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# Comparative Evaluation of Lipid Profile and Glycemic Control in Patients with Coronary Artery Disease with and Without Type 2 Diabetes Mellitus.

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## Abstract

***Background:*** Coronary Artery Disease is one of the leading causes of morbidity and mortality worldwide. Type 2 Diabetes Mellitus significantly increases the risk of coronary artery disease through mechanisms involving dyslipidemia, endothelial dysfunction, and accelerated atherosclerosis. Evaluation of lipid profile and glycemic status in CAD patients is important for cardiovascular risk assessment and management. ***Aim:*** To comparatively evaluate lipid profile and glycemic control in patients with coronary artery disease with and without type 2 diabetes mellitus. ***Objectives:*** To assess and compare lipid profile parameters among CAD patients with and without T2DM. To evaluate glycemic control using fasting blood sugar, postprandial blood sugar, and HbA1c levels in the study groups. To determine the association between dyslipidemia and glycemic status in CAD patients. ***Materials and Methods:*** The present hospital-based comparative cross-sectional observational study was conducted among 200 patients diagnosed with coronary artery disease. Patients were divided into two groups: CAD with T2DM (n=103) and CAD without T2DM (n=97). Detailed clinical evaluation and biochemical investigations including fasting blood sugar, postprandial blood sugar, HbA1c, and lipid profile were performed. Statistical analysis was carried out using SPSS software version 25.0. Independent t-test and Chi-square test were used for comparison, and $p<0.05$ was considered statistically significant. ***Results:*** The mean BMI was significantly higher among CAD patients with T2DM compared to non-diabetic CAD patients (27.1 ± 3.6 vs 25.8 ± 3.4 kg/m$^2$, p=0.009). Hypertension was significantly more prevalent in diabetic CAD patients (71.8% vs 53.6%, p=0.008). Lipid profile analysis revealed significantly higher total cholesterol, triglycerides, LDL-C, and VLDL-C levels along with significantly lower HDL-C levels among diabetic CAD patients ($p<0.001$). Glycemic parameters including fasting blood sugar, postprandial blood sugar, and HbA1c were significantly elevated in CAD patients with T2DM compared to non-diabetic CAD patients ($p<0.001$). Dyslipidemia showed a strong positive association with poor glycemic control ($\chi^2=20.21$, $p<0.001$). ***Conclusion:*** CAD patients with T2DM exhibited significantly worse lipid abnormalities and poor glycemic control compared to non-diabetic CAD patients. Poor glycemic status was strongly associated with dyslipidemia, highlighting the importance of regular monitoring and strict metabolic control to reduce cardiovascular complications in diabetic CAD patients.

**Keywords:** Coronary Artery Disease. Type 2 Diabetes Mellitus. Dyslipidemia.



## INTRODUCTION

Coronary Artery Disease (CAD) remains one of the leading causes of morbidity and mortality worldwide and poses a major public health burden, particularly in developing countries such as India. CAD is characterized by atherosclerotic narrowing of the coronary arteries resulting in myocardial ischemia and impaired cardiac function. Multiple risk factors contribute to the development and progression of CAD, including dyslipidemia, hypertension, obesity, smoking, sedentary lifestyle, and Type 2 Diabetes Mellitus (T2DM). Among these, diabetes mellitus has emerged as one of the strongest independent risk factors for cardiovascular disease due to its close association with endothelial dysfunction, chronic inflammation, and accelerated atherosclerosis. Patients with T2DM are known to have two to four times greater risk of developing CAD compared to non-diabetic individuals.[1]

Abnormal lipid metabolism plays a significant role in the pathogenesis of atherosclerosis and coronary artery disease. Diabetic dyslipidemia is typically characterized by elevated triglyceride levels, increased low-density lipoprotein (LDL) cholesterol, and reduced high-density lipoprotein (HDL) cholesterol. These lipid abnormalities contribute to plaque formation, vascular inflammation, and thrombotic complications. Furthermore, poor glycemic control leads to glycation of lipoproteins and vascular proteins, thereby worsening endothelial injury and promoting progression of coronary artery

lesions. Glycemic status is commonly assessed using fasting blood glucose, postprandial blood glucose, and glycated hemoglobin (HbA1c), which reflect both short-term and long-term glucose regulation.[2]

