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Original Article

Correlation between Duration of Diabetes and Severity of Coronary Artery Disease in Patients Undergoing Coronary Angiography at a Tertiary Care Hospital

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Abstract

Objectives: This study aims to examine the relationship between the duration of diabetes mellitus and the severity of coronary artery disease (CAD) in patients undergoing coronary angiography.

Methodology: A cross-sectional observational study was conducted from June 2022 to June 2023, involving 130 patients diagnosed with type 2 diabetes mellitus who presented with symptoms indicative of CAD. Comprehensive data on demographics, medical history, and diabetes duration were collected. Coronary angiography was performed to assess CAD severity using the Gensini scoring system. Statistical analyses, including Pearson's correlation coefficient and multiple linear regression, were employed to evaluate the relationship between diabetes duration and CAD severity while controlling for potential confounders such as age, gender, hypertension, dyslipidemia, and smoking status.

Results: A significant positive correlation was observed between the duration of diabetes and the Gensini score ($r = 0.65$, $p < 0.001$), suggesting that longer diabetes duration is associated with more severe CAD. Multiple linear regression analysis further established that the duration of diabetes, along with hypertension and dyslipidemia, were significant predictors of higher Gensini scores. Patients with diabetes for over 15 years exhibited the highest mean Gensini scores (68.1 ± 20.3), compared to those with 10-15 years (45.3 ± 15.6) and less than 10 years (27.8 ± 12.4).

Conclusion: The study confirms a significant association between longer diabetes duration and increased severity of CAD. These findings underscore the critical need for early and rigorous management of diabetes and its cardiovascular risk factors to prevent the progression of CAD. Enhanced monitoring and comprehensive cardiovascular risk assessments are essential for improving outcomes in diabetic patients.

Keywords: Diabetes Mellitus, Coronary Artery Disease (CAD), Gensini Score, Coronary Angiography, Cardiovascular Risk, Duration of Diabetes, Hypertension, Dyslipidemia, Type 2 Diabetes, Atherosclerosis

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INTRODUCTION

Diabetes mellitus, a chronic metabolic disorder characterized by persistent hyperglycemia, is a well-established major risk factor for cardiovascular diseases, particularly coronary artery disease (CAD). Among diabetic patients, CAD remains the leading cause of both morbidity and mortality [1]. This study aims to explore the relationship between the duration of diabetes and the severity of CAD in individuals undergoing coronary angiography at a tertiary care hospital. Understanding this relationship is crucial, as prolonged diabetes has been consistently linked to more severe coronary artery involvement, emphasizing the need for early detection and comprehensive management of cardiovascular risks in diabetic populations [2].

Numerous studies have demonstrated that diabetes accelerates atherosclerosis, leading to more severe manifestations of CAD [3]. Chronic hyperglycemia contributes to endothelial dysfunction, systemic inflammation, and lipid abnormalities, which are key mechanisms in the development of atherosclerosis [4]. In a study conducted by Shaikh et al. (2019) at the Tabba Heart Institute in Karachi, the Modified Gensini score was used to assess the relationship between diabetes duration and CAD severity. Their findings indicated that both male gender and longer diabetes duration were significantly associated with higher Gensini scores, reflecting more severe CAD involvement. This research reinforces the critical role of diabetes duration in predicting CAD severity [2]. Similarly, Ul Amin et al. (2019) corroborated these findings, demonstrating a positive correlation between the Gensini score and diabetes duration in patients undergoing coronary angiography. The correlation was particularly pronounced in older and male patients, underscoring the compounded risks of age and gender in diabetic individuals [1].

The impact of glycemic control on CAD severity has also been extensively studied. In 2023, Sliema and colleagues conducted research in Egypt using coronary computed tomography angiography (CCTA) to assess the effect of diabetes on CAD. The study found that patients with long-standing and poorly controlled diabetes exhibited more extensive coronary calcifications and severe obstructive lesions, with the left anterior descending (LAD) artery being the most frequently affected. This highlights a specific anatomical vulnerability in diabetic patients [3].

