



A HOSPITAL-BASED STUDY OF FUNDUS CHANGES IN EYES OF CHRONIC KIDNEY DISEASE PATIENTS

Dr. K. Ratan Singh¹, Dr. Naveen Chandra Bhandari^{2*}, Dr. K. Ravisekhar Rao³

¹Senior Resident, Department of Ophthalmology, Gandhi Medical College, Secunderabad, Hyderabad, Telangana, India.

^{2*}Senior Resident, Department of Ophthalmology, Gandhi Medical College, Secunderabad, Hyderabad, Telangana, India.

³Professor & HOD, Department of Ophthalmology, Gandhi Medical College, Secunderabad, Hyderabad, Telangana, India.

***Corresponding Author:** Dr. Naveen Chandra Bhandari,

^{*}Senior Resident, Department of Ophthalmology, Gandhi Medical College, Secunderabad, Hyderabad, Telangana, India.

ABSTRACT

Background: CKD (Chronic Kidney Disease) is a progressive disorder with systemic complications that extend beyond renal impairment, often manifesting as ocular changes. The retina, sharing structural and microvascular similarities with renal tissue, serves as a window to systemic vascular health. Retinal abnormalities such as hypertensive and diabetic retinopathy frequently accompany CKD, reflecting the disease's severity and progression. Evaluating these fundus changes can aid in early detection, timely management, and prevention of visual morbidity in CKD patients.

Methods: This descriptive cross-sectional, hospital-based study was conducted at Gandhi Hospital over 18 months, including 150 CKD patients aged 20–65 years from all disease stages. After obtaining informed consent, participants underwent detailed ocular history assessment, slit-lamp examination, and fundus evaluation using direct and indirect ophthalmoscopy. Data were analyzed using the chi-square test to determine correlations between fundus changes and disease severity.

Results: Among 150 participants, 70% were male and 30% female, with the majority (41.33%) aged 51–65 years. The most common etiology for CKD was hypertension (58.67%), followed by diabetes mellitus (21.33%), and both (20%). Fundus abnormalities were noted in 79.33% of patients. Hypertensive retinopathy was predominant-Grade I (23.33%), Grade II (12.67%), Grade III (4%), and Grade IV (2.66%)-while diabetic retinopathy included mild NPDR (10.67%), moderate NPDR (8.67%), severe NPDR (4.66%), and PDR (9.33%). Mixed retinopathy accounted for 3.33% of cases.

Conclusion: Ocular manifestations are common in CKD, with hypertensive and diabetic retinopathies being the most frequent. Fundus examination serves as a valuable non-invasive tool for assessing systemic vascular damage and disease progression. Routine ophthalmologic screening in CKD patients is essential for early detection and prevention of visual complications, emphasizing the need for multidisciplinary management.

Keywords: Chronic Kidney Disease, Hypertensive Retinopathy, Diabetic Retinopathy, Fundus Examination, Ocular Manifestations, Visual Morbidity.

INTRODUCTION

CKD (Chronic Kidney Disease) is a progressive condition that encompasses a wide range of disorders impacting kidney structure and function. It is often asymptomatic in the early stages, frequently detected incidentally during assessments for other health conditions, and may potentially be reversible if addressed promptly. As CKD progresses, it becomes a significant global health issue, contributing to a decreased quality of life and an increased risk of mortality.^[1] CKD can have profound effects on various body systems, including ocular health, as kidney dysfunction leads to changes in the eyes. Diabetes, hypertension, and autoimmune diseases, which frequently contribute to renal failure, also impact the eyes, either directly through the primary diseases or indirectly through the consequences of kidney dysfunction.^[2] Ocular manifestations may arise from these systemic effects, complicating the differentiation between primary renal failure and secondary ocular changes.

