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PREVALENCE OF DIABETIC RETINOPATHY IN PATIENTS WITH DIABETES AND CHRONIC KIDNEY DISEASE: A CROSS SECTIONAL STUDY

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Abstract

Background: Diabetic retinopathy (DR) and chronic kidney disease (CKD) are major microvascular complications of type 2 diabetes mellitus (T2DM) that frequently coexist and share common pathogenic mechanisms. The relationship between the severity of DR and stages of CKD in T2DM remains insufficiently explored, particularly in the Indian population. ***Objectives***: To estimate the prevalence of diabetic retinopathy in patients with chronic kidney disease and type 2 diabetes mellitus and to see the association between different grades of diabetic retinopathy and stages of chronic kidney disease. ***Methods***: This hospital-based cross-sectional observational study was conducted on 140 patients with CKD and T2DM. Detailed ophthalmic examination was performed, and diabetic retinopathy was graded using the Early Treatment Diabetic Retinopathy Study (ETDRS) classification. CKD staging was done using standard criteria. Statistical analysis was carried out using appropriate descriptive and inferential tests. ***Results***: The prevalence of diabetic retinopathy was 63.5%. Moderate non-proliferative diabetic retinopathy was the most common grade. Patients with DR had significantly higher serum urea, creatinine, and HbA1c levels compared to those without DR ($p < 0.001$). A significant association was observed between advancing CKD stage and both the presence and severity of DR ($p < 0.001$), with advanced retinopathy predominantly seen in CKD stages 4 and 5. ***Conclusion***: Diabetic retinopathy is highly prevalent among patients with CKD and T2DM, and its severity increases with worsening renal function. Regular retinal screening in CKD patients is essential for early detection and prevention of vision-threatening complications.

Keywords: Diabetic retinopathy; Chronic kidney disease; Type 2 diabetes mellitus; Non-proliferative diabetic retinopathy; Microvascular complications.

INTRODUCTION

Diabetes mellitus (DM) is a major global health problem and one of the leading causes of chronic microvascular complications, particularly diabetic retinopathy (DR) and chronic kidney disease (CKD). Persistent hyperglycemia results in structural and functional damage to small blood vessels, leading to progressive injury to organs such as the retina and kidneys. Diabetic retinopathy is the most common cause of preventable blindness among working-age adults worldwide, while diabetic kidney disease is the leading cause of chronic kidney disease and end-stage renal disease in many countries1,2.

Diabetic retinopathy develops as a result of chronic hyperglycemia-induced retinal microvascular damage, characterized by capillary basement membrane thickening, pericyte loss, microaneurysm formation, and retinal ischemia. The global prevalence of diabetic retinopathy among individuals with diabetes has been estimated to be approximately 34%, with around 10% of patients developing vision-threatening diabetic retinopathy3. Several risk factors such as longer duration of diabetes, poor glycemic control, hypertension, dyslipidemia, and nephropathy have been associated with the development and progression of diabetic retinopathy4.

Chronic kidney disease is another major complication of diabetes mellitus, affecting nearly 20–40% of patients with diabetes5. Diabetic kidney disease is characterized by progressive albuminuria, declining glomerular filtration rate, and structural changes including mesangial expansion, glomerular basement membrane thickening, and glomerulosclerosis. The retina and kidney share similar embryological origin and microvascular architecture, making them susceptible to similar pathophysiological processes in diabetes6.

Several studies have demonstrated a strong association between diabetic retinopathy and chronic kidney disease. The presence of retinopathy has been shown to correlate with the severity of diabetic nephropathy and declining kidney function. Patients with CKD often have a higher prevalence and severity of diabetic retinopathy compared with diabetic individuals without renal disease7. Additionally, the prevalence of DR tends to increase with advancing stages of CKD, suggesting that retinal microvascular damage may reflect systemic microvascular disease burden8.

Despite the established relationship between CKD and diabetic retinopathy, the reported prevalence of DR among patients with diabetes and CKD varies widely across populations due to differences in demographic characteristics, disease duration, access to screening programs, and study methodologies. Furthermore, data from many developing countries remain limited. Estimating the prevalence of diabetic retinopathy in patients with chronic kidney disease and diabetes mellitus is important for early detection of vision-threatening disease and for improving integrated care between nephrologists and ophthalmologists.

Therefore, the present study aims to estimate the prevalence of diabetic retinopathy among patients with chronic kidney disease and diabetes mellitus attending a tertiary care center and to assess the association between diabetic retinopathy and clinical parameters in this population.

OBJECTIVES

- To study the prevalence of diabetic retinopathy in patients with chronic kidney disease and type 2 diabetes mellitus.
- To find association of different grades of diabetic retinopathy with various stages of chronic kidney disease.

