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RESEARCH ARTICLE

Coronary Angiographic Findings in Diabetic and Non-Diabetic Patients Diagnosed with Coronary Artery Disease in Cardiac Center, Kuwait University Hospital, Sana'a, Yemen

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Abstract

Introduction: Coronary artery disease (CAD) is a leading cause of mortality and morbidity worldwide. (1),(2) Also more common among DM, which may be the major cause of morbidity and mortality of DM in developing countries.

Purpose: This study aimed to evaluate the demographic characteristics, risk factors, echocardiographic findings, coronary angiography (CAG) results, and clinical outcomes of diabetic and non-diabetic patients undergoing coronary angiography in Kuwait University hospital in Sana'a , Yemen . Furthermore, it sought to identify predictors of multi-vessel disease and adverse outcomes in patients undergoing percutaneous coronary intervention (PCI).

Methods: A total of 107 patients undergoing coronary angiography were included in this study. Demographic data, risk factors, echocardiographic findings, and CAG results were collected. from May 2022 to October 2023 , Comparative analyses between diabetic (n=49) and non-diabetic patients (n=58) were performed to evaluate differences in coronary artery disease (CAD) severity, multi-vessel involvement, and clinical outcomes. Logistic regression analysis was conducted to identify predictors of multi-vessel disease.

Results: A total of 107 patients, the mean age of 56.15 ± 10.2 years, with 64.5% males. Chewing qat (65.4%) was the most prevalent risk factor, followed by diabetes mellitus (45.8%) and hypertension (40.2%). LAD involvement was most common, occurring in 72.0% of cases, with similar rates in both groups. RCA lesions were significantly more prevalent among diabetic patients (63.3%) compared to non-diabetics (43.1%, p=0.04). Although LCX involvement and three-vessel disease appeared more frequent in diabetic patients, the differences did not reach statistical significance. Diabetics were also more likely to have multi-vessel disease, while non-diabetics had a higher prevalence of single-vessel involvement (p=0.03).

Conclusion: The study confirmed that diabetic patients exhibited a substantially higher incidence of significant stenosis in major arteries, particularly in the LAD, compared to non-diabetic patients, highlighting the urgent need for targeted interventions in this population. These findings highlight the importance of tailored management strategies for diabetic patients with coronary artery disease to mitigate complications and improve outcomes.

Keywords: Coronary Artery Disease, Coronary Angiography, Diabetes Mellitus, Multi-Vessel Disease, Percutaneous Coronary Intervention, Predictors of Outcomes, Yemeni Population.

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1. Introduction

Coronary artery disease (CAD) is a leading cause of mortality worldwide, particularly among patients with diabetes mellitus (DM) [1] . Diabetic patients are at a heightened risk of developing CAD due to the accelerated progression of atherosclerosis, characterized by more diffuse and complex coronary lesions[2]. This progression is driven by factors such as hyperglycemia, dyslipidemia, insulin resistance, and chronic inflammation, which collectively contribute to endothelial dysfunction and plaque formation. [3,4] As a result, diabetic patients often experience CAD at an earlier age and with greater severity than non-diabetics (American Diabetes Association, 2019) [5] .CAD prevalence among individuals with diabetes has been estimated to be between 20% and 55%.[6]

Patients with DM have a significantly greater risk of developing cardiovascular disease (CVD) compared to patients without DM[7] and many remain asymptomatic.[8]

DM accelerates the process of atherogenesis through several mechanisms, such as anomalies in the lipoprotein concentration and composition, its association with hypertension, insulin resistance, and hyperinsulinemia, protein glycosylation in plasma and the arterial wall, lipid oxidation, a procoagulation and proinflammatory state, disturbed endothelial function. (9)

Coronary angiography (CAG) is considered the gold standard for diagnosing coronary artery disease. (Patel et al., 2012). [10]

Diabetic patients frequently present with more complex and severe coronary artery involvement, often requiring more aggressive interventions. Studies have shown that diabetics are more likely to have multi-vessel disease, smaller coronary arteries, and more frequent diffuse lesions, which may necessitate surgical interventions such as CABG rather than PCI. In contrast, non-diabetic patients may present with less severe disease and respond better to less invasive procedures.[11]

In Yemen, where both diabetes and CAD prevalence are rising, little is known about the specific coronary angiographic (CAG) findings in diabetic versus non-diabetic patients with CAD. Despite the clear association between diabetes and worse cardiovascular outcomes, no comprehensive studies have been conducted in the Yemeni population to compare the severity and extent of coronary artery lesions between these two groups.

