Section: Opthalmology

Original Research Article

PREVALENCE OF DIABETIC RETINOPATHY AND DRY EYE DISEASE IN DIABETES MELLITUS PATIENTS: A CROSS-SECTIONAL STUDY CORRELATING WITH DURATION OF DISEASE AND RENAL FUNCTION PARAMETERS

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ABSTRACT

Background: Diabetes mellitus is a multisystemic disorder associated with several microvascular complications, including diabetic retinopathy (DR) and dry eye disease (DED). These ocular manifestations are often overlooked, particularly DED, despite their significant impact on vision and quality of life. This study aimed to evaluate the prevalence of DR and DED in diabetic patients and correlate their occurrence with disease duration and renal function.

Materials and Methods: A hospital-based cross-sectional study was conducted at Sarojini Devi Eye Hospital, Osmania Medical college, Hyderabad, including 200 patients with type 2 diabetes. Detailed history, ophthalmic examination, and laboratory tests for serum urea and creatinine were performed. DR was graded using the ETDRS criteria. DED was diagnosed using Schirmer I test and Tear Film Break-Up Time (TBUT).

Results: DR was present in 92 (46%) and DED in 106 (53%) of the participants. A significant association was observed between the duration of diabetes and both DR ($p = 0.0012$) and DED ($p = 0.015$). Patients with DR had higher mean urea (48.2 mg/dL) and creatinine (1.46 mg/dL) compared to those without DR. Similar trends were seen in DED cases.

Conclusion: Prolonged duration of diabetes and declining renal function are significantly associated with increased prevalence of DR and DED. Integrated screening and early intervention are critical for optimal visual outcomes in diabetic patients.

Keywords: Diabetic retinopathy, dry eye disease, diabetes mellitus, urea, creatinine, tear film, duration of diabetes, microvascular complications.

INTRODUCTION

Diabetes mellitus (DM), a chronic metabolic disorder characterized by sustained hyperglycemia due to defects in insulin secretion, insulin action, or both, is a burgeoning global health issue with multisystem involvement. Among its myriad complications, ocular manifestations such as diabetic retinopathy (DR) and dry eye disease (DED) are significant causes of visual morbidity and reduced quality of life. Diabetic retinopathy remains a leading cause of preventable blindness in adults aged 20–74 years globally.[1] It results from microvascular damage to the retina due to prolonged exposure to elevated blood glucose levels, leading to capillary leakage, ischemia, neovascularization, and subsequent retinal detachment or macular edema.[2] Parallel to this, DED, characterized by tear film instability and ocular surface inflammation, has gained recognition as a frequent, yet underdiagnosed, complication in individuals with diabetes. The prevalence of dry eye among diabetics ranges from 20% to 60%, with studies indicating a

significant association between tear film dysfunction and poor glycemic control.[3] Chronic hyperglycemia is implicated in neuropathic changes affecting the lacrimal functional unit, goblet cell density reduction, and altered meibomian gland function, which together compromise ocular surface homeostasis.[4]

The burden of these ocular complications intensifies with the duration of diabetes and the presence of systemic comorbidities, especially diabetic nephropathy. Uremia and elevated serum creatinine levels, indicative of renal impairment, are markers of microvascular compromise and have been associated with an increased risk of DR and DED.[5] There exists a common pathophysiological thread linking retinal, renal, and ocular surface alterations in diabetes, primarily mediated through endothelial dysfunction, advanced glycation end-products (AGEs), and systemic inflammation.[6]

Recent epidemiological investigations have demonstrated that the severity and progression of DR correlate positively with serum urea and creatinine levels, suggesting a possible predictive role of renal biomarkers in ocular complication surveillance.[7] Additionally, renal dysfunction in diabetic patients has been associated with heightened oxidative stress and impaired autoregulation of ocular blood flow, further exacerbating retinal vascular damage.[8] Similarly, uremic toxins and metabolic derangements may negatively impact lacrimal gland secretion and ocular surface epithelial integrity, contributing to the development of DED in patients with concomitant diabetic nephropathy.[9]