Insulin resistance is another critical factor influencing the complexity of CAD in diabetic patients. Yaseen et al. (2021) investigated fasting insulin levels in relation to Gensini scores and found a significant correlation between insulin resistance and severe CAD. This suggests that insulin resistance is a strong predictor of complex coronary lesions, emphasizing the need for early intervention in insulin-resistant patients to reduce the risk of coronary complications [4].

In addition to fully developed diabetes, prediabetes has also been linked to increased CAD severity. Muhammad et al. (2019) reported that prediabetic individuals undergoing elective coronary angiography exhibited a higher atherosclerotic burden and complexity of CAD, comparable to the severity observed in diabetic patients. This underscores the importance of early screening and intervention for prediabetic individuals to prevent the progression to severe CAD [5]. Narzary et al. (2022) combined diabetes duration and HbA1c levels to assess their relationship with CAD severity. Their findings showed that longer diabetes duration and elevated HbA1c levels were both significantly linked to more severe CAD, as determined by coronary angiography. This reinforces the notion that long-term hyperglycemia significantly contributes to CAD progression [6].

Furthermore, Pathak et al. (2021) compared the severity of CAD in patients presenting with acute myocardial infarction (MI) with and without diabetes. They found that diabetic patients exhibited significantly more triple-vessel or multi-vessel disease compared to non-diabetic individuals, with the severity of CAD closely tied to the duration of diabetes [7]. Several studies have established a strong correlation between longer diabetes duration and more severe coronary artery involvement. The interplay of glycemic control, insulin resistance, and prediabetic conditions further intensifies the risk of CAD in diabetic populations, underscoring the necessity for comprehensive cardiovascular risk management [8]. These findings advocate for early detection, vigilant monitoring, and proactive intervention to mitigate CAD progression, thereby improving patient outcomes.

Recent research has also introduced novel insights into the evolving understanding of diabetes and CAD. Emerging biomarkers, such as high-sensitivity C-reactive protein (hs-CRP) and N-terminal pro-B-type natriuretic peptide (NT-proBNP), have been shown to improve CAD severity prediction in diabetic patients.

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Elevated hs-CRP levels, for example, are independently associated with increased risks of cardiovascular events and mortality in type 2 diabetic patients, indicating the significant role of inflammation in CAD progression [8]. Additionally, advancements in imaging techniques like coronary computed tomography angiography (CCTA) provide more detailed assessments of coronary plaque characteristics, offering deeper insights into the pathophysiological mechanisms linking diabetes with more severe CAD [9]. Studies have also emphasized the importance of evaluating epicardial adipose tissue (EAT) as a novel marker of CAD severity, suggesting that metabolic and anatomical factors beyond traditional risk factors should be considered in the risk stratification of diabetic patients [10].

The primary objective of this study was to investigate the relationship between the duration of diabetes mellitus and the severity of coronary artery disease (CAD) in patients undergoing coronary angiography. Given the well-established link between diabetes and accelerated atherosclerosis, we aimed to provide further insights into how prolonged exposure to hyperglycemia affects coronary artery involvement. By examining this correlation in a tertiary care setting, we sought to contribute to the growing body of evidence on the need for early and comprehensive cardiovascular risk management in diabetic patients. Understanding this relationship can help guide clinicians in better stratifying risk and implementing personalized interventions to prevent severe CAD complications in individuals with long-standing diabetes.

METHODOLOGY

Study Design: This was a cross-sectional, observational study conducted over a period of one year, from June 2022 to June 2023, at the Hayatabad Medical Complex in Peshawar, Pakistan. The primary aim of the study was to assess the correlation between the duration of type 2 diabetes mellitus (T2DM) and the severity of coronary artery disease (CAD) in patients undergoing elective coronary angiography. The study design was chosen to provide a snapshot of the relationship between diabetes duration and CAD severity, allowing for the evaluation of associations between these variables at a single point in time.

