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Impact of Diabetes on Short-Term Outcomes in STEMI Patients Undergoing Primary Percutaneous Coronary Intervention (PCI)

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ABSTRACT

Diabetes mellitus is a major global health issue, significantly increasing the risk of morbidity and mortality, especially after myocardial infarction. **Objectives:** To assess the impact of diabetes on short-term outcomes in STEMI patients treated with primary PCI. **Methods:** This comparative cross-sectional study enrolled 200 patients undergoing elective coronary angiography at Shahida Islam Medical Complex, Lodhran, using non-probability consecutive sampling. Qualitative variables, such as gender and hypertension, were summarized as frequencies, while quantitative variables, including age, BMI, and HbA1c, were expressed as mean ± standard deviation (SD). Outcomes, including stroke, arrhythmia, renal failure, and mortality, were compared using the Chi-square test, whereas changes in serum creatinine were analyzed with independent t-tests. Statistical significance was set at $p < 0.05$. Data were collected using a structured proforma and analyzed using SPSS version 21.0. The combined effect of categorical variables was calculated and reported as risk ratios with 95% confidence intervals. **Results:** Diabetic patients were older and had a higher prevalence of hypertension, smoking, and prior ischemic heart disease (IHD). They showed significantly worse short-term outcomes, including higher rates of stroke (5.6%, p=0.040), renal failure (11.1%, p=0.020), and mortality (10.0%, p=0.030) compared to non-diabetics. **Conclusions:** There are worse short-term outcomes possibly related to diabetes mellitus in STEMI patients undergoing PCI, particularly for stroke, renal failure, and mortality. These findings highlight the need for aggressive management of diabetic patients presenting with STEMI.

INTRODUCTION

STEMI is a severe type of acute coronary syndrome. Overall, ACS is frequently a medical emergency, with primary percutaneous coronary intervention (PCI) a key treatment. Despite advances in PCI techniques, diabetes mellitus (DM) and poor. Glycaemic management continues to be an important risk factor.to achieve poor results after PCI. Primary PCI has been the preferred revascularization approach in patients with acute STEMI since it can facilitate rapid coronary perfusion and desirable clinical outcomes. However, patients with diabetes who undergo PCI tend to be predisposed to distinct challenges and unfavorable outcomes due to the intricate interplay between diabetes and heart conditions [1]. Diabetes mellitus is a chronic disorder that arises when the pancreas ceases insulin production or the body becomes resistant to the insulin it generates. It is a disease of macromolecule metabolism that impairs the body's capacity to produce or react to insulin, complicating the maintenance of normal blood glucose levels. An endocrine hormone released by the duct gland acts as a key, facilitating the entry of aldohexose from meals into cells for energy synthesis [2]. In the blood, all macromolecule meals are converted into aldohexose. endocrine aids aldohexose's cellular uptake. Sugar is transported from the blood into your cells via the endocrine system, where it may be stored or used for energy. Polygenic diseases are characterized by either an

