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Original Research Article

Study on the Correlation between Diabetic Retinopathy and Systemic Complications in Diabetes Mellitus

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Abstract:

Introduction: Diabetic Retinopathy (DR) is a highly specific microvascular complication commonly seen in individuals with both type 1 and type 2 diabetes mellitus (DM), often leading to considerable visual impairment among adults globally. Various systemic factors play a role in the onset and progression of DR. Early detection and effective management of these risk factors during the initial stages of diabetes mellitus may help reduce the likelihood of DR development and limit its progression and severity.

Aim: The aim of this study is to describe the correlation between Diabetic Retinopathy and Systemic Complications in Diabetes Mellitus in a tertiary care hospital in Bhopal.

Materials and Methods: The study consists of 350 diabetic patients who visited the Ophthalmology Outpatient Department at Chirayu Medical College & Hospital Bhopal, between May 2023 till May 2025. Each patient underwent a thorough clinical evaluation, along with relevant investigations, to identify the presence of systemic complications such as retinopathy, nephropathy, neuropathy, cardiovascular disease, cerebrovascular events, and diabetic foot. The study also examined the association between the duration of diabetes and both the stage of retinopathy and the occurrence of systemic complications.

Results: A total of 350 diabetic patients with a mean age of 50.0 ± 15.0 years were included in the study and among them males were 211 (31.7%) and females were 99 (31.7%). A significant association was observed ($p<0.001$) between the duration of diabetes and the presence and severity of diabetic retinopathy. The overall prevalence of nephropathy, neuropathy, diabetic foot, CVS, CAD was 54.28 % and they were significantly more common in patients with DR as compared to those with no DR and complications increases with the severity of retinopathy.

Conclusion: Patients with DM should be encouraged to optimise their control of the disease in order to prevent the development and progression of diabetic retinopathy. Of the systemic risk factors studied, a positive association was found between hypertension, CKD, CAD, CVA and diabetic retinopathy.

Keywords: Diabetic Retinopathy, Diabetes Mellitus, hypertension, CKD, CAD, CVA.

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Introduction

Diabetic retinopathy is a microvascular disorder that affects the eyes of individuals with both type 1 and type 2 diabetes mellitus [1]. According to the World Health Organization, diabetic retinopathy accounts for approximately 4.8% of the 37 million global cases of blindness [2]. In India, there are currently around 31.7 million people living with diabetes, and this figure is projected to increase dramatically to 79.4 million by the year 2030 [3]. Diabetes mellitus is a complex and heterogeneous syndrome characterized not only by disturbances in carbohydrate metabolism but also by abnormalities in lipid and protein metabolism. These metabolic disruptions lead to various pathophysiological alterations throughout multiple organ systems, with the likelihood of complications rising as the duration of the disease increases. The risk factors for development and progression of DR can be broadly divided into modifiable factors; hyperglycaemia, hypertension, hyperlipidemia and obesity, and non-modifiable factors such as; duration of DM, puberty and pregnancy.

After two decades of living with diabetes, nearly all individuals with type 1 diabetes (around 99%) and approximately 60% of those with type 2 diabetes develop some form of retinopathy. Diabetic nephropathy eventually affects about 25 to 40 percent of patients with type 1 diabetes and 20 to 30 percent of those with type 2 diabetes. Additionally, neuropathy is present in approximately 60 to 70 percent of people with diabetes. Diabetes also serves as a major risk factor for cardiovascular diseases. These systemic complications contribute significantly to increased morbidity and mortality rates among diabetic patients. The detection of diabetic retinopathy often signals the presence of such complications, positioning ophthalmologists as key figures in the early identification and management of these diabetes-related health issues.

Classification of diabetic retinopathy: The Early Treatment Diabetic Retinopathy Study (ETDRS) Diabetic Retinopathy Grading Scale (Modified Airlie House) and International Clinical Diabetic Retinopathy (ICDR) Severity Scale are the two major and most commonly used classification systems for diabetic retinopathy. The ETDRS Grading Scale is more commonly used in research contexts whereas the ICDR Severity Scale is more commonly used in the clinical context. Additionally, the United Kingdom National Screening Committee (UK NSC) diabetic retinopathy grading system is notable for its widespread use in digital fundus photo screening programmes worldwide.

In general, diabetic retinopathy can be classified as non-proliferative or proliferative. Non-proliferative can then be further classified by severity ranging from mild to moderate and severe. Non-proliferative diabetic retinopathy (NPDR) is characterised by the presence of microaneurysms, hard exudates, cotton-wool spots, and/or retinal haemorrhages. Pre-proliferative diabetic retinopathy changes include vasculopathies such as intraretinal microvascular abnormality (IRMA) whereas proliferative diabetic retinopathy is defined by the presence of neovascularisation or vitreous haemorrhage or preretinal haemorrhage.