Setting: The study was conducted in the Cardiology Department of Hayatabad Medical Complex, a tertiary care hospital providing advanced cardiovascular care in Peshawar, Pakistan. The hospital has a dedicated cardiology unit where coronary angiography procedures are routinely performed by experienced interventional cardiologists. Data collection and patient recruitment were carried out in collaboration with the cardiology department's clinical team.

Participants: The study included patients between the ages of 40 and 70 years who were diagnosed with type 2 diabetes mellitus (T2DM) for at least five years. These patients were scheduled for elective coronary angiography to assess coronary artery disease (CAD). To ensure that the study reflected a real-world population, patients with comorbid conditions such as hypertension, dyslipidemia, and a history of smoking were included. However, certain exclusion criteria were applied. Patients with type 1 diabetes mellitus, known severe CAD who had previously undergone coronary artery bypass graft (CABG) surgery or stent placement, and those admitted with acute coronary syndrome (ACS) were excluded. Additionally, patients with significant non-cardiovascular comorbidities, such as severe renal impairment, defined as an estimated glomerular filtration rate (eGFR) of less than 30 mL/min/1.73 m^2, or chronic liver disease, were also excluded from the study.

Ethical Considerations: The study protocol was approved by the Ethical Review Committee of Hayatabad Medical Complex, Peshawar. Written informed consent was obtained from all participants prior to their enrollment in the study. Participants were fully informed of the purpose of the study, their right to withdraw at any time, and the confidentiality of their data. All patient data were anonymized before analysis to ensure privacy and confidentiality.

Variables: The primary variables of interest in this study included the duration of diabetes mellitus (DM), which was measured in years from the time of diagnosis, and the severity of coronary artery disease (CAD). The severity of CAD was assessed using the Gensini scoring system, which quantifies the degree of stenosis in coronary arteries. Additionally, potential confounding factors such as age, gender, hypertension, dyslipidemia, and smoking status were considered. These variables were included as covariates to assess their possible influence on the

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relationship between the duration of diabetes and the severity of CAD.

Data Sources/Measurement: Data were comprehensively collected from each patient using clinical interviews, physical examinations, and laboratory investigations. Demographic data, including age, gender, and smoking status (categorized as current, former, or never smoker), were recorded. Information about the patients' medical history, including the duration of diabetes, the presence of hypertension and dyslipidemia, and their current treatments for these conditions, was also gathered. Clinical measurements such as body mass index (BMI), blood pressure, and fasting blood glucose levels were obtained for each participant. Laboratory investigations were performed by collecting blood samples to measure glycosylated hemoglobin (HbA1c), which served as an indicator of long-term glycemic control. Lipid profiles, including total cholesterol, low-density lipoprotein (LDL), high-density lipoprotein (HDL), and triglycerides, were also measured. Additionally, renal function tests, including serum creatinine and eGFR, were conducted to assess kidney function.

Bias: Selection bias was minimized by recruiting all eligible patients consecutively, ensuring a representative sample of the study population. Confounding factors, such as age, hypertension, dyslipidemia, and smoking status, were carefully accounted for in the analysis to reduce potential confounding bias. Recall bias was minimized by corroborating patient-reported medical histories with clinical records.

Study Size: A total of 300 patients were recruited for the study. This sample size was determined based on a power calculation to detect a moderate correlation between the duration of diabetes and the severity of CAD, assuming a Pearson correlation coefficient of 0.3, with 80% power and a significance level of 0.05. The sample size also accounted for potential dropouts and missing data.

Quantitative Variables: The primary quantitative variables analyzed in this study were the duration of diabetes (in years) and the Gensini score (ranging from 0 to 200+), which reflects the severity of CAD. Other quantitative variables included age, BMI, HbA1c, lipid levels, and blood pressure. These were treated as continuous variables in the analysis.

