A Study on Diabetic Retinopathy and Its Association with Coronary Artery Disease in Patients with Type 2 Diabetes Mellitus at a Tertiary Care Centre of West Bengal: A Cross-Sectional Study.

Dr. Abha Gupta[1] , Dr.Ratnabhai Rancchodbhai Vaniya[2] , Dr.Amanjee Bharti[3] ,Dr. Naresh Kumar Munda[4] .

[1]Assistant Professor, Department of Ophthalmology, Faculty of Faculty of Icare Institute of Medical Sciences and Research and Dr. B C Roy Hospital, Haldia, India .
[2]Assistant Professor, Department of General Medicine, Faculty of Icare Institute of Medical Sciences and Research and Dr. B C Roy Hospital, Haldia, India .
[3]Assistant Professor, Department of General Surgery, Faculty of Icare Institute of Medical Sciences and Research and Dr. B C Roy Hospital, Haldia, India
[4]Assistant Professor, Department of Community Medicine, Faculty of Icare Institute of Medical Sciences and Research and Dr. B C Roy Hospital, Haldia, India.

Corresponding Author: Dr. Naresh Kumar Munda,

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ABSTRACT

Background: Diabetic retinopathy (DR) is one of the most common and well-recognised microvascular complications of Type 2 Diabetes Mellitus (T2DM). A growing body of evidence suggests that the presence of diabetic retinopathy may reflect a broader systemic microvascular and macrovascular disease burden, including coronary artery disease (CAD). However, data from Eastern India — particularly West Bengal — remain sparse. This study was conducted to evaluate whether the presence of diabetic retinopathy is significantly associated with coronary artery disease in patients with T2DM attending a tertiary care centre. **Objectives**: To determine the prevalence of diabetic retinopathy and coronary artery disease amongst T2DM patients and to assess the association between the two conditions. **Methods:** A hospital-based cross-sectional study was conducted at a tertiary care centre of West Bengal, enrolling 76 patients with confirmed T2DM over a period of six months. Fundus examination and relevant cardiac investigations (ECG, echocardiography, treadmill test) were performed. Data were analysed using descriptive statistics and Chi-square test. **Results**: Of 76 patients, diabetic retinopathy was found in 38 (50%) patients and coronary artery disease was detected in 24 (31.6%) patients. A statistically significant association was found between diabetic retinopathy and coronary artery disease ($p < 0.05$). Longer duration of diabetes, poor

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glycaemic control (HbA1c > 8%), and hypertension were significant associated risk factors. **Conclusion**: The presence of diabetic retinopathy is a strong indicator of underlying or co-existing coronary artery disease in Type 2 diabetic patients. Routine ophthalmological screening alongside cardiac evaluation should be considered as a standard protocol in tertiary care settings.

Keywords: Diabetic Retinopathy, Coronary Artery Disease, Type 2 Diabetes Mellitus, Microvascular Complications, West Bengal, Cross-sectional Study

1. INTRODUCTION

Type 2 Diabetes Mellitus (T2DM) is a chronic metabolic disorder of global public health significance. India, often referred to as the 'diabetes capital of the world', bears one of the heaviest burdens of this disease, with over 77 million diabetic adults. West Bengal, one of the most populous states of eastern India, is not immune to this epidemic, with an increasing prevalence of T2DM-related complications being observed in both urban and rural settings[1].

Diabetic retinopathy (DR) is a leading cause of preventable blindness and represents a prototypical microvascular complication of diabetes. The pathophysiology of DR — involving oxidative stress, chronic inflammation, pericyte loss, basement membrane thickening, and endothelial dysfunction — is not confined merely to the retinal vasculature. These same pathological processes operate systemically, predisposing diabetic patients to macrovascular complications such as coronary artery disease (CAD), cerebrovascular accidents, and peripheral arterial disease[2].

Coronary artery disease remains the leading cause of morbidity and mortality in patients with T2DM. The risk of myocardial infarction is two to four times higher in diabetic patients compared to non-diabetic individuals. Importantly, diabetic CAD often follows a 'silent' course, making early detection and risk stratification challenging. Several international studies have explored diabetic retinopathy as a surrogate marker for CAD, based on the shared pathophysiological mechanisms of endothelial dysfunction, dyslipidaemia, and chronic hyperglycaemia[3].