MATERIALS AND METHODS

This hospital-based cross-sectional observational study was conducted in the Upgraded Department of Ophthalmology, Government Medical College Hospital, Jammu, over a period of one year from 1st August 2023 to 31st July 2024. The study was carried out after obtaining approval from the Institutional Ethics Committee, and all procedures were performed in accordance with ethical standards. The study population comprised patients diagnosed with Type 2 diabetes mellitus and chronic kidney disease who attended the ophthalmology outpatient department, were referred from other clinical specialties, or were admitted to the medicine wards of the hospital. Sample size estimation was performed using OpenEpi software version 3.01, based on a previously reported prevalence of diabetic retinopathy of 77.5%, with a 95% confidence interval, 80% power, 7% margin of error, and α level of 0.05. The calculated minimum sample size was 137 patients. Participants were recruited without restriction on sex, ethnicity, or occupation.

Patients aged 40 years and above with confirmed Type 2 diabetes mellitus and chronic kidney disease who were hospitalized or on follow-up were included in the study. Patients with glaucoma, uveitis, media opacities precluding adequate fundus examination, prior vitreoretinal surgery or laser treatment, use of retinotoxic drugs such as chloroquine, connective tissue disorders, or those unwilling to provide informed consent were excluded. Written informed consent was obtained from all eligible participants after explaining the nature and purpose of the study. Each patient underwent a detailed clinical evaluation, including medical history and general physical examination. Relevant history included demographic details, duration and onset of diabetes and kidney disease, family history, smoking and alcohol consumption, hypertension, dialysis or renal transplantation, ocular trauma or surgery, systemic and ocular medications, and allergic history.

Comprehensive ophthalmic examination was performed for all participants. Best-corrected visual acuity for distance and near vision was assessed, and intraocular pressure was measured using a Goldmann applanation tonometer. Examination of the orbit, adnexa, extraocular movements, and pupillary reflexes was carried out. Pupillary dilation was achieved using 0.8% tropicamide combined with 5% phenylephrine hydrochloride. Posterior segment evaluation was conducted using slit-lamp biomicroscopy with a 90-diopter lens and indirect ophthalmoscopy with a 20-diopter lens. Diabetic retinopathy was graded according to the Early Treatment Diabetic Retinopathy Study (ETDRS) classification, and hypertensive retinopathy, when present, was graded using the Keith–Wagener–Barker classification. Fundus photographs were obtained where clinically indicated. All data were entered into a Microsoft Excel spreadsheet and analyzed using IBM SPSS Statistics for Windows, version 25.0. Categorical variables were expressed as frequencies and percentages, while continuous variables were presented as mean ± standard deviation. Comparisons between groups were performed using the chi-square test for qualitative variables and the independent sample t-test for quantitative variables. A p-value of less than 0.05 was considered statistically significant.

RESULTS

The present study included 140 patients with chronic kidney disease and type 2 diabetes mellitus, evaluated over a one-year period. The mean age of the study population was 60.7 ± 9.56 years, with the majority of patients belonging to the 61–70-year age group (35.7%). Males constituted 60.7% of the study population, while females accounted for 39.3%.

Diabetic retinopathy was detected in 89 patients, yielding a prevalence of 63.5%, whereas 51 patients (36.4%) showed no evidence of retinopathy. Among patients with diabetic retinopathy, moderate non-proliferative diabetic retinopathy (NPDR) was the most common grade (40.4%), followed by mild NPDR (28.9%) and severe NPDR (19.1%). Advanced diabetic eye disease (ADED) was observed in 8.9% of patients, while high-risk proliferative diabetic retinopathy (PDR) was present in 3.3%. No patient had early PDR. Systemic hypertension was present in 103 patients (73.5%). Among hypertensive patients, hypertensive retinopathy was observed in 57.3%, with Grade 1 hypertensive retinopathy being the most frequent (39.8%).

Patients with diabetic retinopathy had significantly higher mean serum urea, creatinine, and glycated haemoglobin levels compared to those without retinopathy ($p<0.001$ for all parameters). A significant association was observed between the stage of chronic kidney disease and the presence of diabetic retinopathy ($p < 0.001$). No patient with CKD stages 1 or 2 had diabetic retinopathy, whereas the highest prevalence was seen in CKD stage 5 (25.7%). Furthermore, increasing CKD stage was significantly associated with greater severity of diabetic retinopathy, with severe NPDR, high-risk PDR, and ADED predominantly observed in stages 4 and 5 CKD ($p < 0.0001$).