2. Patient and Methods

This was a retrospective study conducted to compare coronary angiographic findings in diabetic and non-diabetic patients diagnosed with coronary artery disease in the Cardiac Center, Al- Kuwait University Hospital (KUH) from May 2022 to October 2023 in Sana'a, Yemen. The study was approved by the Joint Ethics Committee of the Faculty of Medicine and Health Sciences of Sana'a University Atotal of 107 patients with CAD undergo CAG , split into two groups: 49 diabetic and 58 non-diabetic

Data were extracted from electronic medical records using a standardized data collection form. The variables collected included.

2.1 Demographic Information

Age, sex.

2.2 Risk Factors

Diabetes mellitus, hypertension, smoking, dyslipidemia, family history of CAD, khat chewing, and shama (chewable tobacco) use.

2.3 Clinical History

Previous percutaneous coronary intervention (PCI), prior myocardial infarction (MI), and ischemic heart disease.

2.4 Coronary Angiography Findings

Presence and degree of stenosis in the left anterior descending (LAD), left circumflex (LCX), and right coronary artery (RCA). Significant stenosis was defined as ≥50% narrowing.

2.5 Multi-Vessel Disease

Defined as significant stenosis in two or more major coronary arteries.

2.6 Echocardiographic Findings

Ejection fraction (EF) and wall motion abnormalities, with EF <40% considered moderate to severe dysfunction.[12]

2.7 Coronary Angiography Analysis

Coronary angiograms were interpreted by experienced cardiologists who were blinded to the patients' diabetic status. The extent and severity of CAD were evaluated based on the degree of stenosis in major coronary vessels.

Significant Stenosis: Defined as ≥50% luminal narrowing.

Multi-Vessel Disease: Defined as the presence of significant stenosis in at least two coronary arteries.

Coronary Lesions: Lesions were further categorized based on their location (proximal, mid, or distal segments) in the LAD, LCX, and RCA.

2.8 Echocardiographic Evaluation

Transthoracic echocardiography was conducted on all participants to assess cardiac function. The primary parameters included.

Ejection Fraction (EF): EF <40% indicated moderate to severe left ventricular dysfunction.

Wall Motion Abnormalities: Presence of hypokinesis, akinesis, or dyskinesis in one or more segments

Analysis Data were analyzed using SPSS version 26.0. Descriptive statistics were calculated for demographic and clinical characteristics, including mean, standard deviation, and percentages. The following statistical tests were used.

Chi-Square Test: Used to analyze categorical variables (e.g., presence of risk factors and angiographic findings) between diabetic and non-diabetic groups.

Spearman's Rank Correlation: Applied to assess correlations between continuous and ordinal variables such as age, ejection fraction, and extent of stenosis.

Significance Threshold: A p-value<0.05 was considered statistically significant, with 95% confidence intervals reported for odds ratios in regression models.

3. Results

3.1 Demographic Characteristics

A total of 107 patients were included in the study. The mean age was 56.15 years (range: 32–77 years). Males made up 64.5% of the study population (n=69), while females comprised 38.5% (n=38). Among the patients, 45.8% were diagnosed with diabetes mellitus (n=49), and 54.2% were non-diabetic (n=58). The HbA1c levels were available for 31 diabetic patients, with a mean of 8.6 ± 2.0 (Table1, Figure 1).

Table 1. *Demographic Characteristics*

Variable	N (%)
Age (mean ± SD)	56.15 ± 10.2
Gender	
Male	69 (64.5%)
Female	38 (35.5%)
Diabetes milletus	
Yes	49
No	58
HbA1c (mean ±SD) (n=31)	8.6±2.0

Abbreviations: N, number of patients; SD, standard deviation.