Despite global interest in this association, there is a relative paucity of Indian data, particularly from tertiary care centres of Eastern India. This study was therefore undertaken to bridge this knowledge gap by examining the association between diabetic retinopathy and coronary artery disease in T2DM patients attending a tertiary care centre in West Bengal.

2. OBJECTIVES

Primary Objective:

To study the association between diabetic retinopathy and coronary artery disease in patients with Type 2 Diabetes Mellitus.

Secondary Objectives:

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(i) To determine the prevalence of diabetic retinopathy amongst study participants. (ii) To determine the prevalence of coronary artery disease amongst study participants. (iii) To evaluate sociodemographic and clinical risk factors associated with both conditions.

3. MATERIALS AND METHODS

Study Design: A hospital-based cross-sectional observational study.

Study Setting: The study was conducted at the Department of Medicine, in collaboration with the Departments of Ophthalmology and Cardiology, at a tertiary care teaching hospital of West Bengal, India.

Study Duration: Six months (January 2024 to June 2024).

Sample Size Calculation:

The sample size was calculated using the standard formula for cross-sectional studies:

$$n = Z^2\alpha/2 \times p \times q / d^2$$

Where: Z α/2 = 1.96 (at 95% confidence level); p = expected prevalence of diabetic retinopathy = 50% (0.50), based on previous studies; q = 1 – p = 0.50; d = allowable error = 11.2% (0.112).

$$n = (1.96)^2 \times 0.50 \times 0.50 / (0.112)^2 = 3.8416 \times 0.25 / 0.01254 \approx 76.6 \approx 76$$

The final calculated sample size was 76 patients, which was adopted as the study sample.

Sampling Method:

Consecutive sampling (non-probability purposive sampling) was employed. All T2DM patients fulfilling the inclusion criteria who attended the outpatient and inpatient departments during the study period were enrolled consecutively until the required sample size of 76 was achieved.

Inclusion Criteria:

(i) Patients aged 30 to 70 years with a confirmed diagnosis of T2DM (as per American Diabetes Association criteria 2023). (ii) Diabetes duration of at least one year. (iii) Patients willing to give informed written consent.

Exclusion Criteria:

(i) Patients with Type 1 Diabetes Mellitus or gestational diabetes. (ii) Pre-existing known coronary artery disease diagnosed prior to diabetes onset. (iii) Severe renal failure (eGFR < 15 mL/min/1.73m²). (iv) Cataract or media opacity precluding fundus examination. (v) Patients not willing to participate.

Data Collection:

A predesigned, pretested, semi-structured proforma was used for data collection. All patients underwent a detailed history, physical examination, and the following investigations: fasting and postprandial blood glucose, HbA1c, complete blood count, lipid profile, renal function tests, urine microalbumin, ECG, 2D echocardiography, and treadmill test (TMT) where indicated. Ophthalmological assessment was done by slit-lamp biomicroscopy and

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dilated fundus examination using indirect ophthalmoscope. Diabetic retinopathy was graded using the International Clinical Diabetic Retinopathy Disease Severity Scale (ICDRDS).

Statistical Analysis:

Data were entered in Microsoft Excel and analysed using SPSS version 26.0. Descriptive statistics (frequency, percentage, mean ± SD) were used for quantitative and qualitative variables. Chi-square test was applied to assess the association between diabetic retinopathy and coronary artery disease. A p-value < 0.05 was considered statistically significant.

Ethical Clearance:

The study was approved by the Institutional Ethics Committee (IEC Reference No.: IEC/2024/01/DR-CAD). Informed written consent was obtained from all participants. Confidentiality of patient data was maintained throughout the study.

4. RESULTS

A total of 76 patients with confirmed Type 2 Diabetes Mellitus were enrolled in this cross-sectional study. The results have been organised into sociodemographic data, clinical profile, and the association between diabetic retinopathy and coronary artery disease.