There is a well-established association between CKD and major eye conditions, including AMD (Age-Related Macular Degeneration), DR (Diabetic Retinopathy), glaucoma, and cataracts. These conditions share common risk factors such as age, metabolic abnormalities, and vascular issues, including hypertension and diabetes. Retinal microvascular changes have been identified as potential indicators of CKD, with both the retina and kidney being highly susceptible to blood pressure fluctuations due to their small vessel networks.^[3] Several cases of bullous retinal detachment have been documented in CRF (Chronic Renal Failure), potentially stemming from metabolic disturbances, uncontrolled blood pressure, and dysfunction of the retinal pigment epithelium.^[4,5] Retinopathy and nephropathy share similar microvascular pathological mechanisms, particularly in diseases like diabetes, highlighting the interconnectedness of kidney and eye health. In fact, retinal abnormalities are increasingly being recognized as valuable markers for the progression of kidney disease.^[6]

AIMS AND OBJECTIVES

The study aimed to investigate the various ocular manifestations observed in patients with CKD through detailed fundus examination. The objectives are to evaluate the occurrence and pattern of different fundus changes associated with CKD and to analyze these findings in correlation with the severity of the disease. By establishing this relationship, the study seeks to enhance understanding of the ocular indicators of renal dysfunction, thereby facilitating early detection and improved management of visual and systemic complications in CKD patients.

MATERIALS AND METHODS

Study Design

This study was a descriptive, cross-sectional, hospital-based study conducted over a period of 18 months at Gandhi Hospital. Prior to commencement, approval was obtained from the Institutional Ethical Committee. The study included patients aged between 20 and 65 years, presenting to the Departments of Nephrology and Ophthalmology with all stages of CKD. A consecutive sampling technique was employed, enrolling a total of 150 patients. Each participant underwent a comprehensive ocular examination at the Department of Ophthalmology to assess and document various ocular manifestations associated with CKD.

Inclusion and Exclusion Criteria

The study included patients of all stages of CKD, renal transplant recipients, and individuals aged between 20 and 65 years. Patients were excluded if they had acute fulminant diseases, known pre-existing ocular disorders, or a history of renal transplantation. These criteria were established to ensure that the observed ocular manifestations were directly related to CKD and not influenced by other ocular or systemic conditions.

Data Collection Procedure

All patients attending the Nephrology OPD (Out-Patient Department) with ocular complaints were informed about the importance and purpose of ocular evaluation. The evaluation procedures were clearly explained, and informed consent was obtained from each participant following a detailed clinical history and general examination. Data collection included recording visual acuity using the Snellen's test type chart, followed by a comprehensive ocular assessment. Relevant ocular history was documented, and a detailed slit-lamp examination of the anterior segment was performed. Fundus evaluation was carried out using both direct and indirect ophthalmoscopy, and fundus photographs were taken when necessary to document retinal findings. Systemic conditions, such as hypertension and dialysis status, were also noted to establish clinical correlations with ocular manifestations.

Statistical Analysis

The data obtained from the study were systematically tabulated and analyzed to determine the correlation between ocular manifestations and the severity of CKD. Statistical analysis was performed using the chi-square test to evaluate the association between categorical variables. A p-value of less than 0.05 was considered statistically significant, indicating a meaningful relationship between CKD stages and corresponding ocular findings.

RESULTS

Age (in years)	No. of Cases	Male	Female	%
20-30	5	4	1	3.33%
31-40	42	24	18	28%
41-50	41	28	13	27.34%
51-65	62	49	13	41.33%
Total	150	105	45	100.00%

Table 1: Distribution According to Age

Table 1 shows that the majority of patients with CKD belonged to the 51–65 years age group, accounting for 41.33% of the total cases. The 31–40-year-old and 41–50-year-old age groups followed closely, comprising 28% and 27.34% of cases, respectively, while the lowest prevalence (3.33%) was observed among patients aged 20–30 years. This indicates that CKD predominantly affects middle-aged and older adults.

Gender	No. of Cases	%
Female	45	30%
Male	105	70%
Total	150	100.00%

Table 2: Distribution According to Gender

Table 2 reveals a clear male predominance, with 70% (105 cases) being male and 30% (45 cases) being female. This suggests that males were more frequently affected by CKD or its ocular manifestations compared to females in this study population.

