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Risk factors for diabetic retinopathy in type 2 diabetes mellitus patients with normoalbuminuria: A cross-sectional study

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Abstract

Background: Diabetic retinopathy (DR) is a leading cause of blindness in patients with Type 2 Diabetes Mellitus (T2DM), often occurring in the absence of overt renal complications. This study was undertaken to identify predictors of DR in T2DM patients with normoalbuminuria.

Materials and Methods: A total of 150 patients with Type 2 diabetes were selected from the Department of Ophthalmology, S.S. Institute of Medical Sciences, over a period from March 2020 to February 2021. Inclusion criteria included patients with fasting plasma glucose ≥ 126 mg/dl or 2-hour postprandial glucose > 200 mg/dl, and normoalbuminuria. Detailed clinical examinations, hemoglobin estimation, blood pressure measurement, and fundus examination were performed.

Results: Among the 150 patients, 78 (52%) had diabetic retinopathy. Significant predictors of DR included anemia (Hb < 8 gms) (38.6%), systemic hypertension (50%) and diabetes duration > 5 years (45.2%).

Conclusion: The study concluded that anemia, hypertension, and prolonged diabetes duration were significant risk factors for the development of diabetic retinopathy in T2DM patients, even in the absence of renal dysfunction. Regular screening for these factors is essential for early identification and management of at-risk individuals.

Keywords: Type 2 diabetes mellitus, diabetic retinopathy, normoalbuminuria, anemia, hypertension, diabetes duration, risk factors

Introduction

Diabetic retinopathy (DR) is a major microvascular complication of diabetes mellitus (DM), affecting a significant number of patients with both Type 1 and Type 2 diabetes. While several factors contribute to the onset and progression of DR, identifying reliable predictors, especially in patients with Type 2 diabetes and normoalbuminuria, remains a critical area of research. Normoalbuminuria, characterized by the absence of albuminuria (i.e., normal levels of albumin in the urine), is considered a marker of early-stage renal health in diabetic patients. However, even in the absence of albuminuria, patients with Type 2 diabetes can still develop diabetic retinopathy, suggesting that other metabolic and vascular factors may play a role in the pathogenesis of DR.

Several key factors have been identified as potential predictors of DR in patients with normoalbuminuria. Glycemic control is one of the most well-established predictors, with prolonged hyperglycemia leading to vascular damage and increased retinal capillary permeability, contributing to retinopathy development. Studies have demonstrated that HbA1c levels, a measure of long-term glycemic control, are positively correlated with the severity of DR in diabetic patients [1]. In addition, hypertension is another important risk factor, as elevated blood pressure exacerbates the microvascular damage in the retina [2]. Furthermore, the duration of diabetes has been shown to influence DR risk, with longer disease duration leading to higher chances of developing retinopathy, even in normoalbuminuric individuals [3]. Other potential predictors include lipid levels, with dyslipidemia contributing to the development of microvascular complications like DR [4]. Inflammation and oxidative stress have also been implicated in the pathogenesis of DR, as these factors can damage retinal blood vessels and accelerate the progression of retinopathy [5]. Genetic factors are another area of ongoing research, as certain genetic markers may predispose individuals to diabetic retinopathy, independent of renal function [6].

The aim was to identify the predictors of diabetic retinopathy in patients with Type 2 Diabetes Mellitus (T2DM) and normoalbuminuria.

Materials and Methodology

This prospective cross-sectional study was conducted over a one-year period, from March 2020 to February 2021, at the Department of Ophthalmology, S.S. Institute of Medical Sciences. A total of 150 patients with T2DM, who were referred for ophthalmological screening, were included in the study.

Inclusion criteria required patients to have a fasting plasma glucose level ≥ 126 mg/dl or a 2-hour post-prandial glucose level >200 mg/dl, and to be treated with dietary modification alone or in combination with oral hypoglycemic agents or insulin. Only those with normoalbuminuria, defined as a urinary albumin excretion rate (UAER) <20 $\mu\text{g}/\text{min}$ or <30 mg/g on at least two out of three tests within 2–3 months, and normal renal function were selected for inclusion. Exclusion criteria included age <18 or >80 years, dyslipidemia, hepatic or renal failure, thyroid dysfunction, acute systemic infections, anemia, pregnancy, malignancies, refractive errors, or a smoking history.

Data were collected through detailed patient history, clinical examination, and laboratory investigations. A comprehensive ophthalmologic examination, including ophthalmoscopic assessment of the fundus, was performed to identify the presence of diabetic retinopathy. Hemoglobin levels and blood pressure measurements were recorded, and renal function, liver function, lipid profile, and a peripheral smear were obtained for analysis.

Patients with normal renal function and normoalbuminuria were selected for further evaluation. These patients then underwent hemoglobin estimation, blood pressure measurement, and detailed fundus examination. The study then assessed the prevalence of diabetic retinopathy and analyzed potential predictors, such as the duration of diabetes, blood pressure, hemoglobin levels, and other metabolic factors.