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insufficient production of endocrine or an efficient use of the endocrine that is produced [3]. Damage to nerves, eyes, kidneys, and other organs may occur if polygenic disease-related elevated blood glucose goes untreated. The International Diabetes Federation statistics indicate a global rate of 537 million adults with diabetes in 2021, according to their data [4]. Diabetes was the 9th leading cause of death globally in 2020, killing over 2 million people annually as a direct consequence of diabetes and because of kidney disease [5]. Regional studies have shown that diabetes is a major determinant of PCI outcomes, with higher rates of adverse events. Additionally, global practices regarding the choice of vascular access sites differ significantly for diabetic patients [6]. The top five causes of death in the world include being overweight or obese, high blood pressure, smoking, high sugar levels, and lack of exercise. The rising population of obesity, the decrease in physical activity levels, and the ageing population are leading to the prevalence of diabetes mellitus. The prevalence of adult diabetes mellitus will increase to 4.4% in 2030 as compared to 2.8% in 2000 [5]. Not only that, but most cases would originate from the US, China, and India by 2030. Mortality and morbidity rates are greater among diabetics due to the increased risk of myocardial infarction, which is 2-4 times higher in this population. Men with diabetes have a fourfold increased risk, whereas women with the disease have an eightfold increased risk [7]. Globally, it is estimated that 415 million individuals have diabetes, with 91% of these cases being T2D, as reported by the IDF. The IDF forecasts 642 million additional diabetes cases by 2040, increasing the current worldwide prevalence to 2.8% [8]. The risk of atherosclerosis-related cardiovascular disorders, such as acute myocardial infarction (MI), is typically two times higher in those with DM [9]. Consequently, it is not uncommon for individuals with STEMI to also have DM. Only 17.5% of STEMI patients in our group had ever had diabetes. This number is in agreement with what other registries have found. Variables defined and the population of the study play a great role in the reported frequencies. As an illustration, based on recent data, the Polish Registry of Acute Coronary Syndromes (PL-ACS) identified 28.4% of the patients with acute coronary syndromes (ACS) to have diabetes [10]. This is significantly higher than the outcome that we reported in our research, since the ORPKI registry has not been gathering information about DM on cases diagnosed during hospital stays. Additionally, there are possibilities that the incidence of DM among STEMI patients is lower as compared to the entire group of patients with the diagnosis of ACS [11]. The total number of patients with STEMI who had PCI decreased in tandem with the number of individuals diagnosed with DM. Other primary-PCI networks also verified this slow but steady decline in STEMI patients. Several studies have shown that women have a higher increase in cardiovascular risk due to type 2 diabetes compared to males. Patients' prognoses after STEMI have been greatly improved by recent advancements in primary percutaneous coronary intervention (PPCI). Myocardial revascularisation and therapy have come a long way, but patients with DM and ACS still have a much greater death rate, particularly among women, than those without DM. Clinical trials seldom investigate variations in the progression of MI in individuals with diabetes mellitus, even though this population accounts for a sizable fraction of STEMI patients. Type 2 diabetes was identified in 5,346 (20.5%) STEMI patients, with a significantly greater prevalence in females (28% vs. 16.6%; P<0.001) compared to males. Among persons with DM, the proportion of females was higher (47.1% vs. 31.3%; P<0.001) than in those without the illness. Severe coronary atherosclerosis was significantly associated with the onset of type 2 diabetes. Ibanez *et al.* (2018) discovered that women with STEMI and type 2 diabetes had a markedly elevated risk of mortality both during hospitalization and within one year [12]. Major adverse cardiovascular events (MACE) occur at a much higher rate in diabetes individuals with diabetes compared to non-diabetic people when they present with STEMI. One possible link between the poorer prognosis in DM patients and prognostic indicators such as infarct size and the amount of reperfusion damage following PCI has been proposed. Enzymatic techniques or single-photon emission computed tomography were the major tools utilized in recent research to evaluate infarct size in both diabetic and non-diabetic individuals. Infarct size in diabetic individuals is comparable to or smaller in most of these investigations[13].

Despite advances in primary PCI, diabetic patients with STEMI continue to experience higher rates of adverse short-term outcomes, including stroke, renal failure, and mortality. Most regional studies are limited by small sample sizes or focus on single outcomes, and there is a lack of comprehensive data on multiple short-term complications in diabetic STEMI patients undergoing PCI in Pakistan. This study aims to address this gap by evaluating the impact of diabetes on a range of in-hospital outcomes. This study aimed to assess the impact of diabetes on short-term outcomes in STEMI patients treated with primary PCI.

METHODS

This comparative cross-sectional study was conducted between August 2024 and January 2025 at the Shahida Islam Medical Complex in Lodhran. Ethical approval (Ref. No. SIMC/ET.C/0042/24) was obtained from the institutional review board of the Shahida Islam Medical

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Complex in Lodhran. The study included 200 STEMI patients aged 40–70 years who underwent primary PCI, selected through non-probability consecutive sampling after providing written informed consent. Patients with steroid use or outside the age range were excluded. Participants were divided into Group A (diabetic) and Group B (non-diabetic). Data on demographic characteristics (age, sex, height, weight, BMI), risk factors (smoking, hypertension, diabetes, previous ischemic heart disease), laboratory parameters (HbA1c, fasting blood sugar, lipid profile, serum creatinine), and in-hospital outcomes (stroke, arrhythmia, renal failure, mortality) were collected using a structured proforma. Quantitative variables were expressed as mean ± standard deviation, median, and interquartile ranges, while qualitative variables were presented as frequencies and percentages. Group comparisons were performed using an independent sample t-test for quantitative variables and a chi-square test for qualitative outcomes, with p-values <0.050 considered statistically significant. Data were collected using a structured proforma and analyzed using SPSS version 21.0. The combined effect of categorical variables was calculated and reported as risk ratios with 95% confidence intervals.