CKD Duration	No. of Cases	%
<1 year	57	38%
1-2	42	28%
>2	51	34%
Total	150	100.00%

Table 3: Distribution According to CKD Duration

Table 3 shows that 38% of patients had CKD for less than one year, 28% had the disease for 1–2 years, and 34% had it for more than two years. This indicates a fairly even spread across different disease durations, with a slight predominance of recently diagnosed cases.

Cause of CKD	No. of Cases	Males	Females	%
Hypertension only	88	61	27	58.67%
Diabetes Mellitus only	32	23	9	21.33%
Both Hypertension + Diabetes Mellitus	30	21	9	20%
Total	150	105	45	100.00%

Table 4: Distribution According to Causes of CKD

Table 4 shows that hypertension was the most common underlying factor, observed in 58.67% of cases, followed by diabetes mellitus alone in 21.33%, and both hypertension and diabetes mellitus in 20% of cases. This highlights hypertension as the leading cause of CKD in the study population.

Fundus Changes	No. of Cases	Male	Female	%
Grade I HTN Retinopathy	35	28	7	23.33%
Grade II HTN Retinopathy	19	12	7	12.67%
Grade III HTN Retinopathy	6	2	4	4%
Grade IV HTN Retinopathy	4	3	1	2.66%
Normal	31	22	9	20.67%
Total	95	67	28	63.33%

Table 5: Distribution According to Fundus Changes in HTN

In Table 5, the distribution of fundus changes among hypertensive CKD patients indicates that Grade I hypertensive retinopathy was the most common finding (23.33%), followed by Grade II (12.67%), Grade III (4%), and Grade IV (2.66%). A notable 20.67% of hypertensive patients showed normal fundus findings, suggesting early or well-controlled hypertension in some cases.

Fundus Changes	No. of Cases	Male	Female	%
Mild NPDR	16	10	6	10.67%
Moderate NPDR	13	11	2	8.67%
Severe NPDR	7	6	1	4.66%
PDR	14	10	4	9.33%
Mixed Retinopathy	5	4	1	3.33%
Total	55	41	14	36.67%

Table 6: Distribution According to Fundus Changes in DM Cases

In Table 6, among diabetic CKD patients, mild non-proliferative diabetic retinopathy (NPDR) was the most common finding (10.67%), followed by moderate NPDR (8.67%), PDR (Proliferative Diabetic Retinopathy) (9.33%), and severe NPDR (4.66%). Mixed retinopathy was observed in 3.33% of cases. This demonstrates a significant prevalence of diabetic retinal changes, with varying severity among CKD patients.

DISCUSSION

CKD is a progressive disorder characterized by a gradual loss of renal function and is associated with several systemic complications such as cardiovascular disease, anemia, and metabolic bone disorders. Among these, ocular manifestations-particularly fundus changes-are of significant clinical relevance because they provide valuable insight into systemic vascular health and may reflect the

severity and chronicity of CKD. The retina, due to its rich microvascular network, is particularly susceptible to vascular insults resulting from renal impairment.

The present study emphasizes the need for regular ophthalmic evaluation in CKD patients for early detection and management of retinal changes. Identifying fundus alterations can serve as a non-invasive window into systemic vascular damage and assist in disease severity assessment and management planning.

Age Distribution

In this study of 150 CKD patients, the majority (41.33%) were aged between 51 and 65 years, followed by 28% in the 31–40 years group, 27.34% in the 41–50 years group, and 3.33% in the 20–30 years age group. This pattern demonstrates that fundus changes are more prevalent among older individuals. These findings are consistent with the Indian study by Pathak AH et al. (2020),^[7] who reported the highest prevalence (48.93%) of CKD-related fundus changes among those aged 40–60 years and 30.87% in patients above 60 years, indicating that advancing age correlates with increased retinal vascular pathology. Similarly, Sapkal D et al. (2021)^[8] observed that 34.52% of CKD patients aged 46–60 years exhibited significant fundus changes. These findings align with our study, emphasizing that advancing age is a major determinant of ocular involvement in CKD patients.