Table 1: Demographic Characteristics of the Study Population (n = 140)

Variable	Number (%)
Mean age (years)	60.7 ± 9.56
Male	85 (60.7)
Female	55 (39.3)

Table 2: Prevalence and Grades of Diabetic Retinopathy (n = 89)

Grade of Diabetic Retinopathy	Number	Percent
Mild NPDR	25	28.9
Moderate NPDR	36	40.4
Severe NPDR	17	19.1
High-risk PDR	3	3.3
ADED	8	8.9
Total	89	100.00

Table 3: Comparison of Biochemical Parameters in Patients With and Without Diabetic Retinopathy

Parameter	DR Present	DR Absent	p-value
Urea (mg/dl)	113.7 ± 57.9	74.6 ± 22.0	<0.001
Creatinine (mg/dl)	4.59 ± 2.79	2.47 ± 1.06	<0.001
HbA1c (%)	10.23 ± 1.72	8.71 ± 1.19	<0.001

Table 4: Association Between CKD Stage and Diabetic Retinopathy

CKD Stage	DR Present n (%)	DR Absent n (%)	P value
Stage 1–2	0	3 (2.1)	p < 0.001
Stage 3	25 (17.8)	29 (20.7)	
Stage 4	28 (20.0)	15 (10.7)	
Stage 5	36 (25.7)	4 (2.85)	

DISCUSSION

Diabetes mellitus is a major global health problem, with diabetic retinopathy representing one of its most common microvascular complications and a leading cause of visual impairment. Chronic kidney disease, another microvascular consequence of diabetes, shares common pathogenic mechanisms with diabetic retinopathy, including chronic hyperglycaemia, oxidative stress, and endothelial dysfunction. The coexistence of these conditions highlights the systemic nature of diabetic microangiopathy.

In the present study, the mean age of patients was 60.7 ± 9.56 years, with the majority belonging to the 61–70-year age group. This age distribution is comparable to previous studies by Bello et al., Muller et al., Park et al., and Pai et al., which reported mean ages ranging between 57 and 66 years, reflecting the cumulative effect of long-standing diabetes and renal disease in older individuals.9-12 A male predominance was observed in our study, similar to findings reported by Lin et al.13 and Muller et al.,10 although Park et al.11 reported a slight female predominance. The prevalence of diabetic retinopathy in our study was 63.5%, which is comparable to reports by Muller et al. (71%)10 and Pai et al.12 (77.5%).
With regard to the severity of diabetic retinopathy, moderate NPDR was the most common presentation in our study, followed by mild and severe NPDR. Similar distributions have been reported by Pai et al.12 suggesting that NPDR constitutes the predominant form of retinopathy in patients with CKD. Advanced diabetic eye disease and high-risk proliferative diabetic retinopathy were observed predominantly in patients with advanced renal disease, indicating progressive microvascular damage with worsening renal function. Systemic hypertension was highly prevalent in our study population, and more than half of the hypertensive patients exhibited hypertensive retinopathy. These findings are consistent with those of Muller et al.10 and Rouf et al.,14 supporting the role of hypertension as a major contributory factor in both retinal and renal microvascular damage.

Biochemical analysis demonstrated significantly higher serum urea, creatinine, and HbA1c levels in patients with diabetic retinopathy compared to those without retinopathy. These findings are consistent with previous studies and highlight the association between poor glycaemic control, advanced renal dysfunction, and the development of diabetic retinopathy. A significant association was observed between CKD stage and both the presence and severity of diabetic retinopathy. Diabetic retinopathy was absent in early CKD stages and most prevalent in stage 5 CKD, with advanced retinopathy occurring predominantly in stages 4 and 5. Similar associations have been reported by Zhang et al.,15 Grunwald et al.,16 and He et al.,7 supporting the concept that worsening renal function parallels increasing severity of retinal microangiopathy. However, this finding contrasts with the study by Pai et al.,12 which did not demonstrate a significant association between CKD stage and diabetic retinopathy.

Overall, the findings of the present study reinforce the strong relationship between chronic kidney disease and diabetic retinopathy, particularly in advanced stages of renal dysfunction. These results emphasize the importance of regular ophthalmic screening in patients with CKD and type 2 diabetes mellitus to facilitate early detection and timely management of sight-threatening retinopathy.

CONCLUSION

The prevalence of diabetic retinopathy among patients with chronic kidney disease and type 2 diabetes mellitus was 63.5%. A significant association was observed between advancing stages of CKD and both the presence and severity of diabetic retinopathy ($p<0.001$), indicating parallel progression of renal and retinal microvascular damage. These findings highlight the need for routine ophthalmic screening in patients with CKD to enable early detection and timely management of diabetic retinopathy, thereby reducing the risk of vision-threatening complications.

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