Several studies have demonstrated that patients with CAD and coexisting T2DM have poorer clinical outcomes, increased severity of coronary lesions, higher incidence of myocardial infarction, and greater mortality compared to non-diabetic CAD patients. Evaluation of lipid profile and glycemic control in such patients is therefore essential for risk stratification, therapeutic planning, and prevention of future cardiovascular events. Early detection and management of dyslipidemia and uncontrolled hyperglycemia can significantly reduce cardiovascular complications and improve prognosis.[3]

In recent years, increasing prevalence of diabetes and lifestyle-related disorders has contributed to a substantial rise in cardiovascular diseases among middle-aged and elderly populations. Urbanization, unhealthy dietary habits, physical inactivity, and obesity have further accelerated this trend. Comparative assessment of lipid abnormalities and glycemic parameters in CAD patients with and without T2DM can provide valuable insights into metabolic derangements associated with cardiovascular disease and help formulate effective preventive strategies. Hence, the present study was undertaken to comparatively evaluate lipid profile and glycemic control among patients with coronary artery disease with and without type 2 diabetes mellitus.[4]

**AIM**

To comparatively evaluate lipid profile and glycemic control in patients with coronary artery disease with and without type 2 diabetes mellitus.

**OBJECTIVES**

1. To assess and compare the lipid profile parameters among coronary artery disease patients with and without type 2 diabetes mellitus.
2. To evaluate glycemic control using fasting blood sugar, postprandial blood sugar, and HbA1c levels in the study groups.
3. To determine the association between dyslipidemia and glycemic status in patients with coronary artery disease.

## MATERIALS AND METHODS

**Source of Data**

The data for the present study were collected from patients diagnosed with coronary artery disease attending the Department of General Medicine and Department of Cardiology at a tertiary care teaching hospital. Relevant demographic, clinical, biochemical, and laboratory data were obtained from patients after informed written consent.

**Study Design**

The present study was conducted as a hospital-based comparative cross-sectional observational study.

**Study Location**

The study was carried out in the Departments of General Medicine and Cardiology of a tertiary care teaching hospital.

**Study Duration**

The study was conducted over a period of 18 months from January 2024 to June 2025.

**Sample Size**

A total of 200 patients were included in the study. The study population was divided into two groups:

- Group A: 100 patients with coronary artery disease and type 2 diabetes mellitus
- Group B: 100 patients with coronary artery disease without type 2 diabetes mellitus

**Inclusion Criteria**

1. Patients aged more than 30 years diagnosed with coronary artery disease.
2. Patients willing to participate and provide informed written consent.
3. Patients diagnosed with CAD based on clinical findings, ECG changes, cardiac biomarkers, echocardiography, or coronary angiography.
4. Patients with established type 2 diabetes mellitus in the diabetic group.
5. Non-diabetic CAD patients in the comparison group.

**Exclusion Criteria**

1. Patients with type 1 diabetes mellitus.
2. Patients with chronic kidney disease, chronic liver disease, or thyroid disorders.

3. Patients on lipid-lowering therapy initiated within the previous three months.
4. Patients with acute infections, inflammatory disorders, or malignancy.
5. Pregnant women and critically ill patients.
6. Patients unwilling to participate in the study.

**Procedure and Methodology**

After obtaining approval from the Institutional Ethics Committee, eligible patients fulfilling the inclusion criteria were enrolled in the study. Detailed history regarding age, gender, smoking status, alcohol consumption, hypertension, duration of diabetes, family history of coronary artery disease, and medication history was recorded using a structured proforma. Thorough clinical examination including measurement of blood pressure, height, weight, and body mass index was performed.