Statistical Methods: The primary outcome of the study was to evaluate the correlation between the duration of diabetes and the severity of coronary artery disease (CAD), as measured by the Gensini score. Pearson's correlation coefficient was used to assess the strength and direction of this relationship. To control for potential confounders, a multiple linear regression analysis was conducted, adjusting for age, gender, hypertension, dyslipidemia, and smoking status. Beta coefficients and p-values were reported for each variable, with significance set at $p < 0.05$. Confounding factors such as hypertension and dyslipidemia were assessed through patient history, clinical examination, and laboratory results, with their control status considered in the analysis. Smoking status was categorized as current, former, or never smoker. Multicollinearity was tested using variance inflation factors (VIF), particularly between age and duration of diabetes, and addressed if necessary by adjusting the regression model. Several statistical assumptions were verified, including linearity (checked via scatterplots), independence (ensured through independent participant data), and homoscedasticity (assessed by plotting residuals against fitted values). Multicollinearity was examined, with VIF values above 5 indicating the need for model adjustment. All statistical analyses were conducted using SPSS version 26.0.

RESULTS

Participants: A total of 130 patients participated in this study, with an average age of 56.8 ± 7.5 years. Of these, 85 (65.4%) were male, reflecting a higher prevalence of coronary artery disease (CAD) among men in this sample. All participants had type 2 diabetes mellitus (T2DM) for a minimum of 5 years, with the mean duration of diabetes being 12.3 ± 5.4 years. The study population included a significant proportion of individuals with common cardiovascular risk factors: 102 patients (78.5%) had hypertension, and 98 (75.4%) were diagnosed with dyslipidemia. Smoking was another notable risk factor, with 40% of participants classified as current or former smokers. Additionally, the mean HbA1c level, a marker of long-term glycemic control, was 8.2 ± 1.4%, indicating that many participants had suboptimal diabetes management. The average body mass index (BMI) was 29.1 ± 4.3 kg/m², classifying the majority of patients as overweight or obese. Table 1 provides a detailed summary of the demographic and clinical characteristics of the study participants.

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Table 1: Demographic and Clinical Characteristics of Patients (N=130)

Characteristic	Mean ± SD or N (%)
Age (years)	56.8 ± 7.5
Gender (Male)	85 (65.4%)
Duration of Diabetes (years)	12.3 ± 5.4
Hypertension	102 (78.5%)
Dyslipidemia	98 (75.4%)
Smoking	52 (40%)
HbA1c (%)	8.2 ± 1.4
BMI (kg/m²)	29.1 ± 4.3

Descriptive Data: The primary variables of interest were the duration of diabetes and the severity of CAD, as measured by the Gensini score. The Gensini score quantifies the extent and severity of coronary artery stenosis, providing a numerical representation of CAD severity. The average Gensini score was calculated for different subgroups of patients based on the duration of diabetes to explore the relationship between diabetes duration and CAD progression.

In addition to the primary variables, other confounding factors such as age, gender, hypertension, dyslipidemia, and smoking status were considered in the analysis. These factors were included in the multiple linear regression model to adjust for potential confounding influences on the relationship between diabetes duration and CAD severity.

Table 2: Correlation between Duration of Diabetes and Gensini Score

Variable	Pearson's Correlation Coefficient (r)	P-value
Duration of Diabetes (years)	0.65	<0.001

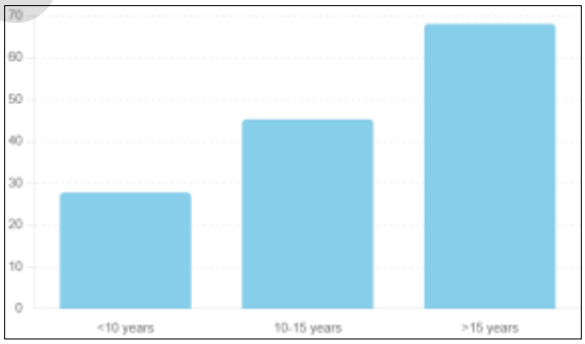
Outcome Data: The severity of CAD, assessed using the Gensini scoring system, demonstrated a clear positive correlation with the duration of diabetes. Pearson's correlation coefficient showed a significant positive association between the length of time a patient had diabetes and their Gensini score ($r = 0.65$, $p < 0.001$). This indicates that patients with a longer duration of diabetes tend to have more severe CAD. A scatter plot visually illustrates this relationship, depicting the trend of increasing CAD severity with prolonged diabetes exposure. Table 2 summarizes the correlation results, confirming that the duration of diabetes is a significant predictor of CAD severity.