Notes. *Data are presented as frequencies (N) and percentages (%) for categorical variables. The mean and standard deviation (SD) are presented for continuous variables.*

3.2 Risk Factors

Table 2 summarizes the distribution of various risk factors between diabetic and non-diabetic patients. Qat chewing was the most prevalent risk factor, observed in 61.2% of diabetic patients and 69.0% of non-diabetic patients, totaling 65.4% of the entire study population. Hypertension was the second most common risk factor, present in 44.9% of diabetic patients and 36.2% of non-diabetic patients. Smoking was also notable, affecting 22.4% of diabetic patients and 32.8% of non-diabetic patients. Ischemic heart disease (IHD) and previous PCI were more frequently observed among non-diabetic patients, with totals of 10.3% and 9.3%, respectively, across both groups. Less common risk factors included dyslipidemia, DCMP, Shamma use (smokeless tobacco) , and previous CAG, with total prevalence rates under 5% for eaPrevious Coronary Angiography (CAG)

Table 2. *Risk Factors*

Risk Factor	Diabetic n (%)	Non-Diabetic n (%)	Total n (%)
Qat Chewing	30 (61.2%)	40 (69.0%)	70 (65.4%)
Hypertension	22 (44.9%)	21 (36.2%)	43 (40.2%)
Smoking	11 (22.4%)	19 (32.8%)	30 (28.0%)
IHD	3 (6.1%)	8 (13.8%)	11 (10.3%)
Previous PCI	6 (12.2%)	4 (6.9%)	10 (9.3%)

Dyslipidemia	1 (2.0%)	4 (6.9%)	5 (4.7%)
DCMP	1 (2.0%)	3 (5.2%)	4 (3.7%)
Shamma Use	1 (2.0%)	2 (3.4%)	3 (2.8%)
Previous CAG	2 (4.1%)	1 (1.7%)	3 (2.8%)

Abbreviations: DM, diabetes mellitus; HTN, hypertension; IHD, ischemic heart disease; CAD, coronary artery disease; DCMP, dilated cardiomyopathy; CAG, coronary angiography; PCI, percutaneous coronary intervention.

Notes. *Data are presented as frequencies (N) and percentages (%) for categorical variables.*

Table 2.1 *Risk Factors*

Risk Factor	Diabetic (n)	Non-Diabetic (n)	p-valu (e)
Qat Chewing	30	40	0.526
Hypertension	22	21	0.474
Smoking	11	19	0.334
Ischemic Heart Disease (IHD)	3	8	0.326
Previous PCI	6	4	0.539
Dyslipidemia	1	4	0.468
Dilated Cardiomyopathy (DCMP)	1	3	0.734
Shamma Use	1	2	1.000
Previous Coronary Angiography (CAG)	2	1	0.882

3.3 Echocardiographic Findings

The mean ejection fraction (EF) among the study population was 52.3% (SD ± 7.8%), with 15.9% (n=17) of patients having an EF < 40%, indicating moderate to severe systolic dysfunction. Wall motion abnormalities were detected in 33.6% (n=36) of patients, with a higher incidence in those with multi-vessel disease and severe coronary artery stenosis. The most commonly affected areas were the anterior and inferior walls, corresponding to LAD and RCA lesions, respectively. Valvular abnormalities were present in 14.0% (n=15) of patients, with mitral regurgitation being the most common lesion (8.4%, n=9), followed by aortic stenosis (3.7%, n=4). Patients with significant valvular disease were more likely to have a reduced ejection fraction and severe coronary artery involvement.

Table 3. *Echocardiographic Findings Among the Study Population.*

Echocardiographic Finding	N (%)
EF < 40%	17 (15.9%)
Wall Motion Abnormalities	36 (33.6%)
Valvular Lesions	15 (14.0%)
Mitral Regurgitation	9 (8.4%)
Aortic Stenosis	4 (3.7%)

Abbreviations: EF, ejection fraction; LAD, left anterior descending artery; RCA, right coronary artery.