The ETDRS Diabetic Retinopathy Grading Scale assigns a retinopathy severity score from level 10 to 85. If no abnormality is found, ETDRS level 10 is assigned. If only microaneurysms are present, ETDRS level 20 (very mild NPDR) is assigned. The ETDRS level 35 is equivalent to mild NPDR, and is characterised by the presence of hard exudates, cotton-wool spots, and/or mild retinal haemorrhages. Standard retinal photographs of retinal haemorrhages and IRMA are used to define moderate and severe NPDR in the ETDRS grading. The number of quadrants in which those signs are present is also taken into account. In contrast, a simple 4-2-1 rule is used in the ICDR Severity Scale: mild NPDR is defined as the presence of microaneurysms only. Severe NPDR is diagnosed when there are ≥20 diffuse intraretinal haemorrhages and/or microaneurysms in all four quadrants, venous beading in at least two quadrants, or intraretinal microvascular abnormalities in at least one quadrant. Moderate NPDR on the other hand has severity falling below the 4-2-1 rule but more than merely microaneurysms. In both grading scales, proliferative diabetic retinopathy is defined as the presence of neovascularisation. High-risk and advanced proliferative diabetic retinopathy (ETDRS level, 71-85) refers to the presence of neovascularisation complications including preretinal haemorrhage, vitreous haemorrhage, or retinal detachment [4].

Materials and Methods

This study included 350 diabetic patients who visited the Department of Ophthalmology at Chirayu Medical College & Hospital Bhopal, between May 2023 to May 2025. A thorough medical history was obtained, documenting age at diabetes onset, disease duration, treatment modalities for diabetes, any prior ocular therapies, and other systemic illnesses. Each patient underwent a comprehensive eye examination. The severity of diabetic retinopathy (DR) was assessed using fundus biomicroscopy and classified according to the Early Treatment Diabetic Retinopathy Study (ETDRS) guidelines into five categories: 1) No DR, 2) Mild Non-Proliferative Diabetic Retinopathy (NPDR), 3) Moderate NPDR, 4) Severe NPDR, and 5) Proliferative Diabetic Retinopathy (PDR).

For study purpose, the eye with the more advanced stage of retinopathy was taken into consideration. Nephropathy was identified based on elevated serum creatinine levels and the presence of microalbuminuria. Clinical evaluation of diabetic neuropathy included sensory tests for pain, touch, temperature, and vibration, along with assessment of superficial and deep tendon reflexes. Coronary artery disease (CAD) was diagnosed using patient history, medical records, electrocardiograms (ECG), and echocardiography (ECHO). Cerebrovascular disease was identified through documented history of stroke. Following data collection, statistical analyses were performed on the compiled results.

Observation Table & Results:

A total of 350 individuals diagnosed with diabetes mellitus participated in the study. Their ages ranged between 35 to 65 years, with an average age of 50.0 ± 15.0 years. Among these participants, 211 (68.3%) were male and 99 (31.7%) were female.

Diabetic retinopathy was identified in 128 patients. Within this group, 45 patients exhibited mild non-proliferative diabetic retinopathy (NPDR), 40 patients had moderate NPDR, 30 patients were diagnosed with severe NPDR, and 13 patients

presented with proliferative diabetic retinopathy (PDR). As the duration of diabetes increases, the presence & severity of retinopathy increases significantly.

Overall, systemic complications were observed in 54.28% of the patients. These complications were significantly more frequent in individuals with diabetic retinopathy as compared to those without retinopathy ($p < 0.001$). Among the systemic conditions, hypertension was the most commonly seen complication, followed by chronic kidney disease, peripheral neuropathy, coronary artery disease, diabetic foot and cerebrovascular accident. These systemic complications were notably more prevalent in patients with diabetic retinopathy than in those without DR. When evaluating the distribution of systemic complications across different stages of retinopathy, the highest proportion was found in patients with mild NPDR, followed by those with moderate NPDR, severe NPDR, and proliferative diabetic retinopathy.