RESULTS

The mean age diabetic 58.3 ± 8.4 and non-diabetic patients was 55.1 ± 9.2 years with statistically significant p-value 0.032, weight(kg), BMI (kg/m2), Serum Creatinine (mg/dL), HbA1c, fasting blood sugar (mg/dL) and LDL (mg/dL) showed statistically significant p-value as <0.050 except male gender and height(cm) were showed insignificant as p-value 0.540 and 0.078 respectively (Table 1).

Table 1: Comparison of Demographic Variables with respect to Research Groups

Variables	Diabetic (n=90)	Non-Diabetic (n=110)	p-Value
Age (years)	58.3 ± 8.4	55.1 ± 9.2	0.032
Male Gender, n (%)	60 (66.7%)	78 (70.9%)	0.540
Height (cm)	165.2 ± 7.1	167.4 ± 6.9	0.078
Weight (kg)	75.5 ± 11.0	71.3 ± 9.8	0.045
BMI (kg/m^2)	27.6 ± 3.5	25.4 ± 2.9	0.022
Serum Creatinine (mg/dL)	1.3 ± 0.4	1.1 ± 0.3	0.015
HbA1c (%)	8.2 ± 1.1	5.4 ± 0.5	<0.001
Fasting Blood Sugar (mg/dL)	142 ± 38	96 ± 14	<0.001
LDL (mg/dL)	120 ± 25	112 ± 22	0.054

*Cronbach's alpha for data reliability: 0.068

The smoker patients in diabetic groups 43(53.30%) compared with non-diabetic 55 (50%), with a statistically insignificant 0.0680. Hypertensive 72 (80%) and previous IHD was 30 (33.3%) with a significant difference between both groups as p-value 0.001 and 0.006, respectively (Table 2).

Table 2: Comparison Of Risk Factors with Respect to Research Groups

Characteristics	Diabetic (n=90)	Non-Diabetic (n=110)	p-Value
Smoking	48 (53.3%)	55 (50%)	0.680
Hypertension	72 (80%)	60 (54.5%)	0.001
Previous IHD	30 (33.3%)	18 (16.4%)	0.006

The stroke 5 (5.6%), renal failure 10 (11.1%), and mortality 9 (10%) showed statistically significant difference between diabetic and non-diabetic patients as p-value<0.050, while arrhythmia observed among both groups was insignificant, with a p-value of 0.080 (Table 3).

Table 3: Comparison of Outcomes Concerning Research Groups

Outcome	Diabetic (n=90)	Non-Diabetic (n=110)	p-Value
Stroke	5 (5.6%)	1 (0.9%)	0.040
Arrhythmia	12 (13.3%)	7 (6.4%)	0.080
Renal Failure	10 (11.1%)	3 (2.7%)	0.020
Mortality	9 (10%)	3 (2.7%)	0.030

Diabetic patients showed a higher risk of several adverse outcomes compared to non-diabetics. The risk of hypertension was 1.47 times higher in diabetics, indicating they were 47% more likely to have hypertension. Similarly, diabetics had a twofold increased likelihood of a prior history of ischemic heart disease (RR 2.03). Post-PCI, the risk of renal failure was over four times higher in diabetics (RR 4.07), and mortality was nearly four times higher (RR 3.67). The risk of stroke was also elevated (RR 6.11), although the wide confidence interval (0.73–51.11) reflects uncertainty due to the low number of events. While not statistically significant, there was a trend toward increased arrhythmia in diabetics (RR 2.10, p = 0.080). No notable difference was observed between groups for smoking (RR 1.07)(Table 4).

Table 4: Risk Analysis of Outcomes and Co-Morbidities

Characteristic/ Outcome	Diabetic (n=90)	Non-Diabetic (n=110)	Risk Ratio (RR)	95% Confidence Interval (CI)	p-Value
Hypertension	72 (80.0%)	60 (54.5%)	1.47	1.21 to 1.78	0.001
Previous IHD	30 (33.3%)	18 (16.4%)	2.03	1.21 to 3.42	0.006
Smoking	48 (53.3%)	55 (50.0%)	1.07	0.82 to 1.38	0.680
Short-Term Outcomes					
Stroke	5 (5.6%)	1 (0.9%)	6.11	0.73 to 51.11	0.040
Renal Failure	10 (11.1%)	3 (2.7%)	4.07	1.17 to 14.18	0.020
Mortality	9 (10.0%)	3 (2.7%)	3.67	1.03 to 13.04	0.030
Arrhythmia	12 (13.3%)	7 (6.4%)	2.19	0.86 to 5.11	0.080