Venous blood samples were collected from all participants under aseptic precautions after overnight fasting. Fasting blood glucose, postprandial blood glucose, HbA1c, total cholesterol, triglycerides, HDL cholesterol, LDL cholesterol, and VLDL cholesterol levels were measured. Patients were categorized into diabetic and non-diabetic groups based on previous diagnosis and laboratory findings. Lipid profile and glycemic parameters were compared between the two groups to evaluate metabolic abnormalities associated with coronary artery disease.

**Sample Processing**

Approximately 5 mL of venous blood was collected from each participant. Blood samples for fasting glucose and lipid profile were collected after 8–12 hours of overnight fasting. Serum was separated by centrifugation at 3000 rpm for 10 minutes. Biochemical investigations were carried out using an automated analyzer in the central biochemistry laboratory. HbA1c estimation was performed using high-performance liquid chromatography (HPLC) method. Internal quality control measures were maintained throughout the study period.

**Statistical Methods**

The collected data were entered into Microsoft Excel and analyzed using Statistical Package for Social Sciences (SPSS) software version 25.0. Continuous variables were expressed as mean ± standard deviation, while categorical variables were expressed as frequencies and percentages. Independent sample t-test was used for comparison of quantitative variables between the two groups. Chi-square test was applied for categorical data analysis. Pearson correlation analysis was used to determine the association between glycemic control and lipid parameters. A p-value of less than 0.05 was considered statistically significant.

**Data Collection**

Data were collected using a predesigned and prevalidated case record form. Information regarding demographic profile, clinical characteristics, laboratory investigations, lipid profile, and glycemic parameters was systematically documented. Confidentiality of patient information was strictly maintained throughout the study.

## RESULTS

**Table 1: Baseline comparison of CAD patients with and without T2DM**

| Variable | CAD with T2DM n=103 | CAD without T2DM n=97 | Test value | 95% CI | p-value |
|---|---|---|---|---|---|
| Age, years | 58.7 ± 9.8 | 56.4 ± 10.6 | t=1.59 | -0.55 to 5.15 | 0.113 |
| Male | 68 (66.0) | 61 (62.9) | $\chi^2$=0.21 | -10.14 to 16.40 | 0.644 |
| BMI, kg/m² | 27.1 ± 3.6 | 25.8 ± 3.4 | t=2.63 | 0.32 to 2.28 | 0.009* |
| Hypertension | 74 (71.8) | 52 (53.6) | $\chi^2$=7.13 | 5.05 to 31.43 | 0.008* |
| Smoking | 31 (30.1) | 28 (28.9) | $\chi^2$=0.04 | -11.41 to 13.87 | 0.849 |
| Family history of CAD | 37 (35.9) | 24 (24.7) | $\chi^2$=2.95 | -1.45 to 23.81 | 0.086 |
| Duration of CAD, years | 3.8 ± 2.4 | 3.1 ± 2.1 | t=2.20 | 0.07 to 1.33 | 0.029* |

Table 1 shows the baseline comparison between coronary artery disease (CAD) patients with type 2 diabetes mellitus (T2DM) and those without T2DM. The mean age of patients in the CAD with T2DM group was 58.7 ± 9.8 years compared to 56.4 ± 10.6 years in the non-diabetic CAD group. The difference was statistically non-significant (t=1.59, p=0.113), indicating comparable age distribution between the groups. Male predominance was observed in both groups, with males constituting 66.0% in the diabetic CAD group and 62.9% in the non-diabetic CAD group; however, this difference was not statistically significant ($\chi^2$=0.21, p=0.644).

The mean body mass index (BMI) was significantly higher among CAD patients with T2DM (27.1 ± 3.6 kg/m²) compared to those without T2DM (25.8 ± 3.4 kg/m²), showing a statistically significant difference (t=2.63, p=0.009). Hypertension was also significantly more prevalent in the diabetic CAD group, affecting 71.8% of patients compared to 53.6% in the non-diabetic group ($\chi^2$=7.13, p=0.008). Smoking history was observed in 30.1% of diabetic CAD patients and 28.9% of non-diabetic CAD patients, without significant difference between groups (p=0.849). Similarly, family history of CAD was more common among diabetic patients (35.9%) compared to non-diabetic patients (24.7%), although the association did not reach statistical significance (p=0.086). The duration of CAD was significantly longer in patients with T2DM (3.8 ± 2.4 years) than in patients without T2DM (3.1 ± 2.1 years), with a statistically significant difference (t=2.20, p=0.029).

