TPM Vol. 32, No. S5, 2025
ISSN: 1972-6325
https://www.tpmap.org/

Open Access

PREVALENCE AND PATTERN OF OCULAR MANIFESTATIONS IN HEMODIALYSIS PATIENTS IN A TERTIARY CENTRE: A CROSS-SECTIONAL STUDY

LIKHITA MOVVA[1], GENICKSON JEYARAJ R[1], SANDRA SAGAR[2]

[1]DEPARTMENT OF OPHTHALMOLOGY, SAVEETHA MEDICAL COLLEGE AND HOSPITAL, SAVEETHA INSTITUTE OF MEDICAL AND TECHNICAL SCIENCES, CHENNAI, INDIA.
[2]DEPARTMENT OF ORAL AND MAXILLOFACIAL PATHOLOGY, SAVEETHA DENTAL COLLEGE AND HOSPITAL, SAVEETHA INSTITUTE OF MEDICAL AND TECHNICAL SCIENCES, CHENNAI, INDIA.

ABSTRACT

Background: Hemodialysis (HD) is a life-sustaining therapy for patients with end-stage renal disease(ESRD), and it is usually associated with systemic and ocular complications. These ocular manifestations, if unrecognised, can significantly impair quality of life.

Objective: To evaluate the prevalence and the spectrum of ocular manifestations among patients undergoing HD at a tertiary care centre.

Methods: A prospective cross-sectional study was conducted among 72 patients on regular HD. Comprehensive ophthalmic examinations, including visual acuity, intraocular pressure, slit-lamp, and fundus evaluations, were performed. Cataract grading, diabetic retinopathy staging, and hypertensive retinopathy assessment were documented.

Results: A total of 144 eyes were examined. The mean age was 58.7 ± 6.7 years, with a male predominance (70.8%). Cataract was the most common anterior segment finding, present in 56.9% of eyes, predominantly nuclear sclerosis. Pseudophakia was observed in 13.2%. Posterior segment findings included diabetic retinopathy in 25% (18.1% NPDR, 6.9% PDR) and clinically significant macular oedema in 4.2%. Hypertensive retinopathy was highly prevalent, affecting 77.7% of eyes, with Grade 1 changes most frequent. Cup-to-disc ratio >0.5 was noted in 6.9% of eyes. Ocular morbidity was significantly associated with systemic comorbidities, particularly diabetes mellitus and hypertension.

Conclusion: Ocular manifestations are highly prevalent in HD patients, with cataract, hypertensive retinopathy, and diabetic retinopathy being the most common. These findings underscore the importance of routine ophthalmic screening in this vulnerable population to facilitate early detection and intervention, thereby preventing vision-related morbidity.

Keywords: Hemodialysis, Cataract, Diabetic Retinopathy, Hypertensive Retinopathy, Ophthalmology.

INTRODUCTION

Hemodialysis(HD) is essential for managing patients with renal failure due to conditions like chronic kidney disease (CKD), acute kidney injury (AKI), and systemic disorders such as autoimmune diseases and sepsis (1). While it effectively removes toxins, excess fluid, and electrolytes, hemodialysis can induce significant physiological and metabolic changes that affect multiple organ systems, including the eyes (2).

The eye, being highly vascular and metabolically active, is particularly susceptible to hemodynamic shifts, oxidative stress, and biochemical disturbances induced by hemodialysis. These factors, combined with pre-existing comorbidities such as diabetes, hypertension, and systemic inflammation, contribute to a diverse spectrum of ocular manifestations in hemodialysis patients (3). These manifestations may involve the anterior segment (e.g., dry eye syndrome, corneal oedema, and conjunctival calcification), the posterior segment (e.g., hypertensive retinopathy, diabetic retinopathy, and macular oedema), and the optic nerve (e.g., ischemic optic neuropathy) (4)(5).

Patients undergoing hemodialysis for conditions other than CKD may present unique ocular challenges. For example, AKI patients on temporary hemodialysis may experience transient ocular changes, while those with systemic vasculitis

may have ocular inflammation as a direct manifestation of their underlying disease (3)(6). Despite the diverse etiologies and clinical presentations, the common denominator is the physiological stress of dialysis, which can exacerbate or unmask ocular conditions (7).

Previous studies have predominantly focused on CKD-associated ocular manifestations, with limited literature addressing the broader spectrum of ocular changes in patients undergoing hemodialysis for various conditions (8). Moreover, many of these studies are retrospective or narrowly focused on specific ocular pathologies, leaving a gap in understanding the full range of ocular involvement in this population (9).

