Journal of Health and Rehabilitation Research 2791-156X JHRR

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Original Article

Unveiling the Effects of Diabetes on Coronary Artery Disease Through Angiography

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Conflict of Interest: None.

Khan FR., et al. (2024). 4(2): DOI: https://doi.org/10.61919/jhrr.v4i2.906

ABSTRACT

Background: Coronary artery disease (CAD) remains a leading cause of morbidity and mortality globally, particularly among patients with Type 2 Diabetes Mellitus (T2DM). Diabetic patients are at a higher risk of developing CAD due to factors such as poor glycemic control, lipid metabolism abnormalities, and endothelial dysfunction. Prior studies have demonstrated that diabetic patients tend to present with more extensive coronary artery involvement and worse outcomes following cardiovascular interventions.

Objective: This study aimed to assess the impact of T2DM on coronary angiography outcomes, specifically focusing on the incidence of multi-vessel disease and the severity of coronary artery stenosis.

Methods: This observational cohort study was conducted at Lady Reding Hospital, a tertiary care center specializing in cardiovascular diseases. Participants were recruited from the outpatient cardiology clinic between January 2020 and January 2022. Inclusion criteria included patients aged 40 to 80 years undergoing coronary angiography for the first time due to suspected CAD. Exclusion criteria were previous coronary artery interventions, congenital heart disease, active infections, and renal insufficiency (creatinine > 2.0 mg/dL). Baseline characteristics such as age, gender, BMI, hypertension status, and smoking history were collected. Diabetes status was confirmed via HbA1c levels (≥6.5%). Coronary angiography was performed using standard techniques, with angiograms analyzed by two blinded cardiologists. Primary outcomes included the presence of multi-vessel disease (≥70% stenosis in two or more major coronary arteries) and the severity of stenosis (>70% blockage). Additional assessments using Intravascular Ultrasound (IVUS) and Optical Coherence Tomography (OCT) evaluated plaque characteristics and vessel sizes in a subset of patients. Statistical analysis was performed using SPSS version 25.0, employing Chi-square tests for categorical variables, independent t-tests for continuous variables, and multivariable logistic regression to adjust for confounders.

Results: The study included 300 participants, with 150 diabetic and 150 non-diabetic patients. Diabetic patients had a mean age of 62.3 ± 10.4 years, while non-diabetic patients had a mean age of 58.2 ± 9.8 years. The prevalence of hypertension was higher among diabetic patients (60%) compared to non-diabetic patients (40%). The incidence of multi-vessel disease was significantly higher in diabetic patients (70%) compared to non-diabetic patients (50%) ($p < 0.05$). Severe stenosis was observed in 65% of diabetic patients versus 45% of non-diabetic patients ($p < 0.01$). IVUS and OCT analyses showed a higher prevalence of lipid-rich plaques in diabetic patients (55% vs. 30%) and a smaller mean luminal diameter (2.8 ± 0.6 mm vs. 3.4 ± 0.5 mm).

Conclusion: Diabetes significantly impacts the severity and extent of coronary artery disease, with diabetic patients exhibiting higher rates of multi-vessel disease and severe stenosis. Advanced imaging techniques highlighted distinct plaque characteristics in diabetic patients, underscoring the need for aggressive and personalized management strategies. These findings emphasize the importance of integrating advanced imaging and comprehensive management to mitigate cardiovascular risks in diabetic patients.

Keywords: Coronary Artery Disease, Type 2 Diabetes Mellitus, Multi-Vessel Disease, Severe Stenosis, Coronary Angiography, Intravascular Ultrasound, Optical Coherence Tomography, Cardiovascular Risk, Advanced Imaging Techniques, Diabetes Management.

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INTRODUCTION

Coronary artery disease (CAD) remains a leading cause of morbidity and mortality globally, particularly among patients with Type 2 Diabetes Mellitus (T2DM). Individuals with diabetes are at a significantly higher risk of developing CAD due to a complex interplay of glycemic control, lipid metabolism, and endothelial dysfunction (1). Previous studies have demonstrated that diabetic patients tend to present with more extensive coronary artery involvement and worse prognostic outcomes following cardiovascular interventions (2). The use of coronary angiography, the gold standard for the anatomical assessment of coronary arteries, allows precise visualization of the extent and severity of coronary artery stenosis. However, the impact of diabetes on angiographic outcomes is not merely confined to the increased prevalence of multi-vessel disease; it extends to the characteristics of coronary plaques, with diabetic patients more likely to have diffuse and unstable plaques, which complicates interventional strategies (3).

