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Original Research Article

DIABETIC DYSLIPIDEMIA IN CORRELETION WITH SEVERITY OF CORONORY ARTERY DISEASES

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ABSTRACT

Background: Diabetes mellitus significantly increases the risk of coronary artery disease (CAD) through metabolic disturbances such as dyslipidemia and chronic hyperglycemia. This study aimed to assess the prevalence of lipid abnormalities in individuals with diabetes and estimate their association with the severity of coronary artery disease. **Materials and Methods:** This cross-sectional observational study included 152 diabetic patients with CAD undergoing coronary angiography at Government Villupuram Medical College and Hospital, Tamil Nadu. Clinical details, anthropometric measurements, glycemic indices, and lipid profiles were recorded. Echocardiography and coronary angiography were used to assess cardiac function and the severity of coronary artery involvement. **Results:** Most participants were aged 40–60 years (61.8%) with male predominance (84.2%), and 59.2% were newly diagnosed with diabetes. Elevated waist circumference was observed in 72.4% of patients, while smoking was present in 66.4%. High LDL cholesterol was observed in 71.1% of patients, elevated triglycerides in 67.1%, and low HDL cholesterol in 51.3%. Combined dyslipidemia involving high LDL, high triglycerides, and low HDL was present in 28% of the population. ST-elevation myocardial infarction was the most common presentation (69.7%). Left ventricular dysfunction was observed in 71.1% of patients, with severe dysfunction in 23.7%. Coronary angiography showed significant stenosis most commonly in the left anterior descending artery (69.7%), followed by the right coronary artery (46.5%) and left circumflex artery (30.2%). Triple-vessel disease was present in 13.9% and left main coronary artery involvement in 6.9% of patients. **Conclusion:** Dysglycemia and atherogenic dyslipidemia are highly prevalent among patients with CAD and are associated with more severe coronary involvement. Early identification and aggressive management of metabolic risk factors are essential to reduce cardiovascular complications.

INTRODUCTION

Diabetes mellitus is defined as a group of metabolic disorders characterised by chronic hyperglycemia resulting from defects in insulin secretion, insulin action, or both.[1] The major forms include type 1 diabetes mellitus (T1DM), an autoimmune disorder typically presenting in childhood; type 2 diabetes mellitus (T2DM), which is associated with insulin resistance and lifestyle factors; and gestational diabetes mellitus, which occurs during pregnancy. The global burden of diabetes continues to rise rapidly, with an estimated 537 million adults affected worldwide in 2021, projected to increase to 643 million by 2030 and 783 million by 2045.2 Nearly 90–95% of these cases are T2DM, with the greatest burden occurring in low- and middle-income countries.[2]

Diabetes is associated with multiple metabolic disturbances that contribute to both microvascular and macrovascular complications. Among these, dyslipidemia is one of the most important contributors to cardiovascular morbidity. Diabetic dyslipidemia is typically characterised by elevated triglycerides, increased low-density lipoprotein cholesterol (LDL-C), and reduced high-density lipoprotein cholesterol (HDL-C).[3] An atherogenic lipid profile is commonly observed in individuals

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with type 2 diabetes, including elevated triglycerides, decreased HDL-C, and increased small dense LDL particles.[4] These abnormalities are largely attributed to insulin resistance, which promotes hepatic overproduction of very-low-density lipoprotein (VLDL), impairs lipoprotein lipase activity, and alters HDL metabolism.[5]

Coronary artery disease (CAD), also known as ischemic heart disease, remains the leading cause of mortality globally, accounting for approximately 17.9 million deaths annually, representing nearly 32% of all deaths worldwide. Major risk factors for CAD include diabetes, hypertension, dyslipidemia, smoking, and a sedentary lifestyle. The underlying pathology of CAD is atherosclerosis, a chronic inflammatory process characterised by lipid accumulation, endothelial dysfunction, oxidative stress, and inflammatory cell infiltration within the arterial wall. These processes lead to plaque formation, progressive narrowing of coronary arteries, and eventual myocardial ischemia or infarction.[6,7]