3.4 Coronary Angiography Findings

Among the 107 patients, coronary angiography findings revealed that left anterior descending (LAD) artery involvement was observed in 72.0% (n=77) of patients, while right coronary artery (RCA) involvement was noted in 52.3% (n=56). Significant lesions were identified in 48.6% (n=52) of patients, and left circumflex (LCX) artery involvement was seen in 42.1% (n=45). Multi-vessel disease, defined as two and more-vessel disease, was present in 48.6% of patients, with total occlusion detected in 28.0% (n=30). Other findings included single vessel disease (26.2%, n=28) and atherosclerotic changes (22.4%, n=24), with normal coronary angiography reported in 12.1% (n=13) of patients. Overall, these findings underscore the prevalence and significance of coronary artery disease within this studyTable 4).

Table 4. *Coronary Angiography Findings*

CAG Finding	Count (N)	Percentage (%)
LAD	77	72.0%
RCA	56	52.3%
Significant Lesion	52	48.6%
LCX	45	42.1%
Three-Vessel Disease	34	31.8%
Total Occlusion	30	28.0%
Single Vessel Disease	28	26.2%

Atherosclerotic	24	22.4%
Non-Significant Lesion	21	19.6%
Two-Vessel Disease	18	16.8%
Normal CAG	13	12.1%
LMA	13	12.1%
Tortuosity	7	6.5%
Stent Thrombosis	5	4.7%
Ectasia	3	2.8%

Abbreviations: CAG, coronary angiography; LAD, left anterior descending artery; LCX, left circumflex artery; RCA, right coronary artery.

Notes. *Data are presented as frequencies (N) and percentages (%) for categorical variables.*

3.5 Comparative Analysis between Diabetic and Non-Diabetic Patients

Table 5 summarizes the coronary angiography findings comparing diabetic and non-diabetic patients. LAD involvement was most common, occurring in 72.0% of cases, with similar rates in both groups. RCA lesions were significantly more prevalent among diabetic patients (63.3%) compared to non-diabetics (43.1%, p=0.04). Although LCX involvement and three-vessel disease appeared more frequent in diabetic patients, the differences did not reach statistical significance. Diabetics were also more likely to have multi-vessel disease, while non-diabetics had a higher prevalence of single-vessel involvement (p=0.03). Other findings, such as LMA stenosis, ectasia, and atherosclerosis, showed no significant differences between groups.

Table 5. *Analysis Between Diabetic and Non-Diabetic Patients*

Variable	Diabetic (Yes) Count(%)	Non-Diabetic (No) Count(%)	Total Count(%)	p-value
LAD	35 (71.4%)	42 (72.4%)	77 (72.0%)	0.91
RCA	31 (63.3%)	25 (43.1%)	56 (52.3%)	0.04*
LCX	25 (51.0%)	20 (34.5%)	45 (42.1%)	0.10
LMA	6 (12.2%)	7 (12.1%)	13 (12.1%)	0.99
Ectasia	1 (2.0%)	2 (3.4%)	3 (2.8%)	0.62
Tortuosity	3 (6.1%)	4 (6.9%)	7 (6.5%)	0.85
Atherosclerotic	12 (24.5%)	12 (20.7%)	24 (22.4%)	0.65
Normal CAG	6 (12.2%)	7 (12.1%)	13 (12.1%)	0.99
Single Vessels	8 (16.3%)	20 (34.5%)	28 (26.2%)	0.03*
Two Vessels	10 (20.4%)	8 (13.8%)	18 (16.8%)	0.38
Three Vessels	20 (40.8%)	14 (24.1%)	34 (31.8%)	0.07*
Non-Significant	7 (14.3%)	14 (24.1%)	21 (19.6%)	0.20
Significant	28 (57.1%)	24 (41.4%)	52 (48.6%)	0.11
Total Occlusion	13 (26.5%)	17 (29.3%)	30 (28.0%)	0.75
Stent Thrombosis	2 (4.1%)	3 (5.2%)	5 (4.7%)	0.78

Abbreviations: CAG, coronary angiography; LAD, left anterior descending artery; LCX, left circumflex artery; RCA, right coronary artery.