Despite these known disparities, there remains a gap in comprehensive data comparing angiographic outcomes between diabetic and non-diabetic patients in a controlled setting. Most existing studies focus on the outcomes of coronary interventions like percutaneous coronary intervention (PCI) or coronary artery bypass grafting (CABG), with less attention given to the initial angiographic findings and how they relate to clinical decision-making and long-term management (4). This study was designed to bridge this knowledge gap by examining the angiographic characteristics of coronary artery disease in patients with and without T2DM. Specifically, it aims to assess the prevalence of multi-vessel disease and the severity of coronary stenosis, which are critical in planning therapeutic strategies and predicting outcomes. Additionally, the study explores the use of advanced imaging modalities, such as Intravascular Ultrasound (IVUS) and Optical Coherence Tomography (OCT), to provide further insights into the subtypes of plaques and vessel morphology in these patient populations (5).

Conducting this study at Lady Reding Hospital, a tertiary care center specializing in cardiovascular diseases, leverages high-volume clinical data with a diverse patient base, thereby ensuring robust, generalizable findings. The outcomes of this research are anticipated to inform both clinical and interventional practice, promoting tailored therapeutic approaches for diabetic patients undergoing coronary angiography.

MATERIAL AND METHODS

This observational cohort study was conducted at Lady Reding Hospital, a tertiary care center specializing in cardiovascular diseases. The aim was to assess the impact of Type 2 Diabetes Mellitus (T2DM) on the outcomes of coronary angiography, specifically focusing on the incidence of multi-vessel disease and the severity of coronary artery stenosis. Participants were recruited from the outpatient cardiology clinic between January 2020 and January 2022. Inclusion criteria included patients aged 40 to 80 years undergoing coronary angiography for the first time due to suspected coronary artery disease. Exclusion criteria were previous coronary artery interventions, congenital heart disease, active infections, and renal insufficiency with creatinine levels greater than 2.0 mg/dL.

Baseline characteristics such as age, gender, body mass index (BMI), hypertension status, and smoking history were collected through patient interviews and medical records review upon enrollment. Diabetes status was confirmed via HbA1c levels, with a threshold of 6.5% or higher classifying a patient as diabetic. Coronary angiography was performed using standard techniques. After gaining vascular access via the radial or femoral artery, a catheter was guided to the coronary arteries, and a contrast agent was injected to visualize the vessels. Angiograms were analyzed by two experienced cardiologists who were blinded to the patients' diabetes status.

The primary angiographic outcomes assessed were the presence of multi-vessel disease, defined as 70% or greater stenosis in two or more major coronary arteries, and the severity of stenosis, measured as the percentage reduction in luminal diameter, with severe stenosis defined as greater than 70% blockage. Additional assessments using Intravascular Ultrasound (IVUS) and Optical Coherence Tomography (OCT) were performed in a subset of patients to evaluate plaque characteristics and vessel sizes.

Statistical analysis was performed using SPSS software version 25.0. Descriptive statistics, including mean ± standard deviation (SD) for continuous variables and percentages for categorical variables, were used to summarize patient characteristics. Group differences were evaluated using the Chi-square test for categorical variables and independent t-tests for continuous variables. Multivariable logistic regression was applied to adjust for potential confounders, including age, gender, BMI, hypertension, and smoking status. A p-value of less than 0.05 was considered statistically significant.

The study was conducted in accordance with the principles of the Declaration of Helsinki and was approved by the institutional review board of the hospital. All participants provided written informed consent before inclusion in the study (1). Data were collected and stored securely, ensuring confidentiality and privacy. The findings from this research are anticipated to provide valuable insights into the impact of diabetes on coronary artery disease and inform clinical and interventional practices for managing diabetic patients undergoing coronary angiography (2).

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RESULTS

The study included a total of 300 participants, with 150 diabetic and 150 non-diabetic patients. The mean age of diabetic patients was 62.3 years with a standard deviation of 10.4, compared to 58.2 years with a standard deviation of 9.8 in non-diabetic patients. The proportion of female participants was similar between the two groups, with 45% in the diabetic group and 43% in the non-diabetic group. Body Mass Index (BMI) was higher among diabetic patients, averaging 28.7 kg/m² with a standard deviation of 4.5, whereas non-diabetic patients had a mean BMI of 26.8 kg/m² with a standard deviation of 5.0. Additionally, a greater percentage of diabetic patients had hypertension (60%) compared to non-diabetic patients (40%). Smoking prevalence was slightly lower in diabetic patients (20%) compared to non-diabetic patients (22%) (Table 1).