**Table 2: Comparison of lipid profile parameters**

| Lipid parameter | CAD with T2DM n=103 | CAD without T2DM n=97 | Test value | 95% CI | p-value |
|---|---|---|---|---|---|
| Total cholesterol, mg/dL | 201.6 ± 36.8 | 184.2 ± 32.5 | t=3.55 | 7.73 to 27.07 | <0.001* |
| Triglycerides, mg/dL | 182.9 ± 48.7 | 148.6 ± 39.4 | t=5.49 | 21.98 to 46.62 | <0.001* |
| HDL-C, mg/dL | 38.7 ± 8.6 | 43.5 ± 9.1 | t=-3.83 | -7.27 to -2.33 | <0.001* |
| LDL-C, mg/dL | 126.4 ± 29.8 | 108.7 ± 27.6 | t=4.36 | 9.70 to 25.70 | <0.001* |
| VLDL-C, mg/dL | 36.5 ± 9.7 | 29.8 ± 7.9 | t=5.37 | 4.24 to 9.16 | <0.001* |
| Dyslipidemia present | 82 (79.6) | 57 (58.8) | $\chi^2$=10.24 | 8.34 to 33.36 | 0.001* |

Table 2 compares lipid profile parameters between CAD patients with and without T2DM. The mean total cholesterol level was significantly higher among diabetic CAD patients (201.6 ± 36.8 mg/dL) compared to non-diabetic CAD patients (184.2 ± 32.5 mg/dL), with a highly significant difference (t=3.55, p<0.001). Similarly, serum triglyceride levels were markedly elevated in CAD patients with T2DM (182.9 ± 48.7 mg/dL) compared to those without diabetes (148.6 ± 39.4 mg/dL), which was statistically highly significant (t=5.49, p<0.001).

On the other hand, HDL cholesterol levels were significantly lower among diabetic CAD patients (38.7 ± 8.6 mg/dL) than non-diabetic CAD patients (43.5 ± 9.1 mg/dL), indicating reduced protective lipid fraction in diabetic individuals (t=-3.83, p<0.001). LDL cholesterol was significantly higher in the diabetic CAD group (126.4 ± 29.8 mg/dL) compared to the non-diabetic CAD group (108.7 ± 27.6 mg/dL), with strong statistical significance (t=4.36, p<0.001). Likewise, VLDL cholesterol levels were significantly elevated in CAD patients with T2DM (36.5 ± 9.7 mg/dL) in comparison to non-diabetic CAD patients (29.8 ± 7.9 mg/dL), showing a highly significant association (t=5.37, p<0.001).

Dyslipidemia was present in 79.6% of CAD patients with T2DM, whereas it was observed in 58.8% of CAD patients without diabetes. This difference was statistically significant ($\chi^2$=10.24, p=0.001).

**Table 3: Comparison of glycemic control parameters**

| Glycemic parameter | CAD with T2DM n=103 | CAD without T2DM n=97 | Test value | 95% CI | p-value |
|---|---|---|---|---|---|
| Fasting blood sugar, mg/dL | 154.8 ± 37.6 | 92.7 ± 12.8 | t=15.82 | 54.33 to 69.87 | <0.001* |
| Postprandial blood sugar, mg/dL | 226.3 ± 58.4 | 124.9 ± 24.7 | t=16.15 | 88.99 to 113.81 | <0.001* |
| HbA1c, % | 8.1 ± 1.4 | 5.6 ± 0.4 | t=17.39 | 2.22 to 2.78 | <0.001* |
| Poor glycemic control | 76 (73.8) | 14 (14.4) | $\chi^2$=71.10 | 48.35 to 70.36 | <0.001* |

Table 3 presents the comparison of glycemic control parameters between CAD patients with and without T2DM. The mean fasting blood sugar (FBS) level among CAD patients with T2DM was 154.8 ± 37.6 mg/dL, which was significantly higher than the mean FBS level of 92.7 ± 12.8 mg/dL observed in non-diabetic CAD patients. This difference was highly statistically significant (t=15.82, p<0.001). Similarly, postprandial blood sugar (PPBS) levels were markedly elevated in diabetic CAD patients (226.3 ± 58.4 mg/dL) compared to non-diabetic CAD patients (124.9 ± 24.7 mg/dL), demonstrating strong statistical significance (t=16.15, p<0.001).

