E-ISSN 2250-0944

ISSN 2250-1150

doi: 10.48047/ijprt/16.01.283

Research Article

Association Between Diabetes Duration and Coronary Artery Disease Severity in Patients Undergoing Angiographic Evaluation

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Abstract

Objective: To assess the association between type 2 diabetes mellitus (T2DM) duration and the level of coronary artery disease (CAD) in patients undergoing coronary angiography.

Study Design: This was a cross-sectional, observational study.

Place and Duration: The study was conducted at Sindh Institute of Urology and Transplantation (SIUT-BIUT) Hospital Nawabshah, while the cath procedures were performed at (SICVD) Nawabshah between March 2025 to March 2026.

Methods: The study sample included 145 participants aged 40-70 years with T2DM for at least 5 years. Patients who had undergone elective coronary angiography were evaluated. Clinical examination, lab analysis, and medical history were used to collect the data. The Gensini scoring system was used to assess CAD severity. Pearson correlation and multiple regression were used to assess the association between CAD severity and diabetes duration, with age, gender, smoking status, dyslipidemia, and hypertension controlled.

Results: The participants' average age was 57.4±6.8 years, with 61.4% being male (n=89). A mean of 11.8±4.9 years was observed for the duration of diabetes. A considerable positive correlation (r = 0.670, p<0.001) was found between the duration of diabetes and the severity of coronary artery disease (CAD). Gensini scores increased progressively across duration groups: <10 years (32.1±13.7), 10–15 years (52.6 ± 16.4), and >15 years (74.3 ± 22.5). The multivariate regression analysis showed that diabetes duration (B=1.90, p=0.001), hypertension (B=8.10, p=0.010), and dyslipidemia (B=6.90, p=0.020) were significant predictors, with smoking being marginally significant (B=5.10, p=0.050).

Conclusion: The severity of CAD is associated with the longer duration of T2DM. It implies that cardiovascular examination and close control of the risk factors in diabetic patients should be considered early.

Keywords: *Coronary artery disease, Type 2 diabetes mellitus, Diabetes duration, severity, Gensini score.*

Introduction

Type 2 diabetes mellitus (T2DM) is a persistent metabolic disease defined by ongoing high blood sugar levels that stem from problems with insulin production, insulin effectiveness, or a combination of both. The condition develops as the body gradually loses its ability to make enough insulin or to use it properly, which then throws off the normal processing of carbohydrates, fats, and proteins [1]. T2DM has an estimated prevalence of 11.11% in adults aged 20-79 years, with a world population of about 589 million individuals with diabetes by 2024 [2]. A national survey carried out in Pakistan showed that there is a high and increasing cardiometabolic burden in adults with T2DM prevalence at 16.98% and prediabetes prevalence at 10.91% [3].

Coronary artery disease (CAD) in diabetes patients occurs due to the advanced metabolic pathophysiology of chronic hyperglycemia, dyslipidemia, and inflammation that contributes to the enhancement of plaque formation and vascular damage [4]. It has long been established that the pathophysiologic interaction of diabetes and CAD severity is complex: sustained hyperglycemia results in oxidative stress, inflammatory response, and endothelial injury, which, in turn, facilitates the development of complex plaque morphology and obstructive lesions [5]. Emergent causes, including dysregulated epigenetics, oxidative stress cascades, and metabolic memory, to which early glycemic

insults have a long-term vascular impact despite glucose regulation, are also highlighted in recent mechanistic studies [6].

Some cross-sectional observational studies have shown positive correlations between the severity of CAD and diabetes duration, and the cumulative vascular impairment of years of hyperglycemia. In a tertiary care cohort, the researchers found that diabetes duration was a key predictor of higher Gensini scores, indicating that more patients undergoing coronary angiography had coronary involvement [7]. Another cross-sectional angiographic cohort has reported that patients with diabetes histories of more than five or ten years are more likely to show much higher severity scores in a coronary angiography compared with patients with shorter disease histories [8]. In addition, comparative studies of angiographic complexity have revealed that diabetics usually manifest with multi-vessel disease, severe stenosis, and lipid-laden plaques, which are known to have poor clinical outcomes, in comparison to non-diabetics [9].

Despite this evidence, there are still significant gaps in literature. Limited studies have measured the relationship between diabetes duration and angiographically validated CAD severity in large, well-characterized Pakistani cohorts using standardized scoring systems, and even fewer have rigorously controlled for confounders (including glycemic control, hypertension, and lipid abnormalities) [7, 8]. This study seeks to evaluate how the duration of diabetes correlates with the severity of coronary artery disease in patients who are undergoing coronary angiography.