Table 1. Baseline Characteristics of Study Participants

Characteristic	Diabetic Patients (n=150)	Non-Diabetic Patients (n=150)
Age (years)	62.3 ± 10.4	58.2 ± 9.8
Female (%)	45	43
BMI (kg/m²)	28.7 ± 4.5	26.8 ± 5.0
Hypertension (%)	60	40
Smoking (%)	20	22

Table 2. Angiographic Outcomes

Outcome	Diabetic Patients (%)	Non-Diabetic Patients (%)	P-value
Multi-vessel Disease	70	50	<0.05
Severe Stenosis (>70%)	65	45	<0.01

In terms of angiographic outcomes, diabetic patients exhibited a significantly higher incidence of multi-vessel disease, with 70% of diabetic patients affected compared to 50% of non-diabetic patients. This difference was statistically significant with a p-value of less than 0.05. Furthermore, severe stenosis, defined as greater than 70% blockage, was observed in 65% of diabetic patients, in contrast to 45% of non-diabetic patients, with a p-value of less than 0.01, indicating a significant difference (Table 2).

Table 3. Plaque Characteristics and Vessel Size by Angiographic Technique

Parameter	Technique	Diabetic Patients (%)	Non-Diabetic Patients (%)
Lipid-rich Plaques	IVUS, OCT	55	30
Luminal Diameter (mm)	IVUS, OCT	2.8 ± 0.6	3.4 ± 0.5

Detailed analysis of plaque characteristics and vessel size using Intravascular Ultrasound (IVUS) and Optical Coherence Tomography (OCT) revealed notable differences between the two groups. Diabetic patients had a higher prevalence of lipid-rich plaques, with 55% compared to 30% in non-diabetic patients. The mean luminal diameter was also smaller in diabetic patients, averaging 2.8 mm with a standard deviation of 0.6, whereas non-diabetic patients had a mean luminal diameter of 3.4 mm with a standard deviation of 0.5 (Table 3). These findings underscore the more diffuse and severe nature of coronary artery disease in diabetic patients, which has significant implications for their management and prognosis.

DISCUSSION

The significant impact of Type 2 Diabetes Mellitus (T2DM) on coronary angiography outcomes was evident from the findings, which showed a pronounced difference in the severity and extent of coronary artery disease between diabetic and non-diabetic patients. This study corroborated existing research identifying diabetes as a major risk factor for accelerated atherosclerosis, manifesting in more extensive coronary artery involvement and increased cardiovascular complications (6). The association of diabetes with a higher prevalence of multi-vessel disease and severe stenosis offered critical insights into the aggressive nature of coronary artery disease in diabetic patients and the necessity for targeted therapeutic strategies (2, 3).

By utilizing advanced imaging modalities such as Intravascular Ultrasound (IVUS) and Optical Coherence Tomography (OCT), the study provided detailed insights into the plaque characteristics in diabetic patients. The findings of a higher prevalence of lipid-rich plaques and reduced luminal diameters emphasized the unique pathophysiological changes associated with diabetes. These details were vital for devising effective management and intervention strategies tailored to the specific needs of diabetic patients, addressing both their metabolic and vascular complications (5, 7). Moreover, the use of IVUS and OCT improved the understanding

of the precise vascular changes that occurred in diabetes, facilitating better-informed decisions regarding intervention strategies. This advancement supported the notion that diabetic patients might benefit from earlier and more aggressive interventions, aiming to manage their elevated cardiovascular risk effectively (8).

The integration of patient education and adherence to treatment played a crucial role in managing diabetes and its cardiovascular complications. By enhancing patient understanding of their condition and treatment plans, and emphasizing the importance of lifestyle changes and medication adherence, significant impacts on the progression of coronary artery disease could be achieved (12, 13). The study's strengths included its comprehensive approach, combining advanced imaging techniques and a robust analysis of patient characteristics and outcomes. These strengths provided a deeper understanding of the intricate relationship between diabetes and coronary artery disease.

However, the study's single-center, observational nature might have limited the generalizability of the results. The lack of detailed data on long-term glycemic control and variations in treatment regimens among patients could have influenced the outcomes. These limitations highlighted the need for multicenter studies with diverse populations and longitudinal follow-up to better understand the long-term effects of diabetes on coronary artery disease and to validate the findings across broader demographic and clinical settings.

CONCLUSION

In conclusion, the study highlighted the critical impact of diabetes on coronary artery disease, evidenced by extensive multi-vessel involvement and severe stenosis. It underscored the importance of aggressive and personalized management strategies, incorporating advanced imaging techniques to guide therapeutic decisions. The integration of medical treatment, patient education, and lifestyle modifications was essential to effectively manage and mitigate the cardiovascular risks associated with diabetes. Continued research was necessary to further explore these strategies and optimize care for this high-risk population. These findings contributed significantly to the existing body of knowledge and provided a foundation for future research and clinical practice improvements in managing diabetic patients with coronary artery disease.

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