This study aims to address this gap by systematically evaluating the prevalence and patterns of ocular manifestations in patients undergoing hemodialysis for diverse conditions. By correlating these findings with clinical and biochemical parameters, the study sought to identify potential risk factors, provide insights into the pathophysiological mechanisms, and emphasise the importance of regular ophthalmic evaluations (10). Early detection and timely management of ocular conditions in this patient population are critical for preserving vision and improving overall quality of life (11).

METHODOLOGY

A prospective cross-sectional study was conducted among 72 patients undergoing hemodialysis at a tertiary care centre in India from January 2024 to April 2024, following approval from the Institutional Human Ethical Committee. Patients of ≥18 years undergoing regular hemodialysis for ≥3 months were included in the study. Patients with a history of ocular trauma or surgery within the past 6 months were excluded from the study.

Written informed consent was obtained from all participants of the study. Basic demographic data, duration of hemodialysis, and history of comorbidities like diabetes mellitus, hypertension, and cardiovascular diseases were collected from the participants. Best-corrected visual acuity (BCVA) was charted using Snellen's chart and converted to Logarithm of the Minimum Angle of Resolution (LogMAR) for statistical analysis. Intraocular pressure (IOP) was measured with a non-contact tonometer (NCT). Colour vision was documented using the Ishihara Colour Vision Chart. Anterior segment evaluation was done using Slit lamp biomicroscopy, and fundus examination was done using indirect ophthalmoscopy.

The collected data were compiled in a Microsoft Excel sheet. Statistical analysis was performed using SPSS Statistical software(IBM SPSS Software Version 26). All the categorical data were presented as a percentage. The Shapiro–Wilk test was used to determine the distribution of the continuous data. Mean and standard deviation were calculated in the data with a normal distribution.

RESULTS

A total of 144 eyes of 72 patients undergoing hemodialysis were included in the study. The average age of the study population was 58.76 ± 6.74. Out of the total 72 patients, 70.8% were male and 29.2% were female. Diabetes Mellitus was present in 59.7 %, systemic hypertension in 77.8%, and CKD in 91.7%. The average Visual acuity within the study population was 0.67 ± 0.65 as per LogMAR notations. Colour vision was normal among 59.7% and defective in 40.3%. Intraocular Pressure averaged at 14.56 ± 3.60 mmHg, with 86.8% within the normal range. These findings are summarised in Table 1

Table 1 ***Demographic and Clinical Characteristics of Hemodialysis Patients***

Parameter	**Count/Percentage**
Age	58.76 ± 6.74
Sex Male	51 (70.8%)
Female	21 (29.2%)
Systemic Comorbidities T2DM	43 (59.70%)
HTN	56 (77.80%)
CKD	66 (91.70%)
Visual Acuity	0.67 ± 0.65
Colour Vision Normal	86 (59.7 %)
Defective	58 (40.3%)
Intraocular Pressure	14.56 ± 3.60 mmHg

< 10 mmHg	9 (6.3%)
10-15 mmHg	78 (54.1%)
16-20 mmHg	47 (32.7%)
>20 mmHg	10 (6.9%)

Anterior segment examination showed Nasal pterygium in 6 eyes(4%), and Shallow Anterior Chamber in 8 eyes(5.6%). Lens was clear in 43 eyes(29.9%), cataract changes in 82 eyes(56.9%), and Pseudophakia in 19 eyes(13.2%). Nuclear Sclerosis Grade 1 was the most common type of cataract change noted in 56 eyes(38.9%) followed by Nuclear Sclerosis Grade 2 in 11 eyes(7.6%), Nuclear Sclerosis Grade 3 in 1 eye(0.7%), Nuclear Sclerosis Grade 4 in 5 eyes(3.5%), and Posterior Subcapsular Cataract in 9 eyes(6.2%). The findings are summarised in Table 2 and Figure 1.