Moreover, patients were categorized into three groups based on the duration of their diabetes: less than 10 years, 10-15 years, and more than 15 years. The mean Gensini scores for these groups showed a progressive increase in CAD severity with longer diabetes duration. Specifically, patients with less than 10 years of diabetes had an average Gensini score of 27.8 ± 12.4, those with 10-15 years had a score of 45.3 ± 15.6, and those with more than 15 years of diabetes had the highest score of 68.1 ± 20.3. This trend highlights the cumulative impact of prolonged diabetes on coronary artery health. Table 4 provides a detailed comparison of CAD severity by diabetes duration.

Table 3: Multiple Linear Regression Analysis of Factors Associated with Gensini Score

Variable	Coefficient (B)	Standard Error (SE)	P-value
Duration of Diabetes (years)	1.87	0.32	<0.001
Age (years)	0.21	0.14	0.13
Gender (Male)	5.34	3.12	0.09
Hypertension	7.85	2.78	0.01
Dyslipidemia	6.72	2.45	0.02
Smoking	4.89	2.67	0.06

Figure 1: Mean Gensini Score by Duration of Diabetes



Main Results

To further explore the factors influencing CAD severity, a multiple linear regression analysis was conducted, adjusting for potential confounders such as age, gender, hypertension, dyslipidemia, and smoking status. The results indicated that the duration of diabetes was a significant predictor of CAD severity, with a beta coefficient of 1.87 (SE = 0.32, $p < 0.001$). This suggests that for each additional year of diabetes, the Gensini score increased by an average of 1.87 points, even after controlling for other variables.

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Hypertension (β = 7.85, SE = 2.78, p = 0.01) and dyslipidemia (β = 6.72, SE = 2.45, p = 0.02) were also identified as significant predictors of CAD severity, indicating that patients with these conditions had higher Gensini scores, reflecting more severe CAD. In contrast, age (p = 0.13) and smoking status (p = 0.06) were not statistically significant predictors of CAD severity, although smoking showed a borderline significance. Gender (p = 0.09) also did not reach statistical significance. Table 3 provides a detailed breakdown of the multiple linear regression results, offering insights into the individual impact of each variable on CAD severity.

Table 4: Comparison of CAD Severity by Duration of Diabetes

Duration of Diabetes	Number of Patients	Mean Gensini Score ± SD
<10 years	45	27.8 ± 12.4
10-15 years	50	45.3 ± 15.6
>15 years	35	68.1 ± 20.3

DISCUSSION

The primary goal of this study was to explore the relationship between the duration of diabetes mellitus and the severity of coronary artery disease (CAD) in patients undergoing coronary angiography. Our findings reveal a significant positive correlation between diabetes duration and Gensini scores, indicating that longer diabetes duration is associated with more severe coronary artery involvement. This result corroborates earlier studies that consistently demonstrate how prolonged hyperglycemia accelerates atherosclerosis, leading to more severe CAD.

Notably, our study observed that patients with a diabetes duration exceeding 15 years had significantly higher Gensini scores compared to those with shorter diabetes durations. This aligns with previous research, including studies by Ul Amin et al. (2019) [1] and Shaikh et al. (2019) [2], which also reported a progressive increase in CAD severity with prolonged diabetes in different populations . Additionally, Sliema et al. (2023) [3] highlighted that poor glycemic control, especially in long-standing diabetes, is linked to more extensive coronary calcifications and severe obstructive lesions, further supporting the findings of our study . These consistent trends emphasize the chronic impact of diabetes on coronary artery health, especially in the context of suboptimal glycemic management [3].