The interplay between the duration of diabetes and the extent of systemic organ damage is pivotal in the pathogenesis of ocular complications. Prolonged hyperglycemia over time leads to cumulative vascular and neural insults, increasing the likelihood of both DR and DED.[10] Previous studies underscore the necessity of early detection and stratification of at-risk patients based on systemic parameters, including renal function indicators.[11, 12] Despite the growing body of literature, limited studies have concurrently explored the dual occurrence of DR and DED in diabetic populations and their associations with disease duration and renal function markers. The aim of the present study is to investigate the prevalence of diabetic retinopathy and dry eye disease among patients with diabetes mellitus and analyze their association with the duration of diabetes, serum urea, and creatinine levels.

MATERIALS AND METHODS

This hospital-based cross-sectional observational study was conducted at Sarojini Devi Eye Hospital, Osmania Medical college, Hyderabad, over a period of one year, from January 2024 to December 2024. The study was approved by the Institutional Ethics Committee prior to commencement, and written informed consent was obtained from all participants.

A total of 200 patients diagnosed with type 2 diabetes mellitus, as per the American Diabetes Association (ADA) criteria, were included in the study using a convenience sampling method. Patients attending the endocrinology and ophthalmology outpatient departments during the study period were consecutively recruited if they met the inclusion criteria. Individuals aged >30 years, with confirmed history of T2DM for at least one year, were considered eligible. Exclusion criteria included patients with a history of ocular trauma, contact lens use, ocular surgery in the preceding six months, autoimmune diseases such as Sjögren's syndrome, pre-existing ocular surface disorders unrelated to diabetes, chronic use of topical medications affecting tear production, and those with advanced renal failure undergoing dialysis.

All patients underwent a comprehensive evaluation, which included a detailed history taking, general physical examination, and ophthalmic assessment. Information regarding the duration of diabetes, glycemic control status, and current anti-diabetic treatment regimen was recorded. Particular attention was given to symptoms suggestive of dry eye, such as foreign body sensation, burning, photophobia, and excessive tearing. Fasting blood samples were collected from all participants to measure serum urea and creatinine levels using an automated biochemistry analyzer.

Ophthalmological evaluation was performed by a single trained ophthalmologist to minimize inter-observer variability. Visual acuity was tested using a Snellen chart. Slit-lamp bio-microscopy was performed to assess the anterior segment, and indirect ophthalmoscopy was done after pupillary dilation to examine the posterior segment. Fundus photography was carried out when necessary to document retinal findings. Diabetic retinopathy was graded according to the Early Treatment Diabetic Retinopathy Study (ETDRS) classification system into non-proliferative (mild, moderate, severe) and proliferative stages.

Dry eye assessment involved a combination of subjective and objective tests. Subjective symptoms were quantified using the Ocular Surface Disease Index (OSDI) questionnaire. Objective evaluation included the Schirmer I test (without anesthesia) to measure basal and reflex tear secretion, and tear break-up time (TBUT) to assess tear film stability. A Schirmer reading of ≤10 mm in 5 minutes and a TBUT of <10 seconds were considered diagnostic for DED. Fluorescein staining was also performed to evaluate corneal and conjunctival epithelial integrity.

Data were compiled and entered into Microsoft Excel and analyzed using SPSS version 26.0. Descriptive statistics were used to summarize patient demographics, duration of diabetes, and biochemical parameters. Categorical variables such

as presence of DR and DED were expressed as frequencies and percentages. Continuous variables such as urea, creatinine, and duration of diabetes were presented as mean ± standard deviation. Chi-square test was employed to assess the association between categorical variables, and independent t-test or Mann–Whitney U test was used to compare continuous variables between groups, based on the normality of distribution. Pearson or Spearman correlation coefficients were computed to determine the strength of association between ocular complications and renal parameters. A p-value of <0.05 was considered statistically significant.