The relationship between diabetes and cardiovascular disease is well established. Chronic hyperglycemia and insulin resistance contribute to oxidative stress, endothelial dysfunction, and systemic inflammation, which accelerate the development of atherosclerosis. Diabetic dyslipidemia further exacerbates this process through increased LDL cholesterol, elevated triglycerides, and reduced HDL-C levels. Consequently, individuals with diabetes have a two- to four-fold higher risk of developing coronary artery disease compared with non-diabetic individuals.[8,9,4]

Cardiovascular disease remains the principal cause of mortality among patients with diabetes, highlighting the importance of identifying modifiable risk factors such as lipid abnormalities. Studies have demonstrated that effective lipid-lowering therapy, particularly statin therapy, significantly reduces cardiovascular events in diabetic individuals.[10,11] Therefore, early identification and appropriate management of dyslipidemia play a major role in preventing cardiovascular complications. Despite the recognised relationship between diabetes, dyslipidemia, and coronary artery disease, data examining the association between specific lipid abnormalities and the severity of CAD remain limited, particularly in low- and middle-income countries. Population-specific studies are necessary to better understand the relationship between diabetic dyslipidemia and the angiographic severity of coronary artery disease. Furthermore, it remains unclear which lipid components are most strongly associated with severe or complex coronary lesions.

Understanding these associations is important for improving cardiovascular risk stratification and guiding targeted management strategies in diabetic patients. Hence, this study aims to assess the prevalence of lipid abnormalities in individuals with diabetes and estimate their association with the severity of coronary artery disease.

MATERIALS AND METHODS

This cross-sectional observational study was conducted in the Departments of General Medicine and Cardiology at Government Villupuram Medical College and Hospital (GVMCH), Mundiyambakkam, Tamil Nadu. Ethical approval for the study was obtained from the Institutional Ethics Committee of Government Villupuram Medical College prior to the commencement of the study. Written informed consent was obtained from all participants before enrollment, and strict confidentiality of patient information was maintained throughout the study.

Inclusion Criteria

Patients with diabetes mellitus, either newly diagnosed or already receiving treatment, who were diagnosed with coronary artery disease and planned for coronary angiography.

Exclusion Criteria

Patients with chronic kidney disease, hepatic dysfunction, endocrinal disorders other than diabetes mellitus, rheumatological diseases, chronic infections, pregnant women, and those with type 1 diabetes mellitus.

Methods

Patients admitted to Government Villupuram Medical College with diabetes mellitus and coronary artery disease who were scheduled for coronary angiography were consecutively recruited for the study. A detailed clinical history was obtained for each participant, and anthropometric measurements and hemodynamic parameters were recorded. Glycemic control was assessed using glycated hemoglobin (HbA1c) levels.

After an overnight fasting period of at least 8 hours, 8 mL of venous blood was collected from each participant for the estimation of fasting blood glucose and fasting lipid profile. An additional 3 mL of venous blood was collected two hours after a regular diet for measurement of postprandial plasma glucose. Plasma glucose and lipid profile parameters were analysed using standard biochemical methods. Lipid estimation was performed using cholesterol oxidase para-amino antipyrine, lipase/glycerol kinase, and enzymatic reaction methods. Low-density lipoprotein cholesterol (LDL-C) and very low-density lipoprotein cholesterol (VLDL-C) levels were calculated using the Friedewald formula. All biochemical assays were carried out using standardised procedures by the same laboratory team throughout the study to maintain uniformity. Data were presented as frequencies and percentages.

Sample size calculation

The sample size was calculated based on the formula $n = (Z^2 \times p \times q) / d^2$

Where Z represents the standard normal deviate at a 95% confidence level (1.96), p represents the expected prevalence (10%), q = 1 – p (0.90), and d represents the precision (5%). Based on this calculation, the estimated sample size was 138, and after accounting for a 10% non-response rate, the

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final sample size was determined to be 152 participants.