However, the relationship between diabetes duration and CAD severity is multifaceted, involving other key factors. Our study found that hypertension and dyslipidemia were also significant predictors of CAD severity, underscoring the need for a comprehensive approach to managing cardiovascular risk in diabetic patients. These comorbid conditions likely compound the effects of prolonged diabetes on coronary arteries, as previously indicated by studies that identified hypertension and dyslipidemia as major contributors to atherosclerotic burden in diabetic populations [11, 12]. Therefore, addressing not only hyperglycemia but also hypertension and lipid abnormalities is critical for preventing the progression of CAD in patients with diabetes [13].

Although our study controlled for potential confounding factors such as age, gender, hypertension, dyslipidemia, and smoking status, it is important to acknowledge the complexity of interactions between these variables. For example, the absence of a significant association between age and Gensini scores in the multiple linear regression analysis could be partially attributed to multicollinearity between age and diabetes duration. We carefully assessed variance inflation factors (VIFs) to minimize the potential impact of multicollinearity, ensuring that our findings were robust. Nonetheless, future studies may benefit from employing larger sample sizes or advanced statistical techniques to better account for these interactions.

Recent advancements in the field have introduced additional biomarkers and imaging modalities that could enhance the understanding of CAD in diabetic patients. For example, biomarkers like high-sensitivity C-reactive protein (hs-CRP) have been shown to be reliable indicators of systemic inflammation and CAD severity in diabetic individuals. Similarly, coronary computed tomography angiography (CCTA) has proven to be an effective non-invasive tool for assessing coronary artery stenosis, especially in patients with diabetes. Moreover, the exploration of epicardial adipose tissue (EAT) as a novel marker of CAD severity suggests that metabolic factors beyond traditional risk factors play a crucial role in the progression of atherosclerosis in diabetic patients. Integrating these newer markers into clinical practice may provide a

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more nuanced and individualized approach to CAD risk stratification and management.

Despite the strengths of this study, including the detailed assessment of CAD severity using the Gensini scoring system, several limitations must be considered. The cross-sectional design limits the ability to establish a cause-and-effect relationship between diabetes duration and CAD severity. Furthermore, the study was conducted at a single tertiary care center, which may limit the generalizability of the findings to broader populations. Future research should aim to conduct longitudinal, multicenter studies to confirm the results and investigate the causal mechanisms that underlie the association between diabetes duration and CAD severity.

Limitations

Several limitations of this study should be acknowledged. First, the cross-sectional design precludes establishing a causal relationship between diabetes duration and CAD severity. Longitudinal studies would be more suitable to determine how diabetes progression directly influences CAD over time. Second, the study was conducted at a single tertiary care center, which may limit the generalizability of the findings to other populations or healthcare settings. Additionally, while we controlled for key confounders such as age, hypertension, and dyslipidemia, other unmeasured factors, such as lifestyle habits or genetic predispositions, may also influence the severity of CAD. Future research should involve multicenter trials with larger, more diverse populations to validate our findings and provide a more comprehensive understanding of the relationship between diabetes and CAD.

CONCLUSION

This study confirms a significant positive correlation between the duration of diabetes mellitus and the severity of coronary artery disease (CAD), demonstrating that patients with prolonged diabetes are at heightened risk for more severe coronary artery involvement. These findings highlight the critical need for early and aggressive management of diabetes, along with associated cardiovascular risk factors like hypertension and dyslipidemia, to slow the progression of CAD. The integration of novel biomarkers, such as high-sensitivity C-reactive protein (hs-CRP), and advanced imaging techniques, like coronary computed tomography angiography (CCTA), into clinical practice could improve risk stratification and enable more personalized treatment strategies. These tools offer a more comprehensive assessment of cardiovascular risk, leading to tailored interventions that may improve long-term outcomes for diabetic patients.