Methodology

This cross-sectional, observational study included 145 patients with T2DM aged 40-70 years who had a minimum of five years of diagnosis with the disease and were undergoing elective coronary angiography to ascertain CAD. The study included patients having a history of smoking and comorbid conditions like dyslipidemia and hypertension, making it a real-world representation. Exclusion criteria were used to eliminate any participant diagnosed with type 1 diabetes mellitus, who had ACS, those with significant non-cardiac conditions advanced kidney dysfunction, had advanced coronary artery disease, and stent placement or prior coronary artery bypass graft (CABG) surgery.

Data were collected through physical examination, clinical interviews, and laboratory tests. Gender, age, and medical

history were noted, including dyslipidemia, hypertension, and years of diabetes. To assess long-term glycemic control, clinical data including fasting blood glucose, blood pressure, body mass index (BMI), and HbA1c levels were obtained. Also, renal dysfunction was assessed using the serum creatinine and eGFR levels, and lipid profiles were also examined, including triglycerides, HDL, LDL, and total cholesterol.

The two main variables in the study were years since diabetes diagnosis and CAD severity, estimated using the Gensini scoring system for coronary stenosis. Other confounding variables that were controlled as potential confounders during the analysis included age, gender, hypertension, dyslipidemia, and smoking status.

Statistical analysis was carried out to determine the relationship between duration of diabetes and CAD severity using Pearson's correlation coefficient. The age, gender, hypertension, dyslipidemia, and smoking were confounding factors adjusted by multiple linear regression with a significance of $p = 0.05$. Variance inflation factors (VIF) were used to check for multicollinearity, and the conditions of linearity, independence, and homoscedasticity were checked.

Results

This study involved a total of 145 patients. Participants had a mean age of 57.4±6.8 years. The majority of the patients were male (n=89, 61.4%). A mean body mass index (BMI) of 28.6 ± 5.1 kg/m² and an average duration of diabetes of 11.8 ± 4.9 years were measured. Hypertension was present in 110 (n=110, 75.9%) patients, dyslipidemia in 100 (n=100, 69.0%), and smoking in 60 (n=60, 41.4%). The mean HbA1c level was 7.9 ± 1.2% (Table 1).

Table 1: Demographic and Clinical Profile of Patients (N=145)

Characteristic	Mean ± SD or N (%)
Age (years)	57.4 ± 6.8
Duration of Diabetes (years)	11.8 ± 4.9
BMI (kg/m²)	28.6 ± 5.1
HbA1c (%)	7.9 ± 1.2
Gender (Male)	89 (61.4%)
Hypertension	110 (75.9%)

Dyslipidemia	100 (69.0%)
Smoking	60 (41.4%)

Diabetes duration was found to have a positive correlation with the severity of CAD, with a Pearson's correlation value of 0.670 ($p < 0.001$). This implies that the severity of CAD increases with the duration of diabetes (Table 2).

Table 2: Relationship Between Diabetes Duration and CAD Severity (Gensini Score)

Variable	Pearson's Correlation Coefficient (r)	P-value
Duration of Diabetes (years)	0.670	<0.001

Patients with diabetes for more than 15 years had the highest mean Gensini score (74.3 ± 22.5; n=45), indicating more severe coronary artery involvement. Those with a duration of 10–15 years had a moderate mean score (52.6 ± 16.4; n=52), while patients with diabetes for less than 10 years had the lowest mean Gensini score (32.1 ± 13.7; n=48) (Table 3).

Table 3: Gensini Scores by Duration of Diabetes (N=145)

Duration of Diabetes (years)	Gensini Score (Mean ± SD)	Number of Patients
> 15 years	74.3 ± 22.5	45
10–15 years	52.6 ± 16.4	52
< 10 years	32.1 ± 13.7	48

Diabetes duration emerged as the strongest independent predictor of CAD severity in the multivariable linear regression analysis, showing a beta coefficient of 1.90 ($p<0.001$). Increased disease severity was also strongly correlated with dyslipidaemia ($\beta=6.90$, $p=0.020$) and hypertension ($\beta=8.10$, $p=0.010$). A marginal association was found between smoking ($\beta=5.10$, $p=0.050$). Nevertheless, neither male gender ($\beta=4.60$, $p=0.080$) nor age ($\beta=0.20$, $p=0.120$) were statistically significant predictors (Table 4).