The mean HbA1c level, which reflects long-term glycemic control, was significantly higher in the diabetic CAD group (8.1 ± 1.4%) than in the non-diabetic CAD group (5.6 ± 0.4%), with a highly significant difference (t=17.39, p<0.001). Poor glycemic control was observed in 73.8% of CAD patients with T2DM, whereas only 14.4% of CAD patients without diabetes showed poor glycemic status. This difference was statistically highly significant ($\chi^2$=71.10, p<0.001).

**Table 4: Association between dyslipidemia and glycemic status**

| Glycemic status | Dyslipidemia present n=139 | Dyslipidemia absent n=61 | Total n=200 |
|---|---|---|---|
| Good control | 22 (46.8) | 25 (53.2) | 47 (100.0) |
| Fair control | 38 (65.5) | 20 (34.5) | 58 (100.0) |
| Poor control | 79 (83.2) | 16 (16.8) | 95 (100.0) |

Test of significance: $\chi^2$=20.21; 95% CI for dyslipidemia difference between poor and good glycemic control: 19.7% to 53.1%; p-value: <0.001*

Table 4 demonstrates the association between dyslipidemia and glycemic status among patients with coronary artery disease. Among patients with good glycemic control, dyslipidemia was present in 46.8% of cases, while 53.2% did not have dyslipidemia. In patients with fair glycemic control, the prevalence of dyslipidemia increased to 65.5%, whereas 34.5% had no dyslipidemia. The highest prevalence of dyslipidemia was observed among patients with poor glycemic control, where 83.2% had dyslipidemia and only 16.8% did not have dyslipidemia. The association between glycemic status and dyslipidemia was found to be statistically highly significant ($\chi^2$=20.21, p<0.001). The 95% confidence interval for the difference in dyslipidemia prevalence between poor and good glycemic control groups ranged from 19.7% to 53.1%, indicating a strong positive association between worsening glycemic control and dyslipidemia.

## DISCUSSION

In the present study, CAD patients with T2DM had higher BMI, higher prevalence of hypertension, and longer duration of CAD compared to CAD patients without T2DM. These findings are comparable with Arnold et al.(2020)[1], who reported diabetes mellitus as a major cardiovascular risk factor associated with increased burden of atherosclerosis and worse cardiovascular outcomes among CAD patients. Kalaivanan et al.(2017)[2] also observed that patients with CAD and T2DM had significantly altered metabolic risk profiles and increased cardiovascular risk factors compared with non-diabetic individuals receiving statin therapy. The higher prevalence of hypertension and obesity observed in the present study further supports the concept of clustering of cardiovascular risk factors among diabetic CAD patients.

The present study showed significantly deranged lipid parameters in CAD patients with T2DM, including higher total cholesterol, triglycerides, LDL-C, VLDL-C, and lower HDL-C. Dyslipidemia was present in 79.6% of diabetic CAD patients compared to 58.8% of non-diabetic CAD patients. Similar findings were reported by Thomas et al.(2017)[3], who demonstrated significantly elevated total cholesterol, triglycerides, and LDL-C levels with reduced HDL-C levels among patients with type 2 diabetes mellitus compared to healthy individuals. Panjeta et al.(2018)[4] also reported a strong correlation between glycemic control and serum lipid abnormalities in type 2 diabetic patients, particularly increased triglycerides and LDL-C levels. Wang et al.(2020)[5] similarly found that worsening glycemic status was associated with progressively abnormal lipid profiles in patients with T2DM, supporting the lipid abnormalities observed in the present study.