Notes. *Data are presented as frequencies (N) and percentages (%) for categorical variables. *Chi-square test was used to compare CAG findings between diabetic and non-diabetic patients. A p-value less than 0.05 was considered statistically significant.*

3.6 Intra-Operative and Post-Operative Complications

Intra-operative arrhythmia was more common in diabetic patients (20.4%) compared to non-diabetic patients (6.9%, p=0.04). Post-operative arrhythmia was also more frequent among diabetic patients (14.3%) than non-diabetics (5.2%, p=0.05). Periprocedural myocardial infarction (MI) occurred in 10.2% of diabetic patients compared to 1.7% of non-diabetic patients, though this difference was not statistically significant (p=0.08) (Table 6).

Table 6. *Intra-Operative and Post-Operative Complications*

Complication	Diabetic (n=49)	Non-Diabetic (n=58)	p-value
Intra-Operative Arrhythmia	10 (20.4%)	4 (6.9%)	0.04*
Post-Operative Arrhythmia	7 (14.3%)	3 (5.2%)	0.05*
Periprocedural MI	5 (10.2%)	1 (1.7%)	0.08

Abbreviations: MI, myocardial infarction.

Notes. *Data are presented as frequencies (N) and percentages (%) for categorical variables. *Chi-square test was used to compare CAG findings between diabetic and non-diabetic patients. A p-value less than 0.05 was considered statistically significant.*

3.7 Predictive Value of Risk Factors on Coronary Artery Disease Severity

A logistic regression analysis was performed to identify predictors of multi-vessel disease. Diabetes mellitus was found to be a significant predictor (p = 0.03), with diabetic patients being 2.5 times more likely to have multi-vessel disease than non-diabetic patients.

Smoking and hyperlipidemia were also positively associated with multi-vessel disease, but their associations did not reach statistical significance (p = 0.08 and p = 0.09, respectively).

Table 7. *Logistic Regression Analysis of Predictors of Multi-Vessel Disease.*

Predictor	Odds Ratio (95% CI)	p-value
DM	2.50 (1.20–5.10)	0.03*
Smoking	1.80 (0.95–3.40)	0.08
HTN	1.20 (0.60–2.40)	0.50
Hyperlipidemia	1.60 (0.90–3.00)	0.09

Abbreviations: DM, Diabetes millets; HTN, Hypertension; CI, confidence interval; OR odds ratio.

Notes. *Logistic regression analysis was used to calculate odds ratios (OR) with 95% confidence intervals (CI). * A p-value less than 0.05 was considered statistically significant.*

Diabetes mellitus (DM) was significantly associated with stenosis in the LAD (p = 0.01), LCX (p < 0.001), and RCA (p = 0.02), suggesting a strong link between diabetes and multi-vessel coronary involvement. No significant associations were found for hypertension, chewing qat, or family history of CAD with coronary artery disease findings (Table 8).

Table 8. *Associations Between Categorical Risk Factors and CAG Findings (Chi-Square Test).*

Risk Factor	LAD Stenosis (p-value)	LCX Stenosis (p-value)	RCA Stenosis (p-value)	Atherosclerosis (p-value)	Total Occlusion (p-value)
Smoking	p = 0.04†	p = 0.02†	p = 0.20	p = 0.03†	p = 0.18
Diabetes Mellitus(DM)	p = 0.01†	p < 0.001†	p = 0.02†	p = 0.05	p = 0.07
Hypertension	p = 0.35	p = 0.29	p = 0.41	p = 0.38	p = 0.42
Chewing Qat	p = 0.44	p = 0.29	p = 0.55	p = 0.46	p = 0.48
Family History of CAD	p = 0.22	p = 0.27	p = 0.33	p = 0.18	p = 0.09

Abbreviations: LAD, left anterior descending artery; LCX, left circumflex artery; RCA, right coronary artery; CAD, coronary artery disease; DM, diabetes mellitus.

Notes. *Chi-square test was used to assess the association between categorical risk factors (e.g., smoking, diabetes) and coronary artery disease (CAD) findings. A p-value < 0.05 was considered statistically significant (†).*

4. Discussions

4.1 Patient Demographics and Risk Factors

In this study, diabetes mellitus, hypertension, and smoking were identified as the most prevalent risk factors for coronary artery disease (CAD), while khat chewing emerged as the most widespread lifestyle factor, affecting 65.4% of the patients. The high prevalence of diabetes mellitus (45.8%) reflects its growing burden in the Middle Eastern region, where lifestyle factors such as diet and smoking may exacerbate the risk of CAD (Shujaa & Nammas, 2012) [13]. Furthermore, khat chewing has been associated with an increased risk of coronary events due to its active component, cathinone, which can induce vasospasms and elevate blood pressure, thereby compounding cardiovascular risks (Al-Motarreb et al., 2002) [14].

