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IMPACT OF DIABETES MELLITUS ON STEMI PRESENTATION AND CORONARY VESSEL DISEASE IN PATIENTS UNDERGOING PCI: A CROSS-SECTIONAL STUDY

Original Research

Safa Gul[1], Shifa Shakir[1], Seraj Ud Din[2], Hazrat Usman[3], Babar Ali[4]*
[1]Khyber Medical University, Peshawar, Pakistan.
[2]Rehman College of Allied Health Sciences, Peshawar, Pakistan.
[3]Peshawar Institute of Cardiology, Peshawar-Pakistan.
[4]Lecturer Cardiology & Cardiac Perfusion Technology, Institute of Premedical Sciences, Khyber Medical University, Phase-5, Hayatabad, Peshawar-Pakistan.
Corresponding Author: Babar Ali, Lecturer Cardiology & Cardiac Perfusion Technology, Institute of Premedical Sciences, Khyber Medical University, Phase-5, Hayatabad, Peshawar-Pakistan, babarali71995@gmail.com
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ABSTRACT

Background: ST-segment elevation myocardial infarction (STEMI) remains one of the most critical manifestations of coronary artery disease, contributing significantly to global morbidity and mortality. Diabetes mellitus (DM) is recognized as an independent risk factor for adverse cardiovascular outcomes and is often associated with more complex coronary artery involvement. However, the specific relationship between diabetes and the angiographic patterns of STEMI in South Asian populations undergoing percutaneous coronary intervention (PCI) remains insufficiently characterized.

Objective: This study aimed to compare the extent of coronary vessel disease and the type of STEMI presentation between diabetic and non-diabetic patients undergoing PCI, while also describing their demographic, clinical, and procedural characteristics.

Methods: A cross-sectional observational study was conducted at the Peshawar Institute of Cardiology from January to June 2025. A total of 150 patients with STEMI who underwent PCI were enrolled. Inclusion criteria required age ≥18 years, confirmation of STEMI through clinical presentation, electrocardiographic changes, and elevated cardiac biomarkers. Patients with prior CABG, advanced malignancy, or end-stage renal failure were excluded. Data collected included demographics, comorbidities, initial troponin levels, angiographic findings, and procedural characteristics. Patients were stratified by diabetes status. Descriptive statistics and chi-square tests were applied, with significance set at $p < 0.05$.

Results: The mean age of patients was 58.03 ± 10.74 years (range 34–79), with 71.3% males and 28.7% females. Hypertension (68%) and diabetes (28%) were the most frequent comorbidities, followed by tobacco use (14%). Initial troponin values ranged from 2.0 to 50,000 ng/mL (mean 12,111.50 ± 18,556.98). Coronary angiography revealed single-vessel disease in 44.0%, double-vessel disease in 36.7%, and triple-vessel disease in 19.3%. Among diabetic patients (n = 42), single-vessel disease was present in 42.9%, double-vessel in 35.7%, and triple-vessel in 21.4%. In the same group, 47.6% underwent PCI for primary indication, while anterior, lateral, and inferior wall STEMI presentations were seen in 19.0%, 23.8%, and 9.5% respectively. Statistical analysis demonstrated no significant association between diabetes and vessel involvement ($p = 0.921$) or type of STEMI presentation ($p = 0.804$).

Conclusion: Diabetes mellitus was not significantly associated with the angiographic extent of coronary disease or the clinical presentation of STEMI in this cohort. These findings underscore the importance of comprehensive risk factor management in all STEMI patients undergoing PCI, regardless of diabetic status.

Keywords: Coronary Artery Disease (CAD), Diabetes Mellitus (DM), Percutaneous Coronary Intervention (PCI), Risk Factors, ST-Elevation Myocardial Infarction (STEMI), Troponin, Vascular Diseases.

