

Original Research Article

OCULAR MANIFESTATIONS AND VISUAL IMPAIRMENT IN DIABETIC PATIENTS WITH END-STAGE RENAL DISEASE: A ONE-YEAR OBSERVATIONAL STUDY

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ABSTRACT

Background: Diabetes mellitus is a major cause of both end-stage kidney disease (ESKD) and visual impairment globally. Ocular complications are frequently overlooked in diabetic patients on dialysis, leading to delayed diagnosis and irreversible visual loss. This study aimed to evaluate the prevalence and severity of ocular changes, including visual outcomes and complications, in diabetic ESKD patients.

Materials and Methods: A hospital-based, cross-sectional study was conducted over one year among 100 diabetic patients undergoing hemodialysis for ESKD. Detailed ophthalmic evaluation included best corrected visual acuity, intraocular pressure, slit-lamp examination, indirect ophthalmoscopy, and optical coherence tomography. Diabetic retinopathy (DR) was graded using ETDRS criteria. Data were analyzed using SPSS v26, with p<0.05 considered statistically significant.

Results: The mean age of patients was 58.4 ± 9.7 years; 61% were male. DR was present in 80% of eyes, with moderate NPDR being the most common stage (32%). Diabetic macular edema was observed in 28%, and cataracts in 49% of eyes. Visual impairment affected 62% of patients, including 12% who were legally blind. A significant correlation was found between dialysis duration ≥ 12 months and higher DR severity (p=0.021). Visual acuity showed progressive decline with increasing DR grade.

Conclusion: Ocular complications are common in diabetic patients with ESKD and are significantly influenced by dialysis duration and metabolic control. Routine eye screening and multidisciplinary care are essential to prevent irreversible vision loss in this high-risk group.

Keywords: Diabetic retinopathy, macular edema, hemodialysis, end-stage renal disease, visual impairment, ocular complications.

INTRODUCTION

Diabetes mellitus is a major global health concern and stands as a prominent contributor to both chronic kidney disease (CKD) and visual dysfunction. A significant number of patients with diabetes eventually develop end-stage kidney disease (ESKD), necessitating renal replacement therapy. Simultaneously, diabetic retinopathy (DR) is a primary cause of preventable blindness among working-age adults. When these two complications coexist, they reflect the systemic impact of longstanding hyperglycemia and microvascular deterioration.

Globally, the incidence of diabetic kidney disease ranges between 20% and 40% among individuals with type 2 diabetes, and a notable subset progresses to ESKD requiring dialysis.^[1] In tandem, diabetic retinopathy affects nearly one-third of all individuals with diabetes, with a significant proportion developing sight-threatening complications such as macular edema and proliferative changes.^[2] The overlap between advanced renal failure and ocular disease is not merely coincidental, as both conditions share underlying pathophysiological pathways including endothelial dysfunction, chronic inflammation, and microvascular ischemia.^[3]

Hemodialysis, though life-sustaining, may also contribute to ocular complications through shifts in intravascular volume and blood pressure, which can exacerbate ischemic changes in the retina. Furthermore, comorbid conditions frequently encountered in ESKD—such as anemia, secondary hyperparathyroidism, and poorly controlled hypertension—may accelerate ocular morbidity.^[4] Other non-retinal complications such as cataracts, glaucoma, and optic nerve pathologies are also more prevalent in this population.

Although several studies have addressed diabetic retinopathy in the general diabetic population, there is a comparative lack of focused research evaluating visual outcomes and ocular pathology specifically in those with ESKD. This data gap is particularly significant in low-resource settings where routine eye care may not be integrated into nephrology services. This study was designed to assess the prevalence and pattern of ocular changes—including visual impairment and ophthalmic complications—in patients with diabetes undergoing dialysis for endstage kidney disease over a one-year period at a tertiary care hospital.

MATERIALS AND METHODS

This cross-sectional observational study was conducted over a one-year period in the Departments of Ophthalmology at XXXXX Medical College and Hospital. Institutional ethics committee approval was obtained before the initiation of the study.

Eligibility criteria included adult patients aged 18 years or above with a known diagnosis of type 1 or type 2 diabetes mellitus who were undergoing maintenance hemodialysis for end-stage renal disease (defined as eGFR <15 mL/min/1.73m²) for a minimum duration of three months. Patients were excluded if they had a recent history of ocular

surgery, trauma, or if their kidney failure was due to non-diabetic causes. Written informed consent was obtained from all participants.

Sample size and sampling: A total of 100 patients who fulfilled the inclusion and exclusion criteria were enrolled through convenience sampling.

Data collection: All participants underwent a comprehensive systemic and ocular evaluation. Relevant demographic information, duration of diabetes, dialysis history, blood pressure, hemoglobin levels, and recent HbA1c values were recorded.