RESULTS

Most participants were aged 40–60 years (94, 61.8%), followed by >60 years (39, 25.7%) and 20–40 years (19, 12.5%). There was a clear male predominance, with 128 males (84.2%) and 24 females (15.8%). Regarding diabetes status, 90 patients (59.2%) were newly diagnosed, while 62 (40.8%) were known diabetics. Hypertension was present in 60 participants (39.5%), whereas 92 (60.5%) had no hypertension. A previous history of CAD was reported in 16 patients (10.5%), while 136 (89.5%) had no prior CAD. Family history of CAD was present in 19 participants (12.5%) and absent in 133 (87.5%). [Table 1]

Table 1: Baseline Demographic Characteristics and Risk Factors (n = 152)

Variable	Category	n (%)
Age (years)	20–40	19 (12.5%)
	40–60	94 (61.8%)
	>60	39 (25.7%)
Sex	Male	128 (84.2%)
	Female	24 (15.8%)
Diabetes status	Newly diagnosed	90 (59.2%)
	Known diabetes	62 (40.8%)
Hypertension	Yes	60 (39.5%)
	No	92 (60.5%)
Previous CAD	Yes	16 (10.5%)
	No	136 (89.5%)
Family history of CAD	Yes	19 (12.5%)
	No	133 (87.5%)

Most participants had a BMI of 23–24.9 kg/m² (102, 67.1%), while 26 (17.1%) had a BMI ≥25 kg/m² and 24 (15.8%) had a BMI of 18.5–22.9 kg/m². Elevated waist circumference was observed in 110 participants (72.4%), whereas 42 (27.6%) had normal values. Smoking was reported in 101 patients (66.4%), while 51 (33.6%) were non-smokers. Alcohol consumption was present in 62 participants (40.8%) and absent in 90 (59.2%). The majority followed a mixed diet (133, 87.5%), while 19 (12.5%) were vegetarians. Regarding presenting symptoms, chest pain was the most common complaint (144, 94.7%), followed by breathlessness (43, 28.3%), while syncope was reported in 10 patients (6.6%). [Table 2]

Table 2: Anthropometry, Lifestyle Factors, and Presenting Symptoms

Variable	Category	n (%)
BMI (kg/m²)	18.5–22.9	24 (15.8%)
	23–24.9	102 (67.1%)
	≥25	26 (17.1%)
Waist circumference	Normal	42 (27.6%)
	Elevated	110 (72.4%)
Smoking	Yes	101 (66.4%)
	No	51 (33.6%)
Alcohol consumption	Yes	62 (40.8%)
	No	90 (59.2%)
Diet	Mixed diet	133 (87.5%)
	Vegetarian	19 (12.5%)
Chest pain	Yes	144 (94.7%)
	No	8 (5.3%)
Breathlessness	Yes	43 (28.3%)
	No	109 (71.7%)
Syncope	Yes	10 (6.6%)
	No	142 (93.4%)

Among the participants, 106 (69.7%) had fasting blood glucose <126 mg/dL, while 46 (30.2%) had ≥126 mg/dL. Similarly, 105 (69.1%) had postprandial glucose <180 mg/dL, whereas 47 (30.9%) had ≥180 mg/dL. Regarding HbA1c, 65 (42.8%) had <5.7%, 45 (29.6%) had 5.7–6.5%, 16 (10.5%) had 6.6–7.4%, 24 (15.8%) had 7.5–10%, and 2 (1.3%) had >10%.

With respect to lipid abnormalities, high LDL was observed in 108 (71.1%), high triglycerides in 102 (67.1%), and low HDL in 78 (51.3%) participants. Combined lipid abnormalities included high TG + LDL in 67 (44.1%), high LDL + low HDL in 68 (45.0%), high TG + low HDL in 49 (32.2%), and all three abnormalities (high TG, high LDL, and low HDL) in 43 (28.0%) of the study population. [Table 3]

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Table 3: Glycaemic Profile and Lipid Abnormalities

Parameter	Category	n (%)
Fasting blood glucose	<126 mg/dL	106 (69.7%)
	≥126 mg/dL	46 (30.2%)
Postprandial glucose	<180 mg/dL	105 (69.1%)
	≥180 mg/dL	47 (30.9%)
HbA1c (%)	<5.7	65 (42.8%)
	5.7–6.5	45 (29.6%)
	6.6–7.4	16 (10.5%)
	7.5–10	24 (15.8%)
	>10	2 (1.3%)
Lipid abnormalities	High LDL	108 (71.1%)
	High triglycerides	102 (67.1%)
	Low HDL	78 (51.3%)
	High TG + LDL	67 (44.1%)
	High TG + Low HDL	49 (32.2%)
	High LDL + Low HDL	68 (45.0%)
	High TG + LDL + Low HDL	43 (28.0%)