INTRODUCTION

Cardiovascular disease remains the foremost cause of mortality worldwide, with acute myocardial infarction (AMI) constituting a major global health challenge (1). Within this spectrum, ST-segment elevation myocardial infarction (STEMI) represents the most critical presentation, associated with extensive myocardial injury and poor survival if timely reperfusion is not achieved (2). The advent of percutaneous coronary intervention (PCI) as the standard reperfusion strategy has markedly improved outcomes for patients presenting with STEMI, yet considerable disparities remain across high-risk subgroups (3). Diabetes mellitus (DM), a rapidly rising global epidemic, represents one of the most important comorbid conditions that exacerbate cardiovascular risk. In 2021, approximately 537 million adults aged 20–79 years were living with DM, and this number is expected to escalate to 783 million by 2045 (4). Beyond being a chronic metabolic disease, DM serves as an independent and powerful risk factor for cardiovascular disease, including AMI (5,6). Patients with diabetes frequently exhibit greater comorbidity burdens, more complex and diffuse coronary atherosclerosis, and less favorable outcomes after revascularization compared to their non-diabetic counterparts (7). The adverse impact of DM on STEMI outcomes is multifactorial, driven by accelerated atherosclerosis, diffuse plaque distribution, chronic inflammation, and the coexistence of cardiometabolic risk factors such as hypertension, dyslipidemia, and chronic kidney disease (8). These pathophysiological mechanisms result in impaired myocardial reperfusion despite successful epicardial vessel recanalization, larger infarct size, and higher risks of subsequent heart failure and mortality (9). A particularly significant and often underrecognized aspect of diabetic coronary artery disease is coronary microvascular dysfunction (CMD), characterized by abnormal vasomotor responses and structural remodeling of the coronary microcirculation. CMD compromises myocardial blood flow regulation, leading to ischemia even in the absence of major epicardial stenosis. In diabetic patients, this “microvascular disease” adds to the burden of epicardial atherosclerosis, creating a dual pathway of myocardial injury that worsens outcomes after PCI (10,11).

The optimal revascularization approach in diabetic patients with multivessel disease remains controversial (12). While conventional PCI often targets the culprit lesion alone, increasing evidence supports complete revascularization in selected patients to reduce adverse outcomes (13). Moreover, advancements such as ultra-thin drug-eluting stents (DES) and intravascular lithotripsy (IVL) are expanding therapeutic options, offering safer and more effective interventions for patients with complex coronary anatomy. Ultra-thin DES promote faster endothelialization, permitting shorter durations of dual antiplatelet therapy and reducing bleeding risk, an important consideration in diabetic cohorts with heightened vulnerability (14–16). Although numerous international studies have explored the interplay between diabetes and STEMI presentations, results remain inconsistent, and data from South Asian populations, particularly Pakistan, are scarce. Given the high prevalence of DM in the region and its substantial impact on cardiovascular outcomes, there is a pressing need for context-specific evidence. Understanding how diabetes influences the extent of coronary vessel involvement, patterns of STEMI, and clinical outcomes after PCI is essential for optimizing treatment strategies and improving prognostication in this high-risk group. The present study, therefore, aims to compare the extent of coronary vessel disease and STEMI presentation types between diabetic and non-diabetic patients undergoing PCI, while also describing their demographic, clinical, and procedural characteristics, thereby addressing a critical knowledge gap and providing locally relevant insights into the management of STEMI in Pakistan.

METHODS

The study was designed as a cross-sectional observational analysis and was conducted at the Peshawar Institute of Cardiology, Pakistan, over a six-month period from January 1 to June 30, 2025. A total of 150 consecutive patients presenting with ST-segment elevation myocardial infarction (STEMI) and undergoing percutaneous coronary intervention (PCI) during the index hospitalization were enrolled. All patients aged 18 years and above with a diagnosis of STEMI, confirmed by typical clinical presentation, characteristic electrocardiographic changes, and elevated cardiac biomarkers, were considered eligible. Patients with a history of prior coronary artery bypass graft (CABG) surgery, those with incomplete medical records, or those suffering from advanced malignancy or end-stage renal failure were excluded. Additionally, individuals who declined to provide informed consent were not included in the study. Demographic characteristics including age and sex, clinical comorbidities such as hypertension, diabetes mellitus, dyslipidemia, smoking or tobacco use, and family history of ischemic heart disease were systematically recorded. Angiographic findings were classified into single, double, or triple-vessel disease. STEMI presentations were categorized as anterior, inferior, or lateral based on electrocardiographic localization.