Table 4: Determinants of Gensini Score Identified by Multivariable Linear Regression

Variable	Coefficient (B)	Standard Error (SE)	P-value
Duration of Diabetes (years)	1.90	0.30	<0.001
Age (years)	0.20	0.10	0.120
Gender (Male)	4.60	3.20	0.080
Smoking	5.10	2.70	0.050
Dyslipidemia	6.90	2.50	0.020
Hypertension	8.10	2.80	0.010

Discussion

This study aimed to determine whether a longer duration of T2DM is associated with greater angiographic severity of CAD in patients undergoing elective coronary angiography. The findings of our study establish a statistically significant positive relationship between Gensini scores and diabetes duration, indicating that longer exposure to diabetes is correlated with more severe CAD. The idea that diabetes is associated with severe coronary pathology and greater coronary plaque burden can be justified by the significant correlation observed in our study [5]. Gebert et al. noted that diabetic patients had more calcified and non-calcified plaques, as well as an increased burden of low-attenuation and total plaque. This was attributed to a higher risk of myocardial infarction in isolation of other risk factors [10]. Lee et al. discovered that the risk of major adverse cardiac and cerebrovascular events is significantly higher in patients with a longer duration of diabetes, especially in patients with non-obstructive coronary artery disease. This highlights the progression of the effects of diabetes on cardiovascular health [11].

The lowest Gensini score in our study was observed in patients with shorter diabetes duration (<10 years), and the intermediate severity was represented by patients with a 10-15 year duration of diabetes. The highest scores were observed in patients with a duration of over 15 years, suggesting a graded exposure response relationship rather than a yes-or-no diabetic effect. The trend is in line with Ma et al., who reported a positive relationship between poorer glycemic exposure, based on time in range, and more severe CAD in patients with T2DM [12]. It also aligns with the findings of Chen et al., who reported a long-term risk associated with diabetes duration, glycemic control, and the Gensini score of coronary stenosis, supporting the clinical relevance of the observed gradient across our duration groups [13].

But not every study identifies duration as the sole cause of CAD severity. One study indicates that hemodynamically significant CAD is more common among diabetic patients than their non-diabetic counterparts, but diabetes did not serve as an independent predictor of adverse outcomes when clinical risk factors and imaging outcomes were considered [14]. Another concern is that our results are based on anatomical severity, whereas some more recent studies have extended the discussion to prognosis and plaque progression. Indicatively, Liu et al. discovered a correlation between the severity of CAD in T2DM patients and variations in HbA1c [15], whereas Ito et al. found that dysglycemia was associated with vulnerable plaque behavior and plaque progression [16]. They reinforce the idea that long-term diabetes worsens coronary disease, although they also imply that duration is not the only determinant of the biological pathway; glycemic variability, plaque properties, and metabolic regulation are also involved.

In our study, we determined that, in addition to diabetes, hypertension, and dyslipidemia were independent predictors of CAD. Our findings are corroborated by Yang et al., who assert that the severity of coronary heart disease and Gensini score were positively correlated with hypertension, hyperlipidaemia, smoking, and diabetes [17]. However, our results did not indicate that age or male sex were statistically significant independent predictors, whereas a CAD severity study reported significant correlations between a higher Gensini score and older age and male gender [18]. Practically, these findings confirm previous cardiovascular risk stratification in diabetic patients with long-term history as opposed to age or sex alone. Furthermore, progressive worsening of CAD over time with diabetes duration justifies early and regular cardiovascular screening in long-term diabetic patients.

There are a few limitations to this study. Its cross-sectional nature limits the ability to establish causality between diabetes longevity and CAD severity. The small study sample and single-center design can limit the generalizability of the results to larger populations. Potential confounders like diet and physical activity were not taken into consideration, which might have affected the outcomes.

Conclusion

This study demonstrates a strong association between the severity of CAD and the duration of diabetes, which suggests a cumulative effect of chronic

hyperglycemia on coronary pathology. The most important independent predictors were found to be hypertension, dyslipidemia, and duration of diabetes. This underscores the need to evaluate cardiovascular risk among diabetic youths. Multicenter longitudinal and advanced imaging studies, along with biomarkers, should be embraced to better understand the roles of glycemic variability, plaque dynamics, and genetic factors in the severity and progression of CAD in diabetic populations.

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