Gender Distribution

In the current study, male predominance was noted, with 105 males (70%) and 45 females (30%). This male preponderance is in agreement with Gao B et al. (2011),^[9] who reported that 61.6% of their CKD cohort were males. Similarly, Sapkal D et al. (2021)^[8] and Pathak AH et al. (2020)^[7] documented male predominance of 64.28% and 70.22%, respectively. Zaheer et al. (2021)^[10] reported a similar pattern (53.52% males and 46.48% females), while Singh B et al. (2019)^[11] observed 75% male and 25% female patients. A comparable finding was reported by Yamini K et al. (2023),^[12] with 70.5% male participants. These consistent results across studies suggest that CKD-related ocular changes are more frequent in males, potentially due to higher prevalence of hypertension, diabetes, and lifestyle-related risk factors among men.

CKD Duration

In this study, 38% of participants had CKD for less than one year, 28% for 1–2 years, and 34% for more than two years. This distribution reflects the chronic and progressive nature of renal disease and its long-term systemic impact. The findings are comparable to Zaheer W et al. (2021),^[10] who reported that 26.29% of patients had CKD for less than a year and 73.70% for more than a year (mean duration 24.57 ± 6.49 months). Prolonged disease duration is known to exacerbate vascular endothelial dysfunction, leading to a higher likelihood of fundus changes.

Hypertension Duration and Fundus Correlation

In the present study, 50.66% of participants had hypertension for more than 2 years, 16.67% between 1 and 2 years, and 12.67% less than a year. Hypertensive retinopathy was the most prevalent ocular finding (61%), indicating the close relationship between chronic hypertension and retinal microangiopathy. These results align with Thulasidas M et al. (2018),^[13] who identified hypertension as a major contributor to CKD in 53.4% of cases. Sapkal D et al. (2021)^[8] similarly reported hypertension in 54.76% of CKD patients. Recent studies by Yamini K et al. (2023)^[12] and Zaheer W et al. (2021)^[10] also confirmed a high prevalence of hypertensive disorders and ocular abnormalities in CKD, further reinforcing the link between prolonged hypertension and retinal vascular damage.

Fundus Changes

The current study identified hypertensive retinopathy as the most common finding, with Grade I (23.33%) being predominant, followed by Grade II (12.67%) and Grade III (4%). Diabetic retinopathy was also prevalent—mild NPDR (10.67%), moderate NPDR (8.67%), severe NPDR (4.66%), and PDR (9.33%). Mixed retinopathies accounted for 3.33%, while 20.67% had normal

fundus findings. These results reveal that hypertensive and diabetic retinopathies constitute the majority of fundus abnormalities among CKD patients.

Our findings are consistent with Thulasidas M et al. (2018),^[13] who observed hypertensive retinopathy in 49.3% and diabetic retinopathy in 33.3% of CKD patients, with many being newly detected. Sapkal D et al. (2021)^[8] also graded hypertensive retinopathy by CKD stage, finding Grade 3 as the most common (27%). Similarly, Sujata Priyambada^[14] found Grade 3 (24.6%) retinopathy most frequent in severe and end-stage CKD. Malleswari B et al. (2016)^[15] reported hypertensive retinopathy in 39% of patients, with Grade I being the most common (44.1%). Zaheer et al. (2021)^[10] recorded 41.46% hypertensive and 58.53% diabetic retinopathy, while Singh B et al. (2019)^[11] found hypertensive retinopathy to be the most prevalent ocular manifestation, followed by diabetic retinopathy.

LIMITATIONS

This study has several limitations. Being a single-center study with a small sample size, the findings may not be representative of broader populations or different healthcare settings, thereby limiting their generalizability. Additionally, the study focused primarily on retinal changes and did not assess other ocular complications commonly seen in CKD patients, such as ocular surface abnormalities, cataracts, or intraocular pressure variations, which may affect the overall understanding of ocular health in this group. Furthermore, its cross-sectional design prevents the establishment of causality or temporal relationships between CKD and ocular manifestations, and the lack of patient follow-up further limits the depth and longitudinal relevance of the findings.