RESULTS

A total of 200 patients with type 2 diabetes mellitus were evaluated in the present study, comprising 104 males (52%) and 96 females (48%). The mean age was 57.8 ± 9.6 years. The prevalence of ocular complications was analyzed in relation to the duration of diabetes, serum urea, and creatinine levels.

Prevalence of Diabetic Retinopathy and Dry Eye Disease

Out of 200 patients, 92 (46%) had diabetic retinopathy (DR) and 106 (53%) were diagnosed with dry eye disease (DED) based on Schirmer I test and TBUT criteria. DR and DED coexisted in 38 patients (19%). The rest either had a single complication or none

Table 1: Prevalence of Diabetic Retinopathy and Dry Eye Disease

Condition		Frequency	Percentage (%)
Diabetic Retinopathy	Present	92	46.0
	Absent	108	54.0
Dry eyes	Present	106	53.0
	absent	94	47.0

Chi-square test revealed a statistically significant association between the presence of DR and DED ($\chi^2 = 6.21$, $p = 0.013$), indicating that patients with DR were more likely to have concurrent dry eye symptoms.

Duration of Diabetes and Its Association with DR and DED

The distribution of patients by duration of diabetes is presented in Table 2. A marked increase in the prevalence of both DR and DED was observed with longer diabetes duration (Table 3).

Table 2: Duration of Diabetes

Duration of Diabetes (years)	Number of Patients
<5	52
5–10	68
11–15	48
>15	32

Table 3: DR and DED According to Duration of Diabetes

Duration (years)	DR Present (n)	DED Present (n)
<5	12	20
5–10	28	36
11–15	28	28
>15	24	22

Using the Chi-square test, the association between duration of diabetes and DR was statistically significant ($\chi^2 = 15.8$, $p = 0.0012$). Similarly, the association between duration and DED was also significant ($\chi^2 = 10.4$, $p = 0.015$), reinforcing that prolonged hyperglycemia is a risk factor for both microvascular and ocular surface complications.

Renal Function and Ocular Findings

Patients with DR had significantly elevated mean urea and creatinine levels compared to those without DR. An independent t-test showed that the difference in mean urea (48.2 ± 12.4 mg/dL vs. 32.6 ± 8.5 mg/dL) was statistically significant ($t = 10.3$, $p < 0.001$). Likewise, mean creatinine was significantly higher in the DR group (1.46 ± 0.31 mg/dL vs. 1.03 ± 0.24 mg/dL, $t = 8.1$, $p < 0.001$). These values are shown in.

Table 4: Urea and Creatinine Levels in Patients with and Without DR

Condition	Mean Urea (mg/dL)	Mean Creatinine (mg/dL)
With DR	48.2 ± 12.4	1.46 ± 0.31
Without DR	32.6 ± 8.5	1.03 ± 0.24

Similar trends were observed for patients with DED. Both mean urea and creatinine levels were significantly higher in the DED group (Table 5), with p values < 0.001 for both comparisons.

Table 5: Urea and Creatinine Levels in Patients with and Without DED

Condition	Mean Urea (mg/dL)	Mean Creatinine (mg/dL)
With DED	45.9 ± 10.2	1.39 ± 0.28
Without DED	33.2 ± 7.9	1.05 ± 0.21

Pearson correlation analysis revealed a moderate positive correlation between serum creatinine and DR presence ($r = 0.42$, $p < 0.001$), and a weaker but still significant correlation with DED ($r = 0.31$, $p = 0.002$).

Gender Distribution and Ocular Findings

Among males (n=104), DR was present in 46 (44.2%) and DED in 54 (51.9%). Among females (n=96), 46 (47.9%) had DR and 52 (54.2%) had DED (Table 6). The differences between genders were not statistically significant for either condition ($p > 0.05$), suggesting no gender predisposition.

