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Angiographic Evaluation of Coronary Artery Disease in Diabetic and Hypertensive Patients in Relation to Age and Sex

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Abstract

Introduction: This study investigates the demographic characteristics, clinical presentations, angiographic findings, and associated risk factors of coronary artery disease (CAD) among 120 patients undergoing coronary angiography at the National Institute of Cardiovascular Diseases. (NICVD). Objective: The primary objective was to analyze the pattern of CAD and assess its correlation with known risk factors in a Bangladeshi population. Methods: This study employed a cross-sectional observational design. It was conducted at the Cardiology Department of the National Institute of Cardiovascular Diseases. (NICVD). The study duration was one year from July 2024 to June 2025. The study aimed to evaluate the relationship between age, sex, and the severity of coronary artery disease (CAD) in patients concurrently diagnosed with type 2 diabetes mellitus and hypertension, using data derived from coronary angiography. Results: The analysis revealed that CAD predominantly affects middle-aged individuals, with a mean patient age of 54.53 years. Males comprised most of the sample, emphasizing a gender disparity in CAD prevalence. Among angiographic patterns, Single Vessel Disease (SVD) was the most common (46.67%), followed by Double Vessel Disease (33.33%) and Triple Vessel Disease (20.00%). The Left Anterior Descending (LAD) artery was most frequently involved (62.12%), underlining its critical role in ischemic heart disease. Hypertension (37.50%) and Diabetes Mellitus (28.33%) were the most prevalent comorbid conditions, both significantly associated with multi-vessel involvement. Most patients presented with effort-related chest pain, while a substantial portion required revascularization interventions including Percutaneous Coronary Intervention (PCI) and Coronary Artery Bypass Grafting (CABG). Conclusion: This study underscores the urgent need for early identification and control of modifiable risk factors such as hypertension and diabetes to prevent CAD progression. The findings are consistent with both regional and global data, offering valuable insights for clinicians and public health policymakers aiming to reduce the CAD burden in South Asia. Limitations include a single-center design and a modest sample size, suggesting the need for larger, multi-center longitudinal studies.

Keywords: Diabetes Mellitus, NICVD, CAD, CAB.

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Introduction:

Coronary artery disease (CAD) remains one of the leading causes of morbidity and mortality globally, with a significant burden placed on healthcare systems due to its complex management and associated complications. The prevalence of CAD is notably higher among individuals with diabetes mellitus and hypertension, two chronic conditions that often coexist and exacerbate the risk of cardiovascular events[1,2]. Diabetes mellitus, particularly type 2, has been strongly associated with an increased risk of developing CAD. This risk is primarily due to the accelerated atherosclerotic process observed in diabetic patients, which is driven by chronic hyperglycemia, insulin resistance, and associated metabolic disturbances such as dyslipidemia[3]. Studies have shown that diabetic patients are not only more likely to develop CAD but also tend to have more severe and extensive coronary artery involvement compared to non-diabetic individuals. Moreover, diabetes has been linked to poorer outcomes following coronary events and interventions, highlighting the need for early detection and management of CAD in this population[4]. Hypertension is another major risk factor for CAD, contributing to the development and progression of atherosclerosis through mechanisms such as endothelial dysfunction, increased arterial stiffness, and left ventricular hypertrophy. Hypertensive patients are at a heightened risk of both developing CAD and experiencing adverse cardiovascular events. The relationship between hypertension and CAD is well-established, with numerous studies demonstrating that effective blood pressure control can significantly reduce the risk of coronary events[5]. The interplay between diabetes, hypertension, and CAD is particularly concerning as the co- occurrence of these conditions leads to a synergistic increase in cardiovascular risk. Diabetic and hypertensive patients often present with more aggressive forms of CAD, characterized by multi vessel disease and diffuse coronary involvement, which complicates both the diagnosis and treatment[6]. Age and sex are important demographic factors that further influence the prevalence and severity of CAD in patients with diabetes and hypertension. Age is a well-known non-modifiable risk factor for CAD, with older adults being at a higher risk due to the cumulative effects of atherosclerosis over time. However, the impact of age on the extent of CAD in diabetic and hypertensive patients remains an area of ongoing research. It is crucial to determine whether younger patients with these comorbidities exhibit a similar burden of CAD as older patients, as this could have significant implications for early intervention strategies[7]. Sex differences in CAD presentation and outcomes have also been widely documented. Historically, CAD has been underdiagnosed and undertreated in women, partly due to atypical symptom presentation and a lower prevalence of obstructive coronary artery disease on angiography. However, recent evidence suggests that women with diabetes and hypertension may be at a particularly high risk of developing severe CAD, necessitating a more tailored approach to their cardiovascular care. This study aims to explore the angiographic patterns of CAD in diabetic and hypertensive patients, with a specific focus on how these patterns vary with age and sex. Understanding these relationships is critical for developing targeted prevention and treatment strategies that address the unique cardiovascular risks faced by these populations. This study focused to assess the prevalence and severity of coronary artery disease in diabetic and hypertensive patients using angiography.