Ophthalmological assessment included:

- Measurement of best corrected visual acuity (BCVA) using Snellen's chart,
- Intraocular pressure assessment via applanation tonometry,
- Slit-lamp examination for anterior segment findings,
- Fundoscopy with indirect ophthalmoscopy, supplemented with fundus photography,
- Optical coherence tomography (OCT) and fundus fluorescein angiography (FFA), performed as indicated.

Classification

Diabetic retinopathy was staged according to the Early Treatment Diabetic Retinopathy Study (ETDRS) criteria.^[5] Visual impairment was categorized based on BCVA in the better eye.

Study outcomes included

- 1. Distribution of visual acuity (categorized into normal vision, visual impairment, or blindness),
- 2. Severity grading of diabetic retinopathy and macular edema,
- 3. Prevalence of additional ocular pathologies such as cataract, glaucoma, or optic nerve involvement.

Statistical Analysis: Data entry and statistical analysis were carried out using IBM SPSS version 26. Descriptive statistics (mean, SD, frequencies, percentages) were used to summarize data. Associations between dialysis duration and DR severity were evaluated using the Chi-square test. A p-value <0.05 was considered statistically significant.

RESULTS

Table 1: Baseline Demographic and Clinical Characteristics of Study Participants		
Variable	Mean ± SD / Frequency (%)	
Mean Age (years)	58.4 ± 9.7	
Gender Distribution (M:F)	61 : 39	
Duration of Diabetes (years)	12.1 ± 5.8	
Dialysis Duration (months)	17.6 ± 7.2	
Mean HbA1c (%)	8.3 ± 1.4	
Coexisting Hypertension	83 (83%)	
Anemia (Hemoglobin <10 g/dL)	76 (76%)	

Table 2: Visual Acuity in the Better Eye (Snellen Classification)			
Visual Acuity Group	Number of Patients	Percentage	
Normal to Mild ($\geq 6/12$)	38	38%	
Moderate (6/18 to 6/60)	31	31%	

Severe (<6/60 to 3/60)	19	19%
Blindness (<3/60)	12	12%

Table 3: Diabetic Retinopathy (DR) Severity Distribution (ETDRS Classification)			
DR Category	Number of Eyes	Percentage	
No Diabetic Retinopathy	40	20%	
Mild Non-Proliferative DR	44	22%	
Moderate NPDR	64	32%	
Severe NPDR	30	15%	
Proliferative DR (PDR)	22	11%	

Table 4: Prevalence of Diabetic Macular Edema (DME)			
DME Status	Number of Eyes	Percentage	
Present	56	28%	
Absent	144	72%	

Table 6: Relationship Between Duration of Dialysis and Severity of DR			
Dialysis Duration	Mild/No DR	Severe DR (Severe NPDR + PDR)	p-value
<12 months	42	14	
≥12 months	42	30	0.021



Figure 1: Decline in Visual Acuity with Advancing Diabetic Retinopathy

This study involved the ophthalmologic evaluation of 100 patients with diabetes undergoing maintenance hemodialysis for end-stage renal disease (ESKD). The average age of the cohort was 58.4 years, with a male-to-female ratio of approximately 3:2. The patients had longstanding diabetes, averaging 12.1 years in duration, and were undergoing dialysis for an average of 17.6 months. Hypertension (83%) and anemia (76%) were common comorbidities, both of which are known to negatively influence retinal vascular health.

Visual function analysis indicated that only 38% of individuals retained near-normal visual acuity in their better-seeing eye. Moderate visual impairment was present in 31%, while 12% had vision levels that met the criteria for legal blindness. These figures underscore a substantial level of visual disability in this vulnerable population.

Assessment of diabetic retinopathy (DR) showed that 80% of the eyes exhibited signs of retinopathy. Among these, moderate non-proliferative diabetic retinopathy (NPDR) was the most frequently observed stage, seen in 32% of eyes. Mild NPDR was present in 22%, while proliferative diabetic retinopathy (PDR)—the most severe form—was identified in 11% of the sample. Additionally, diabetic macular edema (DME), a major cause of central vision loss, was present in 28% of eyes. Other notable ocular complications included cataract formation in 49% of eyes, likely due to long-term metabolic disturbances and oxidative stress associated with both diabetes and kidney failure. Glaucoma (9%) and optic nerve changes (3.5%) were also noted, although less frequently.

A significant association was observed between the duration of dialysis and the severity of diabetic retinopathy. Patients on dialysis for 12 months or longer were more likely to have advanced DR (p = 0.021), indicating that prolonged exposure to uremia and vascular instability may contribute to retinal deterioration.