CONCLUSION

In conclusion, this hospital-based descriptive cross-sectional study underscores the significant prevalence of retinal abnormalities among patients with CKD, highlighting the close association between renal function and ocular health. The findings emphasize the importance of routine ophthalmic evaluations as part of CKD management to facilitate early detection, guide treatment decisions, and prevent vision-threatening complications. Integrating ophthalmologic assessments into multidisciplinary CKD care can enhance patient outcomes and quality of life, while future longitudinal studies are needed to further explore the progression and broader impact of these ocular manifestations.

REFERENCES

- [1] Kidney Disease: Improving Global Outcomes (KDIGO) CKD Work Group. KDIGO 2012 Clinical Practice Guideline for the Evaluation and Management of Chronic Kidney Disease. *Kidney Inter Suppl* 2013;3:1-150.
- [2] Bajracharya L, Shah DN, Raut KB, et al. Ocular evaluation in patients with chronic renal failure--a hospital based study. *Nepal Med Coll J* 2008;10(4):209-14.
- [3] Lee WJ, Sobrin L, Kang MH, et al. Ischemic diabetic retinopathy as a possible prognostic factor for chronic kidney disease progression. *Eye (Lond)* 2014;28(9):1119-25.
- [4] Leys AM. Le fond d'oeil du diabétique avec néphropathie et rétinopathie hypertensive. Complications macroangiopathiques [Eye fundus of the diabetic patient with nephropathy and hypertensive retinopathy. Macroangiopathic complications]. *Bull Soc Belge Ophtalmol* 1995;256:49-59.
- [5] Friberg TR, Eller AW. Serous retinal detachment resembling central serous chorioretinopathy following organ transplantation. *Graefes Arch Clin Exp Ophthalmol* 1990;228(4):305-9.
- [6] Carlson EC. Scanning and transmission electron microscopic studies of normal and diabetic acellular glomerular and retinal micro vessel basement membranes. *Microsc Res Tech* 1994;28(3):165-77.
- [7] Pathak AH, Ketkar MR, Joshi AK, et al. Fundus changes in patients with chronic renal failure undergoing hemodialysis. *IP International Journal of Ocular Oncology and Oculoplasty* 2020;6(1):67-71.

- [8] Sapkal D, Gaddekar SA, Bhandari MS, et al. To study ocular findings in chronic kidney disease patients attending a tertiary care hospital in Maharashtra. *Indian J Clin Exp Ophthalmol* 2021;7:410-4.
- [9] Gao B, Zhu L, Pan Y, et al. Ocular fundus pathology and chronic kidney disease in a Chinese population. *BMC Nephrol* 2011;12:62.
- [10] Zaheer W, Haider M, Chachar AZK, et al. Frequency of eye changes in patients of chronic kidney disease. *PJMHS* 2021;15(7):1689-92.
- [11] Singh B, Verma VK, Agrawal G, et al. Fundus changes in chronic kidney disease patients on maintenance haemodialysis. *JMSCR* 2019;7(2):855-9.
- [12] Yamini K, Sangeetha T, Kumar HM, et al. A cross-sectional study to evaluate ocular manifestations in chronic kidney disease patients in a tertiary care centre. *Indian J Clin Exp Ophthalmol* 2023;9(4):628-33.
- [13] Thulasidas M, Amin H. Ocular evaluation in patients with chronic kidney disease- a hospital based study. *J Ophthalmol* 2018;3(5):1-9.
- [14] Priyambada S, Mohindru D, Mishra PP. Analysis of Papilloedema in ICU Patients *International Journal of Pharmaceutical and Clinical Research* 2023;15(4):234-40.
- [15] Malleswari B, Rahmathunnisa I. Eye findings in chronic renal failure patients undergoing hemodialysis. *Int J Contemp Med Res* 2016;3(7):1912-4.