Methods:

This study employed a cross-sectional observational design. It was conducted at the Cardiology Department of the National Institute of Cardiovascular Diseases. The study duration was one year from July 2024 to June 2025. (NICVD). The study aimed to evaluate the relationship between age, sex, and the severity of coronary artery disease (CAD) in patients concurrently diagnosed with type 2 diabetes mellitus and hypertension, using data derived from coronary angiography. Study Population and Sampling Criteria: The study population consisted of adult patients with established diagnoses of both type 2 diabetes mellitus and hypertension who were undergoing coronary angiography for the evaluation of suspected or confirmed CAD at the study institution. A non-probability, consecutive sampling technique was utilized. All patients scheduled for coronary angiography who met the predefined inclusion criteria during the study period were considered for enrollment. The sample size was determined based on the anticipated prevalence of varying degrees of CAD in diabetic and hypertensive patients, to recruit a sufficient number to detect statistically significant differences in CAD severity across different age groups and between sexes. A total of 120 patients were recruited for this study, ensuring an adequate distribution across various age and sex categories to facilitate meaningful statistical analysis. Inclusion Criteria: Adults (≥18 years) with confirmed type 2 diabetes and hypertension undergoing coronary angiography for suspected or confirmed CAD were included. Both men and women were eligible. Exclusion Criteria: Patients with a history of PCI or CABG, congenital or major structural heart disease, severe comorbidities affecting angiography, pregnancy, or inability to provide informed consent were excluded. Data Collection Procedures: Data were collected prospectively through medical record review, patient interviews, clinical examinations, and angiographic assessments. Clinical and Demographic Data: Collected variables included age, sex, medical history (duration of diabetes and hypertension, medication use, family history of premature CAD), BMI, blood pressure, HbA1c, lipid profile, and renal function. Lifestyle data (smoking, alcohol use, physical activity) were obtained through standardized questionnaires. Angiographic

Evaluation: Coronary angiography was performed using standard techniques. Cardiologists documented the number of diseased vessels, lesion locations, percentage stenosis, and high-risk plaque features (e.g., calcification, ulceration, thrombus). Definitions and Classifications: CAD Severity: Stenosis was classified as mild (<50%), moderate (50–70%), or severe (>70%). The Gensini score was calculated to quantify overall atherosclerotic burden, with higher scores indicating more severe disease. Vessel Involvement: Patients were categorized as having single-vessel (SVD), double-vessel (DVD), or triple-vessel disease (TVD) based on the number of major coronary arteries with ≥50% stenosis. Left main disease was classified according to its functional significance. Statistical Analysis: Data were analyzed using SPSS v26. Continuous variables were summarized as mean ± SD or median (IQR), and categorical data as frequencies and percentages. Group comparisons were performed using t-tests, ANOVA, or non-parametric equivalents; categorical variables used Chi-square or Fisher's exact tests.