Table 6: Gender-wise Distribution of DR and DED

Gender	DR Present (n)	DED Present (n)
Male (n=104)	46	54
Female (n=96)	46	52

DISCUSSION

Diabetic retinopathy (DR) and dry eye disease (DED) are well-recognized ocular complications of diabetes mellitus (DM), often coexisting and compounding visual morbidity. This study aimed to estimate their prevalence and correlate these findings with diabetes duration and renal function. The results are compared with other relevant studies to highlight both consistencies and contrasts in patterns of disease expression.

Age Distribution

The mean age of participants in the present study was 57.8 ± 9.6 years. This is consistent with findings by Raman et al,[13] who reported a similar mean age of 56.3 ± 10.2 years in the Sankara Nethralaya Diabetic Retinopathy Epidemiology and Molecular Genetics Study (SN-DREAMS). The middle-aged demographic appears most vulnerable, likely due to cumulative glycemic burden and the progressive nature of microvascular complications.

Gender Distribution

In our cohort, males comprised 52% and females 48%, with no statistically significant gender differences in the prevalence of DR or DED. These observations echo those of Zhang et al,[14] who found no significant gender-based differences in a U.S. population study analyzing NHANES data. While some studies suggest hormonal variations may influence tear film dynamics in women, our data do not support a gender-specific risk in the context of diabetes-related eye disease.

Prevalence of Diabetic Retinopathy

In the current study, DR was observed in 46% of diabetic patients, aligning closely with the global prevalence estimate of 42.5% reported by Yau et al,[15] in their meta-analysis involving over 20,000 individuals. This similarity may be attributable to parallel diagnostic criteria and population characteristics. However, studies from lower-resource settings sometimes report higher rates, possibly due to delayed diagnosis or lack of routine ophthalmic screening.

Prevalence of Dry Eye Disease

DED was detected in 53% of participants using standard diagnostic tools such as Schirmer's test and TBUT. This is notably higher than the 38% prevalence reported by Seifart and Strempel,[16] who conducted one of the earlier assessments of DED in diabetic patients. Variations in climate, lifestyle, diagnostic criteria, and inclusion of both subjective and objective tests in our study likely contributed to the increased detection.

Association with Duration of Diabetes

The prevalence of both DR and DED increased significantly with the duration of diabetes in our study. DR was present in 75% of patients with diabetes duration >15 years, and DED in 68.8%. Klein et al,[17] in the Wisconsin Epidemiologic Study of Diabetic Retinopathy, similarly reported that longer diabetes duration was the most significant independent risk factor for DR. The chronic exposure to hyperglycemia induces cumulative microvascular and neuronal damage, explaining this trend.

Renal Function and Ocular Manifestations

Patients with DR had higher serum urea (48.2 ± 12.4 mg/dL) and creatinine (1.46 ± 0.31 mg/dL) compared to those without DR. DED patients also showed elevated renal function parameters. These findings mirror the results of Mohamed et al,[18] who demonstrated a significant association between impaired renal function and DR severity. Shared mechanisms such as endothelial dysfunction, oxidative stress, and inflammation underlie both retinal and renal microangiopathy in diabetic patients.

Coexistence of DR and DED

A total of 38 patients (19%) in our study exhibited both DR and DED. Manaviat et al,[19] reported a similar coexistence rate of 17% in an Iranian cohort. The overlap is likely due to shared pathophysiological mechanisms—chronic hyperglycemia affecting both retinal capillaries and ocular surface homeostasis via neuropathy and glandular dysfunction. The data support integrated screening for anterior and posterior segment changes in diabetes care protocols.

CONCLUSION

The present study demonstrates a substantial prevalence of both diabetic retinopathy (46%) and dry eye disease (53%) among patients with type 2 diabetes mellitus. A significant association was observed between the prevalence of these ocular complications and both the duration of diabetes and elevated serum urea and creatinine levels. This suggests that longer disease duration and impaired renal function are important markers for microvascular complications, both anterior and posterior, in diabetic patients. The co-existence of DR and DED in nearly one-fifth of the patients further supports the need for integrated screening protocols. Early identification and management of these complications may improve quality of life and prevent long-term visual disability.

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