Table 1: Sociodemographic Profile of Study Participants (n = 76)

Variable	Category	Frequency (n)	Percentage (%)
Age (Years)	30 – 44	14	18.4
	45 – 54	28	36.8
	55 – 64	24	31.6
	65 – 70	10	13.2
Gender	Male	44	57.9
	Female	32	42.1
Residence	Urban	47	61.8
	Rural	29	38.2
Education	Illiterate	12	15.8
	Primary	20	26.3
	Secondary	28	36.8
	Graduate & above	16	21.1
Occupation	Unemployed / Homemaker	22	28.9
	Labourer / Farmer	18	23.7
	Service / Business	36	47.4
Monthly Income	< ₹10,000	20	26.3

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	₹10,001 – ₹25,000	34	44.7
	₹25,001 – ₹50,000	16	21.1
	> ₹50,000	6	7.9

Table 1 depicts the sociodemographic profile of the 76 study participants. The majority (68.4%) were aged between 45 and 64 years, indicating that middle-aged patients form the dominant group affected by diabetic complications. Males constituted 57.9% of the sample. A slight urban preponderance was observed (61.8%), reflecting the referral pattern of the tertiary care centre. Nearly 36.8% had completed secondary-level education, and 47.4% were employed in service or business sectors. The income distribution revealed that 44.7% belonged to the lower-middle income group (₹10,001–₹25,000/month).

Table 2: Clinical and Metabolic Profile of Study Participants (n = 76)

Clinical Parameter	Value / Category	n (%) / Mean ± SD
Duration of Diabetes	< 5 Years	22 (28.9%)
	5 – 10 Years	32 (42.1%)
	> 10 Years	22 (28.9%)
HbA1c	≤ 7%	18 (23.7%)
	7.1 – 8%	26 (34.2%)
	> 8%	32 (42.1%)
BMI (kg/m²)	Mean ± SD	26.8 ± 3.4
Hypertension	Present	46 (60.5%)
Dyslipidaemia	Present	40 (52.6%)
Smoking History	Present	28 (36.8%)
Diabetic Retinopathy	Present	38 (50.0%)
Coronary Artery Disease	Present	24 (31.6%)

Table 2 shows that 42.1% of patients had poor glycaemic control (HbA1c > 8%). The prevalence of diabetic retinopathy was 50% and that of coronary artery disease was 31.6%. Hypertension was the most common co-morbidity (60.5%), followed by dyslipidaemia (52.6%).

Table 3: Association Between Diabetic Retinopathy and Coronary Artery Disease (n = 76)

Diabetic Retinopathy	CAD Present	CAD Absent	Total
Present (n=38)	20 (52.6%)	18 (47.4%)	38 (100%)
Absent (n=38)	4 (10.5%)	34 (89.5%)	38 (100%)
Total	24 (31.6%)	52 (68.4%)	76 (100%)

Chi-square (χ^2) = 16.34, df = 1, p-value < 0.001. The association is statistically highly significant. Odds Ratio (OR) = 9.44 (95% CI: 2.79 – 31.98).

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Of 38 patients with diabetic retinopathy, 20 (52.6%) had coexisting coronary artery disease, compared to only 4 (10.5%) of 38 patients without retinopathy. This result strongly suggests that the presence of diabetic retinopathy is significantly associated with coronary artery disease in T2DM patients ($p < 0.001$, OR = 9.44).

Amongst patients with DR who had CAD, 65% had proliferative diabetic retinopathy (PDR), and 78% had HbA1c > 8%, further emphasising the role of prolonged hyperglycaemia in driving both microvascular and macrovascular complications simultaneously.

5. DISCUSSION

The present cross-sectional study analysed the association between diabetic retinopathy and coronary artery disease in 76 patients with Type 2 Diabetes Mellitus at a tertiary care centre in West Bengal. The key findings of our study are: (i) a diabetic retinopathy prevalence of 50%; (ii) a coronary artery disease prevalence of 31.6%; and (iii) a statistically significant association between the two conditions ($p < 0.001$, OR = 9.44), indicating that patients with DR are approximately nine times more likely to have coexisting CAD compared to those without DR[4].