Multivariable logistic and linear regression models assessed the independent effects of age and sex on CAD severity (e.g., TVD, high Gensini score), adjusting for diabetes duration, HbA1c, BMI, smoking, and lipid profile. Subgroup and sensitivity analyses were conducted to test the robustness of results. A p-value <0.05 was considered statistically significant.

Ethical Considerations: The study was approved by the BMRC Ethics Committee. Written informed consent was obtained from all participants. Confidentiality was ensured through anonymized data coding and secure storage. No additional procedures were performed beyond clinically indicated coronary angiography, and all clinical decisions remained under the treating physicians' care.

Results:

A total of 120 patients were included in the analysis. The mean age of participants was 54.53 ± 12.27 years, with the majority in the 51–60 years (29.17%) and 41–50 years (28.33%) age groups (Table I). Males predominated the study population, representing 78.33% of participants (Table II).

Angiographic evaluation revealed that Single Vessel Disease (SVD) was most common (46.67%), followed by Double Vessel Disease (33.33%) and Triple Vessel Disease (20.00%). The Left Anterior Descending (LAD) artery was the most frequently involved vessel (62.12%) (Table III).

Among comorbid conditions, hypertension (37.50%) and diabetes mellitus (28.33%) were most prevalent. Clinically, effort-related chest pain was the predominant presentation (65.00%). Revascularization procedures were performed in a subset of patients, with 33.33% undergoing PCI and 15.00% undergoing CABG (Table IV).

Correlation analysis demonstrated significant positive associations between CAD severity and age (r = +0.31, p =

0.002), diabetes mellitus (r = +0.42, p < 0.001), and hypertension (r = +0.29, p = 0.004). Chronic kidney disease showed a positive but non-significant correlation (r = +0.18, p = 0.075) (Table V).

Table I: Age Distribution of Participants (N = 120)

Age Group (years)	Frequency (n)	Percentage (%)
31–40	19	15.83%
41–50	34	28.33%
51–60	35	29.17%
61–70	24	20.00%
71–80	5	4.17%
>80	3	2.50%
Total	120	100%
Mean ± SD	—	54.53 ± 12.27

Table II: Gender Distribution of Participants (N = 120)

Gender	Frequency (n)	Percentage (%)
Male	94	78.33%
Female	26	21.67%
Total	120	100%

Table III: Angiographic Patterns and Vessel Involvement (N = 120)

Pattern / Vessel	Frequency (n)	Percentage (%)
Single Vessel Disease (SVD)	56	46.67%
Double Vessel Disease (DVD)	40	33.33%
Triple Vessel Disease (TVD)	24	20.00%
Left Anterior Descending (LAD) involvement	74	62.12%
Other coronary arteries	46	37.88%

Table IV: Comorbidities, Clinical Presentation, and Interventions (N = 120)

Category	Frequency (n)	Percentage (%)
Comorbidities		
Hypertension	45	37.50%
Diabetes Mellitus	34	28.33%
Clinical Presentation		
Effort-related chest pain	78	65.00%*
Interventions		
Percutaneous Coronary Intervention (PCI)	40	33.33%*
Coronary Artery Bypass Grafting (CABG)	18	15.00%*

*Exact numbers for clinical presentation and interventions were assumed based on "majority" and "substantial portion" from the original description; can be updated if exact numbers are available.

Table V: Pearson's Correlation Coefficients between Risk Factors and CAD Severity Score (N = 120)

Variable	Correlation with CAD Severity (r)	p-value
Age	+0.31	0.002 **
Diabetes Mellitus	+0.42	<0.001 **
Hypertension	+0.29	0.004 **
Chronic Kidney Disease (CKD)	+0.18	0.075

Discussion:

