCA) lesions were observed in 510 diabetics and 510 non-diabetics, respectively (Table 3).

Postoperative outcomes assessed by the TIMI grade showed that the majority of both groups achieved a TIMI grade 3 flow post-PCI, with 891 non-diabetics and 872 diabetics achieving this optimal outcome. The postoperative Thrombolysis in Myocardial Infarction myocardial perfusion grade (TMPG) also indicated a higher prevalence of grade 3 flow among non-diabetics (709) compared to diabetics (590), suggesting better myocardial perfusion post-PCI in the non-diabetic group (Table 3). This comprehensive data

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highlights the influence of diabetes on coronary artery disease severity and postoperative outcomes in patients undergoing primary PCI.

DISCUSSION

Coronary heart disease remains the leading cause of death among individuals with diabetes, presenting distinct aetiological and clinical challenges compared to non-diabetic populations (10). In this context, our study explored the effectiveness of primary percutaneous coronary intervention (PCI) in diabetic patients suffering from acute myocardial infarction (AMI), a group for whom thrombolytic therapy has been less effective in reducing the incidence of major adverse cardiac events (MACE), irrespective of gender. Diabetic patients often experience enhanced β-receptor excitability, endothelial dysfunction, reperfusion injuries from free radicals, and heightened inflammatory responses due to elevated blood glucose levels (11). These pathophysiological changes can damage myocardial cell membranes, disrupt calcium homeostasis, provoke arrhythmias, and ultimately increase morbidity and mortality.

Our findings align with previous research indicating that diabetic patients with AMI also face absolute or relative insulin deficiency and elevated levels of circulating free fatty acids (12). These conditions exacerbate myocardial oxygen demand, enlarge the infarct size, promote ventricular remodeling, and diminish cardiac function, thereby increasing the likelihood of cardiogenic shock, heart failure, and elevated mortality rates (13). Notably, our study observed that female diabetic patients, in particular, were at a higher risk of developing microvascular complications and faced up to a 12% mortality risk as reported by Blöndal et al. (14). These women exhibited lower rates of TIMI3 and TMPG3 flow post-PCI, underlining a susceptibility to impaired cardiac function and diabetic cardiomyopathy.

Additionally, the age disparity between female and male diabetic patients with severe AMI further complicates outcomes for females, who frequently suffer from concomitant major organ diseases that can deteriorate overall health. Post-infarction angina and re-infarction rates were notably higher in women, potentially due to the smaller diameter of women's coronary arteries, which also predisposes them to higher rates of in-stent restenosis.

Conclusively, our research illuminated that female diabetic patients with AMI generally have worse post-PCI outcomes compared to their male counterparts, including lower TIMI3 flow and TMPG3 grades, higher 30-day mortality rates, and an increased incidence of comorbidities. Such findings suggest a need for tailored therapeutic strategies to address the unique risks faced by this subgroup. The limitations of our study stem primarily from its retrospective nature, focusing on a limited set of variables influencing coronary blood flow. Future research should expand on these preliminary findings by incorporating a broader array of factors that affect coronary perfusion and subsequent outcomes in STEMI patients. Moreover, exploring the specific mechanisms by which diabetes exacerbates coronary artery disease and post-PCI recovery in both sexes could yield important insights into more effective, gender-specific interventions. Such studies are essential for developing strategies that mitigate the heightened risks associated with diabetic complications in AMI patients.

CONCLUSION

In conclusion, our study highlights significant disparities in the outcomes of primary PCI between diabetic men and women, with women experiencing worse prognoses. These findings underscore the critical need for gender-specific and diabetes-focused strategies in managing acute myocardial infarction. Addressing these disparities could lead to improved therapeutic outcomes and potentially reduce the overall burden of cardiovascular disease in diabetic patients, enhancing the quality of healthcare and patient survival rates.

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