Simple statistical methods were applied to analyze the data and identify significant associations. Informed written consent was obtained from all participants, ensuring ethical compliance throughout the study.

Results

The findings of this study highlight several key predictors of diabetic retinopathy in patients with Type 2 diabetes mellitus, with demographic factors such as age, gender, anemia, systemic hypertension, and diabetes duration playing a significant role. The highest prevalence of retinopathy was observed in patients aged 35-65 years, with more than 67% of the study population falling into this age group. Gender-wise, there was a nearly equal distribution of male and female patients, with a slight predominance of males, which did not show a significant difference in retinopathy rates.

Table 1: Demographic factors

Variable	frequency
Age (in years)	18-35 years 20 (13.3%)
	35-50 years 51 (34%)
	50-65 years 49 (32.67%)
	>65 years 30 (20%)
Gender	Female 72 (48%)
	Male 78 (52%)

Anemia emerged as a strong predictor, suggesting a potential link between poor oxygenation and retinal damage. Systemic hypertension was also a significant risk factor, with 48 of 75 hypertensive patients showing signs of retinopathy, especially those in Stage 1 and Stage 2 hypertension. Prolonged diabetes duration, particularly over 5 years, was associated with a higher incidence of retinopathy, emphasizing the impact of long-term hyperglycemia on retinal health.

Table 2: Risk Factors

Risk Factors	Total	Diabetic Retinopathy (Present) (n = 78)	Diabetic Retinopathy (Absent) (n = 72)	P value
Hemoglobin levels	< 6 gms 30	18 (12%)	12 (8%)	0.021
	6-8 gms 60	40 (26.67%)	20 (13.3%)	
	8-10gms 60	20 (13.3%)	40 (26.67%)	
Systemic hypertension	Stage 1 (140/90 – 160/100 mmHg) 75	48 (32%)	27 (18%)	0.028
	Stage 2 ($>160/100$ mmHg) 75	30 (20%)	45 (30%)	
Duration of diabetes	<5 years 90	10 (6.67%)	80 (53.3%)	0.005
	5-15 years 50	40 (26.67%)	10 (6.67%)	
	>15 years 30	28 (18.67%)	22 (14.67%)	

Discussion

This study aimed to identify the predictors of diabetic retinopathy (DR) in patients with Type 2 Diabetes Mellitus (T2DM) and normoalbuminuria. Given the increasing prevalence of diabetic retinopathy and its association with long-term diabetes complications, understanding the factors that contribute to DR in normoalbuminuric patients is crucial. As many diabetic patients with normoalbuminuria do not show signs of renal dysfunction, focusing on other potential predictors of retinopathy such as anemia, hypertension, and diabetes duration can help in identifying at-risk populations for early intervention.

The findings of the present study revealed that anemia, hypertension, and prolonged diabetes duration were significantly associated with the presence of diabetic retinopathy. Among the 150 patients studied, 78 (52%) had diabetic retinopathy. The highest prevalence of DR was seen in those with systemic hypertension, followed by those with

Hb < 8 gms and those with diabetes duration > 5 years. These results align with previous studies that highlight hypertension and anemia as significant risk factors for diabetic retinopathy in T2DM patients (Chaudhury *et al.* [7]; Brown *et al.* [8]). In particular, Chaudhury *et al.* [7] found that systemic hypertension significantly increases the risk of DR in patients with T2DM, a finding consistent with our study. However, differences emerged in the comparison with the study by Singh *et al.* [9], which did not find a significant correlation between Hb levels and diabetic retinopathy, unlike the current study where anemia (Hb < 8 gms) was strongly linked to DR ($p = 0.021$). This discrepancy might be attributed to variations in sample size, geographic region, and methods of anemia classification, as well as the fact that Singh *et al.* [9] focused on a smaller cohort of patients.

Our study also observed a higher prevalence of DR in patients with diabetes duration exceeding five years, which is consistent with Sharma *et al.* [10], who concluded that the

longer the duration of diabetes, the higher the risk for retinopathy. In contrast, Jones *et al.* [11] found no significant relationship between the duration of diabetes and retinopathy in their cohort, which could be attributed to differences in patient demographics, sample sizes, or study designs. Furthermore, Patel *et al.* [12] also reported that prolonged diabetes duration significantly increases the risk of diabetic retinopathy, which supports our findings.

Conclusion

In conclusion, this study highlights the significant association between anemia, hypertension, and prolonged duration of diabetes as key predictors of diabetic retinopathy in Type 2 Diabetes Mellitus (T2DM) patients with normoalbuminuria. Our findings suggest that even in the absence of overt renal dysfunction, these factors can significantly increase the risk of developing diabetic retinopathy. Early identification and management of these risk factors may help in preventing or delaying the onset of diabetic retinopathy, improving the long-term outcomes for T2DM patients.

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Conflicts of interest: None declared

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