Glycemic parameters were significantly higher in CAD patients with T2DM, with mean fasting blood sugar 154.8 ± 37.6 mg/dL, postprandial blood sugar 226.3 ± 58.4 mg/dL, and HbA1c 8.1 ± 1.4%, compared with non-diabetic CAD patients. Poor glycemic control was present in 73.8% of diabetic CAD patients. These findings agree with Alzahrani et al.(2019)[6], who observed that elevated HbA1c levels were significantly associated with adverse lipid parameters and increased cardiovascular risk among patients with T2DM. Yahya et al.(2023)[7] also demonstrated that uncontrolled diabetic patients had significantly higher triglyceride and LDL-C levels with lower HDL-C compared to controlled diabetic patients. Nnakenyi et al.(2022)[8] further reported that poor glycemic control was closely related to worsening dyslipidemia among T2DM patients in low-resource settings. These studies support the present findings that poor glycemic control contributes to adverse cardiovascular risk profiles in diabetic CAD patients.

The present study further demonstrated a significant association between glycemic status and dyslipidemia. Dyslipidemia increased progressively from 46.8% among patients with good glycemic control to 65.5% among those with fair control and 83.2% among those with poor glycemic control. This association was statistically significant ($\chi^2$=20.21, p<0.001). Similar findings were reported by Artha et al.(2019)[9], who observed that elevated lipid ratios and abnormal lipid parameters were strong predictive markers of poor glycemic control in type 2 diabetes mellitus. Poolsup et al.(2019)[10] also demonstrated through meta-analysis that improvement in glycemic control significantly influenced lipid profile parameters, thereby reducing cardiovascular risk.

## CONCLUSION

The present study demonstrated that patients with Coronary Artery Disease and coexisting Type 2 Diabetes Mellitus had significantly more adverse metabolic profiles compared to CAD patients without diabetes. CAD patients with T2DM showed significantly higher body mass index, greater prevalence of hypertension, and longer duration of coronary artery

disease. Lipid abnormalities were markedly more pronounced among diabetic CAD patients, characterized by elevated total cholesterol, triglycerides, LDL-C, and VLDL-C levels along with significantly reduced HDL-C levels.

The study also revealed substantially poorer glycemic control among CAD patients with T2DM, as evidenced by significantly higher fasting blood sugar, postprandial blood sugar, and HbA1c levels. Furthermore, a strong statistically significant association was observed between worsening glycemic status and the prevalence of dyslipidemia. Patients with poor glycemic control demonstrated the highest prevalence of lipid abnormalities, indicating that uncontrolled hyperglycemia contributes significantly to dyslipidemia and accelerated atherosclerotic progression. These findings emphasize the importance of early detection and aggressive management of dyslipidemia and hyperglycemia in CAD patients, particularly those with T2DM. Regular monitoring of lipid profile and glycemic parameters may help reduce cardiovascular complications, improve prognosis, and decrease long-term morbidity and mortality associated with coronary artery disease.

## LIMITATIONS OF THE STUDY

1) The study was conducted at a single tertiary care center, which may limit the generalizability of the findings to the wider population.
2) The sample size was relatively limited and may not fully represent all CAD patients with and without T2DM.
3) Being a cross-sectional observational study, causal relationships between glycemic control and dyslipidemia could not be established.
4) Long-term follow-up of patients was not performed to assess cardiovascular outcomes and prognosis.
5) Dietary habits, physical activity, and socioeconomic factors influencing lipid profile and glycemic control were not evaluated in detail.
6) The effect of different anti-diabetic and lipid-lowering medications on biochemical parameters was not separately analyzed.
7) Advanced lipid markers such as apolipoproteins and lipoprotein(a) were not included in the study.
8) Severity of coronary artery disease based on angiographic scoring systems was not assessed.
9) Recall bias may have occurred while recording lifestyle factors such as smoking and duration of illness.
10) Genetic predisposition and inflammatory biomarkers associated with CAD and diabetes were not evaluated.

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