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Procedural data, including arterial access site and initial troponin levels, were documented at the time of PCI. The primary study variables of interest were diabetes mellitus status, the number of diseased vessels, and the type of STEMI presentation.

Data collection was carried out prospectively using a structured proforma specifically designed for this study. Demographic and clinical details were obtained from patient records, while angiographic and procedural findings were recorded by the interventional team during PCI. Laboratory investigations, including cardiac troponin values, were extracted from hospital laboratory records. Informed consent was obtained from all eligible patients prior to enrollment, ensuring respect for autonomy and compliance with ethical requirements. The sample size was calculated using the OpenEpi software based on the formula for a single proportion: $n = Z^2 \times p \times (1 - p) / E^2$ (3). By assuming an expected prevalence of diabetes mellitus among STEMI patients of 11%, a 95% confidence level ($Z = 1.96$), and a margin of error of 0.05, the minimum required sample size was determined to be 150 participants. A non-probability convenience sampling method was employed to recruit consecutive eligible patients within the study period. Data analysis was performed using SPSS version 25. Continuous variables were summarized as mean ± standard deviation (SD), whereas categorical variables were expressed as frequencies and percentages. Associations between diabetes mellitus and study outcomes, including the extent of vessel involvement and STEMI localization, were assessed using the chi-square (χ^2) test. A p-value < 0.05 was considered statistically significant. Results were presented in tabular form and through clustered bar charts to enhance clarity and interpretability. This study was conducted following ethical principles outlined in the Declaration of Helsinki. Ethical approval was obtained from the Institutional Review Board (IRB) of the Peshawar Institute of Cardiology, reference number IRC/24/114, prior to initiation of data collection.

RESULTS

A total of 150 patients with ST-elevation myocardial infarction undergoing percutaneous coronary intervention were included in the analysis. The mean age was 58.03 ± 10.74 years, with ages ranging from 34 to 79 years. The majority of patients were male, accounting for 71.3%, while females represented 28.7%. Hypertension was the most frequent comorbidity, observed in 68% of patients, followed by diabetes mellitus in 28% and tobacco use in 14%. Dyslipidemia and a positive family history of coronary artery disease were less common, documented in 1.3% and 2.0% of cases, respectively. Initial troponin levels were available in 86% of cases, ranging between 2.0 and 50,000.0 ng/mL, with a mean value of 12,111.50 ± 18,556.98 ng/mL, reflecting marked variability at presentation. Coronary angiographic findings demonstrated single-vessel disease in 44.0% of patients, double-vessel disease in 36.7%, and triple-vessel disease in 19.3%. The radial artery was the most common access site for intervention (94.0%), while the femoral approach was used in 6.0% of cases. When stratified by diabetes status, among the 42 diabetic patients, 18 had single-vessel disease, 15 had double-vessel disease, and 9 had triple-vessel disease. Among the 108 non-diabetic patients, 48 had single-vessel, 40 had double-vessel, and 20 had triple-vessel disease. Statistical comparison revealed no significant association between diabetes mellitus and the number of diseased coronary vessels (χ^2 test, $p = 0.921$). In terms of STEMI presentation, 53.3% of the overall cohort underwent primary PCI. Anterior wall STEMI accounted for 16.0%, lateral wall STEMI for 20.7%, and inferior wall STEMI for 10.0% of cases. Among diabetic patients, 20 underwent primary PCI, with anterior, lateral, and inferior wall STEMI presentations recorded in 8, 10, and 4 cases, respectively. In comparison, non-diabetic patients presented with 60 undergoing primary PCI, including 16 with anterior, 21 with lateral, and 11 with inferior STEMI. Chi-square analysis demonstrated no significant association between diabetes mellitus and the type of STEMI presentation ($p = 0.804$).