4.2 Impact of Diabetes on Coronary Artery Disease

Diabetic patients have been found to have a higher incidence of multi-vessel disease, significant coronary artery stenosis, and total occlusion compared to non-diabetic individuals and this was the same as another study in Sana'a (Al-Kebsi et al., 2024; Bettamer et al., 2021)[15,16].

In our study, the most common vessel involved was LAD in diabetic and non- diabetic groups, followed by RCA and LCX. Previous studies showed that among the vessels involved, LAD was the most common Artery involved in diabetic patients, followed by RCA & LCX [17] [18] [19]. However, Marghany et al. [20] showed that the most prevalent affected vessel in diabetic patients was RCA, which differed from our findings. Regarding the prevalence of LM lesions in

our study, LM coronary lesions were observed to be the same prevalent among diabetics & non-diabetics. Which differ than , Sharma et al study which reported a higher prevalence of LM coronary lesions (11%) in diabetic patients [21] but goes with Moosavi et al (22) result which showed no significant difference in the prevalence of LM coronary affection between diabetic and non-diabetic patients.

The high incidence of significant lesions in major arteries reinforces the importance of early detection and intervention in diabetic patients, who may be at greater risk for adverse outcomes. These findings call for targeted strategies to address the unique challenges faced by this population, particularly in regions with a high prevalence of diabetes and associated cardiovascular risks. Regarding the extent of coronary lesions in diabetic patients in our study, the prevalence of single vessel disease was less frequent among diabetic than non- diabetic patients. However, two-vessel and three-vessel diseases were more prevalent among diabetics than non-diabetics. These findings were similar to those observed in Hasabi et al. [17] and Bharath et al. [23] studies, which showed that single-vessel disease was more prevalent in non-diabetic patients and two and three-vessel disease were more prevalent among diabetic patients compared to the other patients' group. Also, Sharma et al. showed that three-vessel disease was the most prevalent lesion in diabetic patients [24]. Multiple other studies also agreed with our results & showed that three-vessel disease was more common in diabetic patients than non-diabetics [25] [26] [27] .

Unlike our findings, Sousa et al. [22] showed no significant differences in the prevalence of single and two-vessel disease between diabetic and non-diabetic patients. However, there was an agreement between our study and Sousa et al. in the prevalence of three-vessel disease, which was observed to be more in diabetic than non-diabetic patients. [28,29]

Regarding the severity of coronary artery lesions in diabetic patients in our study, non-significant stenosis was more prevalent among non-diabetics than diabetic patients. However, significant stenosis were more prevalent among diabetic than non-diabetic patients. These results were Similar to several other studies [17] [28].

Total occlusion in our study was found in non diabtec patients more than diabetics(29% , 26%) repectivly which is against other studies [17][28].

The syntax trial and other studies have shown that diabetic patients have worse CAD outcomes, primarily due to their more diffuse atherosclerosis (Ong et al., 2006; et al., 2020)[30] . As observed in our findings, diabetic patients tend to have more involvement of multiple arteries, increasing the complexity of treatment (Lehto et al., 2021)[31].

5. Conclusion

The study highlights the high prevalence of coronary artery disease (CAD) in the population, with significant stenosis and multi-vessel disease. Diabetes was identified as a major risk factor, particularly affecting the LAD artery. The impact of local lifestyle factors, such as khat chewing, was also noted. The findings emphasize the need for early detection, targeted interventions, and comprehensive management, especially for diabetic patients.

Recommendation

The study recommends enhancing cardiovascular screening, promoting lifestyle modifications, and improving diabetes management to reduce CAD risk. A multidisciplinary approach involving various healthcare professionals is essential for personalized care. Continued research on lifestyle factors and CAD progression in the Middle Eastern context is also crucial for effective public health initiatives.

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