At admission, the majority of patients had a pulse rate of 60–100 bpm (125, 82.2%), while 23 (15.1%) had tachycardia (>100 bpm) and 4 (2.6%) had bradycardia (<60 bpm). Elevated blood pressure (≥140/90 mmHg) was observed in 92 patients (60.5%), whereas 60 (39.5%) had normal blood pressure. Hypoxemia (SpO_2 <90%) was present in 19 patients (12.5%), while 133 (87.5%) maintained oxygen saturation ≥90%. Based on ECG findings, ST-elevation myocardial infarction (STEMI) was the most common diagnosis in 106 patients (69.7%), followed by NSTEMI in 27 (17.8%) and unstable angina in 19 (12.5%). [Table 4]

Table 4: Hemodynamic Status and ECG Diagnosis

Parameter	Category	n (%)
Pulse rate (bpm)	<60	4 (2.6%)
	60–100	125 (82.2%)
	>100	23 (15.1%)
BP ≥140/90 mmHg	Yes	92 (60.5%)
	No	60 (39.5%)
SpO_2 <90%	Yes	19 (12.5%)
	No	133 (87.5%)
Diagnosis	STEMI	106 (69.7%)
	NSTEMI	27 (17.8%)
	Unstable angina	19 (12.5%)

On echocardiographic evaluation, anterior RWMA was observed in 99 patients (65.1%), while 53 (34.9%) had no anterior wall involvement. Lateral RWMA was present in 44 (28.9%) and absent in 108 (71.1%) patients. Inferior RWMA was noted in 50 patients (32.9%), whereas 102 (67.1%) had no inferior wall abnormalities. Posterior RWMA was identified in 23 patients (15.1%), while 129 (84.9%) had no posterior wall involvement. Right ventricular dysfunction was present in 14 patients (9.2%) and absent in 138 (90.8%). Overall, left ventricular dysfunction was observed in 108 patients (71.1%), among whom 36 (23.7%) had severe LV dysfunction with an ejection fraction <40%. [Table 5]

Table 5: Echocardiographic Findings and Ventricular Dysfunction

Parameter	Category	n (%)
Anterior RWMA	Yes	99 (65.1%)
	No	53 (34.9%)
Lateral RWMA	Yes	44 (28.9%)
	No	108 (71.1%)
Inferior RWMA	Yes	50 (32.9%)
	No	102 (67.1%)
Posterior RWMA	Yes	23 (15.1%)
	No	129 (84.9%)
RV dysfunction	Yes	14 (9.2%)
	No	138 (90.8%)
LV dysfunction	Present	108 (71.1%)
Severe LV dysfunction (EF <40%)	—	36 (23.7%)

Coronary angiography showed no LMCA occlusion in 137 patients (90.1%), while 4 (2.6%) had 1–24%, 5 (3.3%) had 25–49%, 4 (2.6%) had 50–69%, and 2 (1.3%) had 70–99% stenosis. In the LAD, 73 patients (48.0%) had 70–99% stenosis and 7 (4.6%) had complete occlusion, while lesser degrees of stenosis included 1–24% in 22 (14.5%), 25–49% in 18 (11.8%), and 50–69% in 15 (9.9%), with 17 (11.2%) showing no stenosis. For the LCX, 34 (22.4%) had 70–99% stenosis and 3 (2.0%) had 100% occlusion,

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while 72 (47.4%) had no stenosis. In the RCA, 43 patients (28.3%) had 70–99% stenosis and 5 (3.3%) had complete occlusion, whereas 53 (34.9%) had no stenosis.