Table 1: Correlation between duration of Diabetes Mellitus & Diabetic Retinopathy

Duration of Diabetes Mellitus	Diabetic Retinopathy Present	Diabetic Retinopathy Absent	p-Value
1-10 Year	15	107	< 0.001
10-20 Years	59	99	< 0.001
>20 Years	54	16	< 0.001

Table 2: Correlation between duration of Diabetes Mellitus & severity of Diabetic Retinopathy

Duration of Diabetes Mellitus	No DR (Diabetic Retinopathy)	Mild NPDR	Moderate NPDR	Severe NPDR	PDR	p-Value
1-10 Year	110	5	5	6	2	
10-20 Years	100	35	13	12	6	< 0.001
>20 Years	12	5	22	12	5	

Table 3: Correlation between Diabetic Retinopathy & Systemic Complications of Diabetes Mellitus

Diabetic Retinopathy	Hypertension	CKD	Peripheral Neuropathy	CVA	CAD	Diabetic Foot
Present	45	40	39	10	38	18
Absent	40	37	30	7	29	17

Table 4: Correlation between severity of Diabetic Retinopathy with Systemic Complications of Diabetes Mellitus

Systemic Complications	Mild NPDR	Moderate NPDR	Severe NPDR	PDR	p-Value
Hypertension	40	36	5	4	< 0.001
CKD	35	35	4	3	0.003
Peripheral Neuropathy	45	24	0	0	< 0.001
CVA	10	4	2	1	<0.05
CAD	40	8	3	1	< 0.001
Diabetic Foot	8	6	3	2	<0.05

Discussion

The current study evaluated 350 individuals with diabetes mellitus, among whom 128 patients were diagnosed with diabetic retinopathy (DR). The findings suggest that DR may appear as early as 1-10 years of diabetes onset and becomes increasingly prevalent with time, affecting over 88% of patients after 20 years of having the disease. Both the frequency and severity of DR were observed to rise significantly with the duration of diabetes. This correlation between diabetes duration and DR is well-known [5]. The CURES Eye Study reported that 41.8% of patients developed DR after 15 years of diabetes, with severity progressively increasing alongside disease duration [6].

When examining the link between DR and systemic diabetic complications, it was noted that 190 patients with DR exhibited systemic issues, in contrast to only 160 among those without DR a statistically significant difference ($p = 0.001$).

Hypertension has been consistently demonstrated to have a positive association with the development of diabetic retinopathy. Diabetic Kidney Disease: Diabetic nephropathy was diagnosed in 40 patients with DR, compared to those without DR, showing a significant statistical difference ($p = 0.003$). Similar findings were observed by Venkatesh P et al. [7] and Tajunisah I et al. [8], who also reported a positive association between DR and overt kidney disease.

Peripheral neuropathy was present in 39 patients with DR, significantly higher than among those

without DR ($p < 0.001$). These findings align with earlier studies by Venkatesh P et al. [7] and Dyck et al. [9], both of which identified a strong correlation between DR and diabetic neuropathy.

Diabetic Foot complications were present in 18 patients with DR as compared to those without DR a statistically significant difference ($p < 0.05$) was found. The present study is in accordance with the study done by Ahmati I et al. [10] who reported DR to be a significant risk factor for the development of the diabetic foot

Stroke incidence (CVA) was observed in 10 patients with DR, compared to those without DR, indicating a significant association ($p < 0.05$). Nakayama et al. [11] also noted a link between retinopathy and increased stroke risk, particularly among hypertensive patients.

Coronary Artery Disease (CAD) was found more frequently in the DR group than among those without DR, a statistically significant difference. This observation is consistent with the study done by Gadkari SS et al. [12] and Cheung et al. [13], who reported that retinopathy corresponds with a two-fold increase in the risk of developing coronary heart disease and a three-fold increase in the risk of fatal cardiac events.

In this study we found systemic complications of DM correlating with greater severity of diabetic retinopathy. Studies by Venkatesh P et al. [7] and Klein et al. [14] also reported a significant association of overt nephropathy and neuropathy with the severity of DR. A similar pattern was observed for coronary artery disease, by Gerstein HC et al. [15] and Cheung et al. [13] establishing that its prevalence rises with worsening DR severity. Additionally, studies conducted by Klein et al. [14] highlighted that proliferative diabetic retinopathy was independently associated with stroke-related mortality, irrespective of diabetes duration, glycemic status, or other risk factors in both type 1 and type 2 diabetic populations.

Conclusion

Our findings indicate that diabetic retinopathy is linked to an elevated risk of both microvascular and macrovascular complications in individuals with diabetes. The presence of retinopathy may serve as an indicator of vascular injury not only localized to the eyes but also affecting other critical organs, including the brain, heart, and kidneys. Therefore, it is essential to conduct comprehensive evaluations to identify coexisting systemic complications in all patients diagnosed with diabetic retinopathy, regardless of its stage. Early detection and management of associated organ damage can contribute significantly to reducing the overall morbidity and mortality associated with advanced diabetic complications.

Conflict of Interest: None.

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