When comorbidities other than diabetes were examined, hypertension and tobacco use were analyzed in relation to coronary vessel disease and STEMI type. Among the 102 patients with hypertension, 44.1% demonstrated single-vessel disease, 35.3% double-vessel disease, and 20.6% triple-vessel disease, a distribution similar to that observed in the overall cohort. In comparison, non-hypertensive patients showed 43.8% single-vessel disease, 40.0% double-vessel disease, and 16.3% triple-vessel disease, with no significant association between hypertension and the extent of vessel involvement ($p = 0.865$). Likewise, tobacco use did not significantly alter the pattern of vessel disease; 42.9% of smokers had single-vessel disease, 38.1% double-vessel disease, and 19.0% triple-vessel disease compared to 44.2%, 36.5%, and 19.2% in non-smokers ($p = 0.978$). In terms of STEMI presentation, hypertensive patients most commonly presented with lateral wall STEMI (21.6%), followed by anterior STEMI (15.7%) and inferior STEMI (9.8%), while non-hypertensive patients demonstrated a similar distribution. Tobacco users also exhibited comparable STEMI localization patterns, and chi-square analysis showed no significant association of either hypertension ($p = 0.792$) or tobacco use ($p = 0.911$) with STEMI type. These findings suggest that, in this cohort, neither hypertension nor tobacco use had a statistically significant influence on the angiographic pattern of vessel disease or type of STEMI presentation.

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Table 1: Baseline Characteristics of Patients with STEMI Undergoing PCI (n = 150)

Variable	Frequency (%)	Minimum	Maximum	Mean ± SD
Age (Yrs)	-	34	79	58.03±10.74
Gender				
Male	71.3	-	-	-
Female	28.7	-	-	-
Comorbidities				
Hypertension	68.0	-	-	-
Diabetes Mellitus	28.0	-	-	-
Tobacco use	14.0	-	-	-
Dyslipidemia	1.3	-	-	-
Family History of CAD	2	-	-	-
Troponin				
Initial troponin collected	86.0	-	-	-
Initial troponin values (ng/mL)	-	2	50,000	**12,111.50± 18,556.98**
Coronary Vessel Disease				
Single Vessel Disease	44.0	-	-	-
Double Vessel Disease	36.7	-	-	-
Triple Vessel Disease	19.3	-	-	-
Arterial Access Site				
Radial artery	94.0	-	-	-
Femoral artery	6.00	-	-	-
PCI Type				
Primary PCI	53.3	-	-	-
AW STEMI PCI	16.0	-	-	-
LW STEMI PCI	20.7	-	-	-
IW STEMI PCI	10.0	-	-	-

Note: Continuous variables are presented as mean ± standard deviation (SD), and categorical variables as n (%). Troponin values are expressed in ng/mL, CAD = Coronary Artery Disease; PCI = Percutaneous Coronary Intervention; STEMI = ST-Elevation Myocardial Infarction; AW = Anterior Wall; LW = Lateral Wall; IW = Inferior Wall; SD = Standard Deviation.

Table 2: Association between Diabetes and Number of Diseased Vessels

Diabetes Status	Single-vessel (n)	Double-vessel (n)	Triple-vessel (n)	Total (n)	p-value
Yes	18	15	9	42	0.921
No	48	40	20	108	
Total	66	55	29	150	

Note: No significant association observed between diabetes and the number of diseased vessels (χ^2 test, p = 0.921).