AUTHORS' CONTRIBUTION

MIK, MN, MSDK, Ah, MRK, and MHO: Concept and design, data acquisition, interpretation, drafting, final approval, and agree to be accountable for all aspects of the work. MIK, MN, MSDK, Ah, MRK, and MHO: Data acquisition, interpretation, drafting, final approval and agree to be accountable for all aspects of the work.

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REFERENCES

1. Amin RU, Ahmedani MA, Karim M, Raheem A. Correlation between Gensini Score and Duration of Diabetes in Patients Undergoing Coronary Angiography. Cureus. 2019;11(2):e4010.
2. Shaikh GA, Shaikh SA, Khan W, Karim M. Correlation between duration of diabetes and severity of coronary artery disease. Pakistan Hear J. 2019;52:69-74.
3. Sliema SS, Mohamed YG, Rayan MM. Impact of diabetes duration and control on the extent and severity of coronary artery disease in egyptian patients: evaluation by coronary CT angiography. QJM An Int J Med. 2023;116.
4. Yaseen RI, Beda MY, Ibrahim FA. Correlation between severity of coronary artery disease and insulin resistance in diabetic patients. Egypt J Hosp Med. 2021;84:2084-9.
5. Muhammed A, Zaki MT, Elserafy AS, Amin SA. Correlation between prediabetes and coronary artery disease severity in patients undergoing elective coronary angiography. Egypt Hear J. 2019;71:34.
6. Narzary KC, Boro SK, Das NK. Impact of Duration of Disease and Glycosylated Haemoglobin Level in Determining the Severity of Coronary Artery Disease in Patients with Type-2 Diabetes Mellitus: A Prospective, Cross-sectional, Observational Study. Clin Diagn Res. 2022;16(6):39.
7. Pathak SR, Gajurel RM, Poudel CM, Shrestha H, Thapa S, Thapa S, et al. Angiographic severity of coronary artery disease in diabetic and non-diabetic acute stemi patients in a tertiary care centre of Nepal. Kathmandu Univ Med J. 2021;19:410-4.
8. Gedebjerg A, Bjerre M, Kjaergaard AD, Nielsen JS, Rungby J, Brandslund I, et al. CRP, C-peptide, and risk of first-time cardiovascular events and mortality in early type 2 diabetes: a Danish cohort study. Diabetes Care. 2023;46:1037-45.
9. Abdelrahman KM, Chen MY, Dey AK, Virmani R, Finn AV, Khamis RY, et al. Coronary computed tomography angiography from clinical uses to emerging technologies: JACC state-of-the-art review. J Am Coll Cardiol 2020;76:1226-43.
10. Huang J, Gu J-X, Bao H-Z, Li S-S, Yao X-Q, Yang M, et al. Elevated serum small dense low-density lipoprotein cholesterol may increase the risk and severity of coronary heart disease and predict cardiovascular events in patients with type 2 diabetes mellitus. Dis Markers 2021;2021:1-8.
11. Zhou H-T, Zhao D-L, Wang G-K, Wang T-Z, Liang H-W, Zhang J-L. Assessment of high sensitivity C-reactive protein and coronary

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plaque characteristics by computed tomography in patients with and without diabetes mellitus. BMC Cardiovasc Disord. 2020;20:435.

12. Conte E, Andreini D, Magnoni M, Masson S, Mushtaq S, Berti S, et al. Association of high-risk coronary atherosclerosis at ccta with clinical and circulating biomarkers: insight from CAPIRE study. J Cardiovasc Comput Tomogr. 2021;15:73-80.

13. Pouraliakbar H, Abouie A, Ziaeifar E, Rakhshankhah N, Shabestari AA, Rabiei P, et al. Determinants of perivascular adipose tissue stranding as a novel imaging marker and its relation to inflammatory biomarker high-sensitivity c-reactive protein. Polish J Radiol. 2023;88:141-8.

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