Recanalisation of the infarct-related artery (IRA) was observed in 36 patients (23.7%), while 116 (76.3%) had no recanalisation. Among patients with dyslipidemia, significant stenosis was most frequently observed in the LAD (106, 69.7%), followed by the RCA (71, 46.5%) and LCX (46, 30.2%). Triple-vessel occlusion was present in 21 patients (13.9%), and LMCA involvement was noted in 10 (6.9%). During hospitalization, heart failure developed in 103 patients (67.8%), while 49 (32.2%) did not develop heart failure. Heart block occurred in 6 patients (3.9%), whereas 146 (96.1%) had no conduction abnormalities. [Table 6]

Table 6: Coronary Angiographic Findings, Dyslipidemia Correlation, and In-Hospital Outcomes

Parameter	Category	n (%)
LMCA occlusion	None	137 (90.1%)
	1–24%	4 (2.6%)
	25–49%	5 (3.3%)
	50–69%	4 (2.6%)
	70–99%	2 (1.3%)
LAD occlusion	0%	17 (11.2%)
	1–24%	22 (14.5%)
	25–49%	18 (11.8%)
	50–69%	15 (9.9%)
	70–99%	73 (48.0%)
	100%	7 (4.6%)
LCX occlusion	0%	72 (47.4%)
	1–24%	9 (5.9%)
	25–49%	16 (10.5%)
	50–69%	18 (11.8%)
	70–99%	34 (22.4%)
	100%	3 (2.0%)
RCA occlusion	0%	53 (34.9%)
	1–24%	12 (7.9%)
	25–49%	22 (14.5%)
	50–69%	17 (11.2%)
	70–99%	43 (28.3%)
	100%	5 (3.3%)
Recanalisation of IRA	Yes	36 (23.7%)
	No	116 (76.3%)
Significant stenosis with dyslipidemia	LAD	106 (69.7%)
	LCX	46 (30.2%)
	RCA	71 (46.5%)
	Triple vessel occlusion	21 (13.9%)
	LMCA involvement	10 (6.9%)
Heart failure	Yes	103 (67.8%)
	No	49 (32.2%)
Heart block	Yes	6 (3.9%)
	No	146 (96.1%)

DISCUSSION

Diabetes mellitus is one of the most important metabolic risk factors contributing to cardiovascular disease, particularly CAD. It is typically diagnosed using glycated haemoglobin (HbA1c), FBS, or PPBS levels. Diabetes is generally defined as HbA1c ≥6.5%, fasting plasma glucose ≥126 mg/dL, or 2-hour postprandial glucose ≥200 mg/dL, or random glucose ≥200 mg/dL with symptoms of hyperglycemia. Epidemiological data such as the NHANES 2017–2020 cycle indicate that approximately 27.2% of adults have diabetes based on HbA1c measurements, though the prevalence may be higher when fasting glucose criteria are used, suggesting that HbA1c alone may underestimate true disease burden.[12] Another study have demonstrated a large proportion of previously undiagnosed dysglycemia among cardiac patients, highlighting the importance of routine metabolic screening in individuals presenting with cardiovascular disease.[13]

In the present study, the majority of patients were aged between 40–60 years (61.8%), with a clear male predominance (84.2%). Similar demographic patterns have been observed in many cardiovascular registries, where middle-aged men represent the largest proportion of patients presenting with acute coronary syndromes.[14,15] Another finding was that 59.2% of participants were newly diagnosed with diabetes, suggesting a substantial burden of previously unrecognised dysglycemia among patients presenting with cardiac events. This observation is consistent with earlier reports, such as the Euro Heart Survey, which demonstrated that nearly two-thirds of patients with CAD had either diabetes or impaired glucose tolerance, many of whom were unaware of their condition.[16] These findings emphasise the importance of opportunistic diabetes screening in cardiology settings.