DISCUSSION

Diabetes mellitus (DM) can result in a prothrombotic state, accompanied by platelet hypersensitivity, hypofibrinolysis, and coagulation disorders [14]. The present study findings reported a significant adverse impact of diabetes on in-hospital outcomes post-PCI. Diabetic patients exhibited a

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higher-risk profile, with significantly greater prevalence of hypertension (80% vs 54.5%) and prior ischemic heart disease, consistent with findings from other regional studies [15, 16]. Consistent with Karayiannides *et al.* diabetic patients were older, had higher BMI, and elevated serum creatinine, reflecting greater metabolic dysfunction and renal vulnerability. Previous studies have similarly reported higher prevalence of prior MI, PCI, multivessel disease, and lower rates of complete revascularization in diabetic STEMI patients [17]. Earlier research reported advanced age and renal impairment among diabetic STEMI patients undergoing PCI, highlighting their contribution to poorer myocardial reperfusion outcomes. Hypertension and prior ischemic heart disease were significantly more common among diabetics, corroborating the ISACS-TC Registry (2021), which emphasized the higher cardiovascular comorbidity burden in this population [19]. Stroke occurred in 5.6% of diabetics versus 0.9% of non-diabetics, indicating a six-fold increased risk, while arrhythmia rates were higher in diabetics but not statistically significant. Earlier researchers reported cerebrovascular risks in ACS patients with diabetes due to endothelial dysfunction, hypercoagulability, and proinflammatory states. Autonomic imbalance and ischemia-related myocardial scar may also explain increased arrhythmic events [20]. Renal failure was significantly more frequent in diabetics, likely reflecting baseline nephropathy and susceptibility to contrast-induced nephropathy, in line with earlier findings [21]. Mortality was notably higher in diabetics, consistent with the FAST-MI Registry 2021, which identified diabetes as a major predictor of 30-day mortality due to impaired myocardial healing, reduced collateral circulation, and systemic inflammation [22]. Follow-up studies also show a high occurrence of arrhythmias in STEMI patients regardless of diabetic status [23]. Risk ratio analysis further confirmed that diabetes significantly increases the likelihood of adverse short-term outcomes, particularly mortality, renal failure, and stroke, with risks more than tripled or quadrupled. These results mirror findings from Punjab-based and Rawalpindi registries, highlighting diabetes as a strong independent predictor of in-hospital complications, including cerebrovascular events and renal failure [23, 24]. Trends toward higher arrhythmia rates in diabetics, although not statistically significant, align with other regional studies [25]. This study reinforces that diabetes mellitus remains a significant predictor of adverse cardiovascular outcomes in STEMI patients undergoing primary PCI, even with modern interventional strategies. Overall, these findings underscore the urgent need for optimized management of diabetic patients with coronary artery disease in Pakistan. Enhanced preventive strategies, rigorous control of cardiovascular risk factors, and careful periprocedural management during PCI are essential to improve outcomes in this high-risk population. This study's strengths include its prospective comparative design and comprehensive analysis of multiple short-term outcomes.

However, limitations include the single-center scope, moderate sample size, and lack of long-term follow-up. Additionally, we did not assess medication adherence, glycemic control before admission, or procedural metrics, which could influence outcomes.

CONCLUSIONS

Diabetes mellitus significantly worsens the short-term prognosis of STEMI patients undergoing primary PCI, as evidenced by increased rates of stroke, renal failure, and in-hospital mortality. These findings highlight the importance of strict glycemic control before and after the procedure, proactive measures to preserve renal function such as hydration protocols and low-contrast techniques, vigilant neurological monitoring, and individualized pharmacotherapy and rehabilitation programs to optimize patient recovery and reduce complications.

Authors' Contribution

Conceptualization: HMM
Methodology: HMM, SEG
Formal analysis: HMM, ZI
Writing and Drafting: HMM, ZI
Review and Editing: HMM, ZI, SEG

All authors approved the final manuscript and take responsibility for the integrity of the work

Conflicts of Interest

All the authors declare no conflict of interest.

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