The visual acuity outcomes varied substantially across different DR stages. The average acuity was best in patients with no DR (approximate Snellen equivalent 6/9) and declined progressively with increasing severity, reaching 6/60 in patients with PDR. This relationship was clearly demonstrated in the accompanying bar graph, emphasizing the direct impact of DR progression on visual function.

DISCUSSION

This one-year observational study aimed to assess the prevalence, severity, and clinical profile of ocular complications in patients with diabetes undergoing long-term hemodialysis for end-stage kidney disease (ESKD). The data reveal a striking burden of vision-threatening conditions in this population, with diabetic retinopathy (DR), diabetic macular edema (DME), and cataracts being the most prevalent. These findings align with existing literature, emphasizing the compounded microvascular effects of prolonged diabetes and renal insufficiency.^[1]

Visual Impairment Prevalence

In this study, only 38% of participants had normal to mildly impaired visual acuity in their better eye. A significant proportion (31%) experienced moderate impairment, while 12% met the criteria for legal blindness. These results indicate a greater degree of visual morbidity than typically seen in diabetic populations without advanced kidney disease. Grunwald et al. in the Chronic Renal Insufficiency Cohort (CRIC) study similarly reported that patients with concurrent DR and CKD experienced greater visual decline than those with DR alone.^[2]

Diabetic Retinopathy Pattern

Our findings show that 80% of eyes had some form of DR, with moderate non-proliferative DR (32%) being the most common, followed by mild NPDR (22%) and proliferative DR (11%). These values closely mirror those reported by Gupta et al., who found a DR prevalence of nearly 78% among Indian patients with diabetic nephropathy on dialysis.^[3] Poor glycemic control (mean HbA1c: 8.3%), longstanding diabetes, and delayed ophthalmologic referral may explain the high DR burden in our cohort.

A significant observation in this study was the strong relationship between dialysis duration and DR severity. Patients on dialysis for ≥ 12 months were more likely to have severe DR (p = 0.021). Yoshikawa et al. reported a similar trend, attributing worsening DR to repeated hemodynamic fluctuations and prolonged exposure to uremic toxins during dialysis.^[4]

Diabetic Macular Edema and Visual Consequences DME was observed in 28% of eyes, a prevalence consistent with other dialysis-based studies in India and Southeast Asia, where rates of 25–30% have been reported.^[5] The underlying mechanisms of DME in ESKD patients likely involve systemic fluid shifts, breakdown of the blood-retinal barrier, and increased vascular permeability—all of which are aggravated by uremia and dialysis-induced inflammation.^[6] Persistent macular edema is a wellknown cause of central vision loss, and early detection remains essential to prevent irreversible damage.

Cataract and Non-Retinal Pathologies

Cataracts were found in 49% of the eyes, a higher rate than typically seen in age-matched diabetic patients without renal disease. Chronic oxidative stress, longterm corticosteroid use, and disturbances in calciumphosphate metabolism have all been implicated in cataractogenesis among dialysis patients. Bapat et al. specifically highlighted the role of secondary hyperparathyroidism in accelerating cataract formation in CKD patients.^[7]

In addition, glaucoma (9%) and optic neuropathy (3.5%) were noted in a smaller fraction of patients. Though less frequent, these conditions are equally significant due to their insidious progression and irreversible visual impact if left untreated. Singh et al. reported comparable findings in a cohort of Indian dialysis patients, reinforcing the need for comprehensive eye examinations.^[8]

Visual Function and Retinopathy Severity

A clear trend was observed wherein visual acuity declined progressively with increasing DR severity. Patients with no DR had a mean Snellen equivalent of 6/9, which decreased to 6/60 in those with proliferative DR. These findings align with the results from the UK Prospective Diabetes Study (UKPDS 50), which identified DR grade as a strong predictor of future visual decline.^[9] The gradual but significant deterioration in visual function across DR stages reinforces the need for early-stage diagnosis and intervention.

CONCLUSION

This study highlights the high prevalence of visionthreatening ocular complications in diabetic patients undergoing hemodialysis for end-stage kidney disease. The majority of patients exhibited some form of diabetic retinopathy, with a significant portion progressing to moderate and severe stages. Diabetic macular edema and cataracts were also commonly encountered and significantly impacted visual outcomes. The severity of retinopathy showed a clear association with longer dialysis duration and suboptimal glycemic control.

These findings underscore the urgent need for integrating regular ophthalmological evaluations into the routine care of diabetic ESKD patients. Early identification and management of retinopathy and related complications could substantially reduce the burden of visual impairment in this high-risk population. Multidisciplinary care models involving nephrologists, ophthalmologists, and endocrinologists should be adopted to ensure comprehensive and preventive ocular health management.

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