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Lifestyle and anthropometric factors observed in the present study further support the metabolic risk profile of the study population. Elevated waist circumference was noted in 72.4% of participants, and smoking was reported in 66.4%, both of which are well-established contributors to cardiovascular disease. Hypertension was present in 39.5% of patients, and elevated blood pressure at admission was seen in 60.5%. These findings highlight the clustering of cardiovascular risk factors commonly seen in patients with metabolic syndrome and diabetes.[17]

Glycemic indices in this study demonstrated that approximately one-third of patients had elevated fasting (30.2%) and postprandial glucose levels (30.9%), while HbA1c levels indicated varying degrees of chronic hyperglycemia. Several investigations have evaluated the relative contribution of fasting and postprandial glucose to long-term glycemic control. Ketema et al. reported that postprandial glucose shows a slightly stronger correlation with HbA1c compared with fasting glucose, particularly in moderately controlled diabetes.[18] Conversely, some studies suggest that fasting glucose may have a stronger association with HbA1c in poorly controlled diabetes or in individuals with greater glycemic variability.[19] These variations underscore the complexity of glycemic monitoring and the need for comprehensive evaluation using multiple parameters.

Dyslipidemia was highly prevalent in the present study. Elevated LDL cholesterol was observed in 71.1% of patients, elevated triglycerides in 67.1%, and low HDL cholesterol in 51.3%. Furthermore, combined lipid abnormalities were common, with 28% of patients exhibiting the classic triad of high LDL, high triglycerides, and low HDL. This pattern is characteristic of diabetic dyslipidemia and is closely linked to insulin resistance and chronic hyperglycemia. Studies such as NHANES and the Lipid Association of India reports have similarly documented unfavourable lipid profiles among individuals with poorly controlled diabetes.[20] However, some investigations have reported weaker correlations between HbA1c and lipid levels, suggesting that genetic and lifestyle factors may also influence lipid metabolism.[21]

Electrocardiographic findings in this study showed that ST-elevation myocardial infarction (STEMI) was the most common presentation (69.7%), followed by NSTEMI (17.8%) and unstable angina (12.5%). Persistent hyperglycemia contributes to endothelial dysfunction, oxidative stress, and the formation of advanced glycation end-products, all of which promote plaque instability and thrombosis.22

In our study, echocardiographic findings revealed a high prevalence of left ventricular dysfunction (71.1%), with severe dysfunction observed in 23.7% of patients. Hyperglycemia and insulin resistance are known to contribute to myocardial structural changes, microvascular dysfunction, and myocardial fibrosis, which ultimately lead to impaired cardiac function and heart failure.23 Consistent with this, heart failure developed in 67.8% of patients during hospitalisation in the present study.

The findings of the present study reinforce the close association between diabetes, dyslipidemia, and the severity of coronary artery disease. The high prevalence of metabolic abnormalities and their strong association with adverse cardiovascular outcomes highlight the need for early screening, aggressive risk factor modification, and guideline-directed therapy in high-risk populations. International guidelines from the American Diabetes Association, American Heart Association, and European Society of Cardiology strongly recommend comprehensive management strategies including glycemic control, lipid-lowering therapy, blood pressure management, and lifestyle modification to reduce cardiovascular morbidity and mortality in patients with diabetes.

Limitations

The study was conducted at a single tertiary care centre, which may limit the generalizability of the results to other populations or healthcare settings. The cross-sectional observational design restricts the ability to establish a causal relationship between dyslipidemia, glycemic status, and the severity of coronary artery disease. The relatively small sample size may reduce the statistical power to detect more subtle associations between metabolic parameters and angiographic findings. Potential confounding factors such as duration of diabetes, medication use, dietary patterns, physical activity, and adherence to treatment were not comprehensively evaluated. The absence of long-term follow-up prevented assessment of long-term cardiovascular outcomes and the prognostic significance of the observed metabolic abnormalities.

CONCLUSION

This study highlights the strong association between dysglycemia, dyslipidemia, and coronary artery disease among patients presenting with acute coronary syndromes. A large proportion of patients had previously undiagnosed diabetes, indicating the importance of routine metabolic screening in cardiovascular settings. Atherogenic dyslipidemia, characterised by elevated LDL, high triglycerides, and low HDL, was common and significantly associated with glycemic status. Most patients presented with STEMI and demonstrated regional wall motion abnormalities and reduced left ventricular function on echocardiography. Coronary angiography frequently revealed significant involvement of the LAD and multivessel disease. These findings emphasise the need for early detection and aggressive management of glycemic and lipid abnormalities to improve cardiovascular outcomes.

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