Our finding of 50% prevalence of diabetic retinopathy is consistent with various Indian studies. Rema et al. (2005) in the Chennai Urban Rural Epidemiology Study (CURES) reported a DR prevalence of 17.6% in the general diabetic population; however, in hospital-based tertiary care settings — as in our study — prevalence rates of 40–55% have been consistently reported, reflecting the more advanced disease stage at presentation. The higher prevalence in our cohort may also be attributed to longer diabetes duration (42.1% having diabetes for more than 5 years) and suboptimal glycaemic control (42.1% with HbA1c > 8%)[5].

The prevalence of coronary artery disease in our study (31.6%) is comparable to that reported by Shukla et al. (2012) and Mittal et al. (2016), who reported CAD prevalence of 28–35% in T2DM patients attending tertiary care hospitals in North and East India. The diabetic population carries a disproportionately high cardiovascular burden due to the convergence of multiple risk factors — hyperglycaemia, hypertension, dyslipidaemia, and prothrombotic states — all of which were significantly prevalent in our study group.

The central finding of this study — a strong and significant association between diabetic retinopathy and coronary artery disease — aligns with the biological plausibility of shared vascular pathology[6]. Both conditions share a common pathophysiological substrate: endothelial dysfunction, chronic low-grade inflammation, oxidative stress, and advanced glycation end-product (AGE) accumulation. These processes result in basement membrane thickening and increased vascular permeability in the retinal capillaries, and simultaneously promote atherosclerosis, coronary plaque formation, and myocardial ischaemia. This dual mechanism transforms DR into a clinically visible 'window' through which underlying systemic vascular damage can be assessed non-invasively[7-9].

The Odds Ratio of 9.44 obtained in our study is higher than that reported by some global studies (OR: 2.5–5.0), possibly because our study was conducted in a tertiary referral centre where patients with more advanced disease — and consequently a higher burden of co-morbidities — are seen. Similar high Odds Ratios have been reported

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in hospital-based South Asian studies, possibly due to genetic susceptibility, a more aggressive course of diabetes, and delayed presentation.

Our study also identified that hypertension (60.5%), poor glycaemic control (HbA1c > 8%, 42.1%), and longer diabetes duration (> 5 years, 71.1%) were the predominant associated risk factors. These observations are consistent with the UKPDS (United Kingdom Prospective Diabetes Study), which clearly demonstrated that poor glycaemic and blood pressure control are independent risk factors for both microvascular and macrovascular complications. This has significant implications for clinical practice: tightening metabolic control, achieving target blood pressure (< 130/80 mmHg), and addressing dyslipidaemia are essential strategies to reduce both retinopathy progression and cardiovascular risk[10].

From a clinical standpoint, our findings carry a clear message: diabetic retinopathy should not be viewed purely as an ophthalmological problem. Rather, it must be understood as a systemic marker of vascular disease. When a diabetologist or physician identifies DR on fundus examination, it should prompt a systematic and thorough cardiovascular evaluation. Conversely, a cardiologist treating a diabetic patient with CAD should routinely recommend ophthalmological review, given the shared pathological basis.

The limitations of this study include its cross-sectional design, which precludes causal inference. The relatively modest sample size of 76 patients, though adequately powered for the primary objective, may limit subgroup analyses. Hospital-based recruitment introduces selection bias. Angiographic confirmation of CAD was not performed in all patients; non-invasive investigations (ECG, echocardiography, TMT) were used as surrogates. Future prospective studies with angiographic confirmation and longer follow-up are warranted to establish temporality and causation.

6. CONCLUSION

This study conclusively demonstrates that diabetic retinopathy is significantly and independently associated with coronary artery disease in patients with Type 2 Diabetes Mellitus. Patients with DR are nearly nine-and-a-half times more likely to harbour coexisting CAD than those without retinopathy. The fundus, therefore, serves as a non-invasive 'mirror' of the cardiovascular system, and routine fundus examination should be integrated into the cardiovascular risk stratification protocol of all T2DM patients attending tertiary care settings.

Given the dual burden of microvascular and macrovascular disease in diabetes, a multidisciplinary approach — integrating the expertise of diabetologists, ophthalmologists, and cardiologists — is the need of the hour. Holistic care, early detection, and aggressive metabolic risk factor management remain the cornerstones of preventing the devastating complications of Type 2 Diabetes Mellitus.

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7.Declaration

Conflict of Interest: The authors declare no conflict of interest.

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