Table 3: Association between Diabetes and Type of STEMI Presentation

Diabetes Status	Primary PCI (n)	Anterior STEMI (n)	Lateral STEMI (n)	Inferior STEMI (n)	Total (n)	p-value
Yes	20	8	10	4	42	0.804
No	60	16	21	11	108	
Total	80	24	31	15	150	

Note: No significant association observed between diabetes and type of STEMI presentation (χ^2 test, p = 0.804).

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Table 4: Subgroup Analysis of Hypertension and Tobacco Use with Vessel Disease and STEMI Type

Comorbidity	Single-vessel n (%)	Double-vessel n (%)	Triple-vessel n (%)	p-value (vessels)	Anterior STEMI n (%)	Lateral STEMI n (%)	Inferior STEMI n (%)	p-value (STEMI)
Hypertension (Yes, n=102)	45 (44.1)	36 (35.3)	21 (20.6)	0.865	16 (15.7)	22 (21.6)	10 (9.8)	0.792
Hypertension (No, n=48)	21 (43.8)	19 (40.0)	8 (16.3)		8 (16.7)	9 (18.8)	5 (10.4)	
Tobacco Use (Yes, n=21)	9 (42.9)	8 (38.1)	4 (19.0)	0.978	3 (14.3)	5 (23.8)	2 (9.5)	0.911
Tobacco Use (No, n=129)	57 (44.2)	47 (36.5)	25 (19.2)		21 (16.3)	26 (20.2)	13 (10.1)	