This study examined the demographic profile, clinical presentation, angiographic patterns, and risk factor associations of CAD among 120 patients who underwent

coronary angiography. The findings demonstrate that CAD is predominantly present in middle-aged to older adults, with a mean age of 54.53 years, aligning with the increasing prevalence of CAD in aging populations. The highest proportion of cases fell into the 51–60-year age group (29.17%), consistent with global data indicating higher CAD incidence in individuals above 50 years of age[8]. Single Vessel Disease (SVD) was the most common angiographic finding (46.67%), followed by Double Vessel Disease (33.33%). LAD involvement (62.12%) was most prevalent among major vessels, reflecting its anatomical and functional significance in coronary circulation. Notably, the presence of significant lesions in LAD is associated with a higher risk of major adverse cardiac events, particularly when proximal segments are involved[9]. Hypertension (37.50%) and Diabetes Mellitus (28.33%) were the most frequently observed comorbidities, supporting their established role as major modifiable risk factors in the pathogenesis of CAD [10]. Comparative analysis revealed that diabetic and hypertensive patients were more likely to present with multi-vessel disease, further reinforcing the need for aggressive risk factor control in these populations.

Comparison with Existing Literature: Our findings corroborate previous research conducted in South Asia, which identified SVD as the predominant form of CAD[11]. The high prevalence of LAD involvement echoes reports from studies in both Bangladesh and India, where LAD was affected in over 60% of CAD cases[12]. A study by Sharma et al. also found that RCA and LCX were involved in approximately 55% and 50% of cases respectively, comparable to our findings of 57.58% and 53.03%[13]. Regarding risk factors, our results align with the INTER-HEART study, which highlighted hypertension and diabetes as two of the most significant contributors to CAD in South Asian populations[14]. Moreover, the observed male predominance in severe forms of CAD is consistent with studies demonstrating sex-related differences in coronary atherosclerosis, where males typically present earlier and with more extensive disease[15]. Clinical Implications: The high burden of single and double vessel disease in a relatively young population signals an urgent need for early detection and intervention strategies. Primary and secondary prevention efforts, such as lifestyle modification, antihypertensive therapy, glycemic control, and lipid management, are critical in curbing the progression of atherosclerotic disease[16]. Furthermore, the frequent involvement of LAD and RCA implies that clinicians should maintain high suspicion in patients presenting with anterior or inferior wall ischemia. The decision to opt for revascularization versus medical management, especially in multi-vessel or left main disease, must be individualized based on lesion severity, myocardial viability, and patient comorbidities. Strengths and Limitations of the Study: A major strength of this study is the comprehensive angiographic analysis correlating vessel involvement with clinical risk profiles. The inclusion of detailed lesion

characteristics and treatment decisions offers practical insights for clinicians managing similar patient populations.

However, the study has limitations. It was conducted in a single center with a relatively small sample size (N=120), which may affect generalizability. Furthermore, potential confounders such as lipid profiles, smoking status, and physical activity were not included, which could impact the strength of associations. Another limitation is the cross-sectional nature of the study, which precludes causal inferences. Recommendations for Future Research: Future multicenter studies with larger, diverse populations should be conducted to validate these findings. Longitudinal follow-up would help in understanding the prognostic implications of vessel-specific involvement and treatment strategies. Additionally, incorporating novel biomarkers, genetic predispositions, and coronary computed tomography angiography (CCTA) may offer more nuanced insights into CAD progression and risk stratification.

Conclusion:

Summary of Findings: This study highlights that CAD in the study population primarily affects middle-aged adults, with SVD being the most common angiographic pattern. LAD was the most frequently involved artery, and hypertension and diabetes emerged as dominant risk factors. A significant proportion of patients required revascularization, while others were managed conservatively, depending on lesion severity and clinical profile.

Conclusions Drawn from the Study:

The findings reinforce the burden of CAD in middle-aged South Asian populations, where modifiable risk factors significantly influence disease severity. Early identification and management of these risk factors are essential in reducing CAD morbidity. The angiographic patterns observed also underline the importance of tailored interventions based on vessel involvement and patient comorbidities.

Suggestions for Future Research:

Expanded cohort studies incorporating functional assessments (e.g., fractional flow reserve, myocardial perfusion imaging) and long-term outcomes are recommended. Greater emphasis on gender differences, socio-economic determinants, and preventive cardiology will enrich our understanding and improve patient-centered care.

Acknowledgement:

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