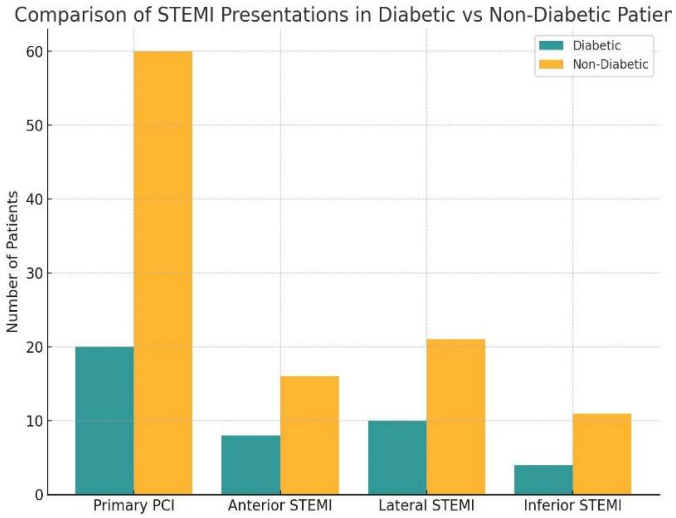

Figure 2 Comparison of STEMI Presentations in Diabetic vs Non-Diabetic Patier

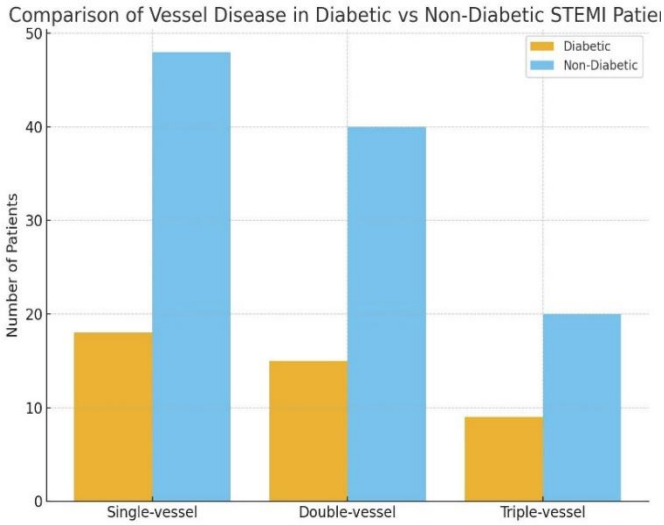

Figure 2 Comparison of Vessel Disease in Diabetic vs Non-Diabetic STEMI Patier

DISCUSSION

This study explored the relationship between diabetes mellitus and patterns of coronary vessel disease in patients presenting with ST-elevation myocardial infarction undergoing percutaneous coronary intervention. The findings demonstrated no significant association between diabetes and the extent of vessel involvement or type of STEMI presentation. These results diverge from several international reports that have described a higher prevalence of multivessel disease among diabetic patients, yet align with other studies that found no significant differences in angiographic extent of disease between diabetic and non-diabetic groups (16,17). The demographic profile of the cohort revealed a mean age of 58.03 years and a predominance of male patients, reflecting the well-documented higher incidence of STEMI in middle-aged men (18). Hypertension emerged as the most prevalent comorbidity, present in over two-thirds of patients, a figure substantially higher than global averages but consistent with trends in South Asian populations where hypertension is recognized as a major cardiovascular risk factor. The prevalence of diabetes at 28% was comparable to previous large registries, while tobacco use was lower than some Western cohorts, suggesting regional variations in risk factor distribution (19-21). Coronary angiographic analysis revealed that single-vessel disease was the most frequent finding, followed by double- and triple-vessel involvement. The absence of a significant association between diabetes and vessel disease burden suggests that factors other than diabetes alone, such as genetic predispositions, lifestyle patterns, and environmental influences, may have influenced disease distribution in this population. Similarly, the distribution of STEMI presentations—anterior, lateral, and inferior wall—was comparable between diabetic and non-diabetic patients, echoing findings from certain Western cohorts where no difference in STEMI localization was observed (22).

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Several factors may explain these results. The modest sample size limited statistical power to detect subtle differences between groups. Additionally, heterogeneity in population characteristics and treatment practices compared to international studies may have contributed to divergent findings. The relatively high prevalence of hypertension in this cohort may also have acted as a stronger determinant of vessel disease burden, potentially attenuating the independent effect of diabetes on angiographic severity. An important strength of this study was its prospective design and the systematic collection of demographic, clinical, angiographic, and procedural data, ensuring robust internal validity. The near-universal adoption of radial access (94%) for PCI highlights alignment with international best practices, reflecting procedural strength and quality of care at the study center. However, limitations were evident. The single-center observational design restricts external generalizability, and the relatively small sample size may have limited the ability to identify more nuanced associations. Long-term outcomes such as mortality, recurrent ischemic events, and heart failure were not assessed, thereby restricting prognostic interpretation. The use of non-probability sampling further limits the representativeness of the cohort. These findings suggest that while diabetes remains an important cardiovascular risk factor, its direct relationship with angiographic patterns of STEMI presentation may not be uniform across populations. Future research should prioritize large-scale, multicenter studies in South Asia, incorporating longer follow-up to evaluate prognostic outcomes. Further exploration of interactions between diabetes, hypertension, and other comorbidities in shaping coronary disease patterns is warranted. Such studies could provide critical insights into optimizing individualized treatment strategies and improving risk stratification in high-burden populations.

CONCLUSION

This study concluded that diabetes mellitus did not significantly influence the severity of coronary artery disease or the pattern of STEMI presentation among patients undergoing percutaneous coronary intervention. Both diabetic and non-diabetic individuals demonstrated comparable angiographic findings and STEMI distributions, underscoring that other comorbid conditions, particularly hypertension, may exert a stronger impact on clinical outcomes. These findings highlight the importance of comprehensive risk factor management for all STEMI patients rather than focusing solely on diabetes status. The study contributes valuable regional insight, emphasizing the need for larger, multicenter investigations to further clarify the interplay between diabetes, coronary artery disease, and acute STEMI presentation in South Asian populations.

AUTHOR CONTRIBUTION

Author	Contribution
Safa Gul	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Shifa Shakir	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Seraj Ud Din	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Hazrat Usman	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Babar Ali*	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published

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