Table 2 Anterior Segment Findings Among Hemodialysis Patients

Anterior Segment Findings	Count
Pterygium	6(4%)
Shallow AC	8(5.6%)
Clear Lens	43(29.9%)
Pseudophakia	19(13.2%)
Nuclear Sclerosis 1	56(38.9%)
Nuclear Sclerosis 2	11(7.6%)
Nuclear Sclerosis 3	1(0.7%)
Nuclear Sclerosis 4	5(3.5%)
Posterior Subcapsular Cataract	9(6.2%)

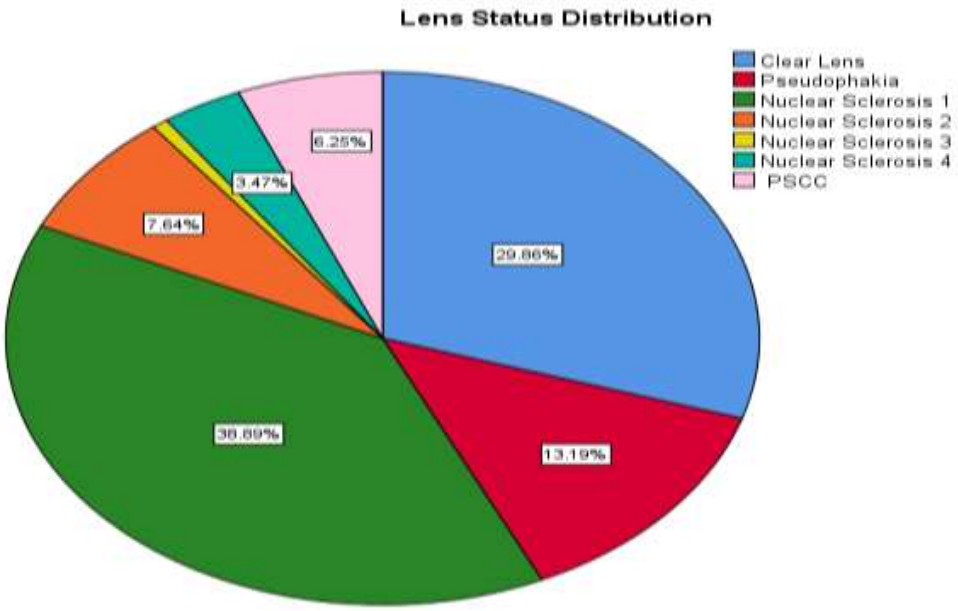

Figure 1 Lens Status Observations in Hemodialysis Patients

Fundus examination showed 45.8% eyes with a normal Cup to Disc ratio of 0.2-0.3:1. 6.9% eyes had a Cup to Disc ratio of more than 0.5:1.(Figure 2) Foveal reflex was present in 27.8% and absent in 43.1% eyes. Diabetic retinopathy was observed in a significant subset, with 18.1% showing non-proliferative diabetic retinopathy (NPDR) and 6.9% having proliferative diabetic retinopathy (PDR). Clinically Significant Macular Edema (CSME) was seen in 4.2% of the group. (Figure 3)

TPM Vol. 32, No. S5, 2025
ISSN: 1972-6325
https://www.tpmap.org/

Open Access

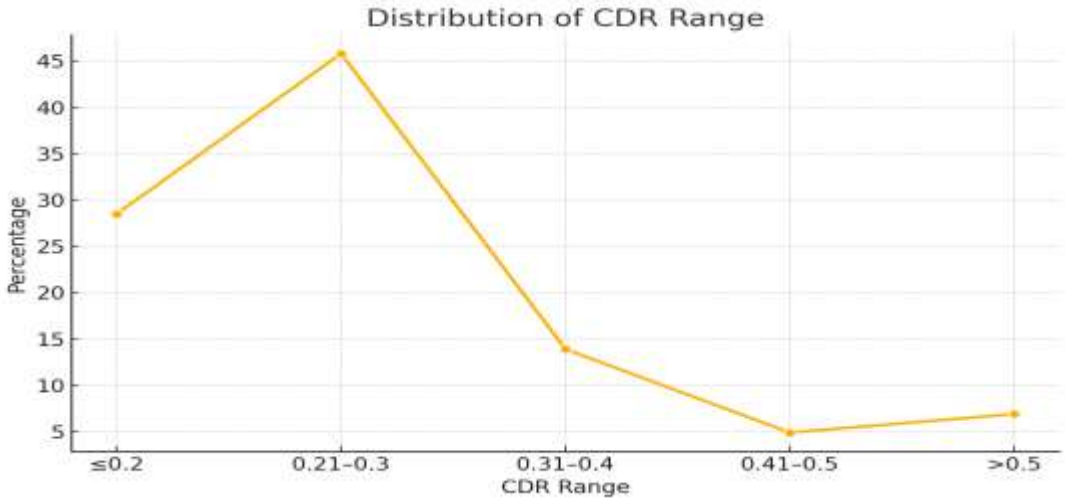

Figure 2 Cup-to-Disc Ratio (CDR) Distribution in Hemodialysis Patients

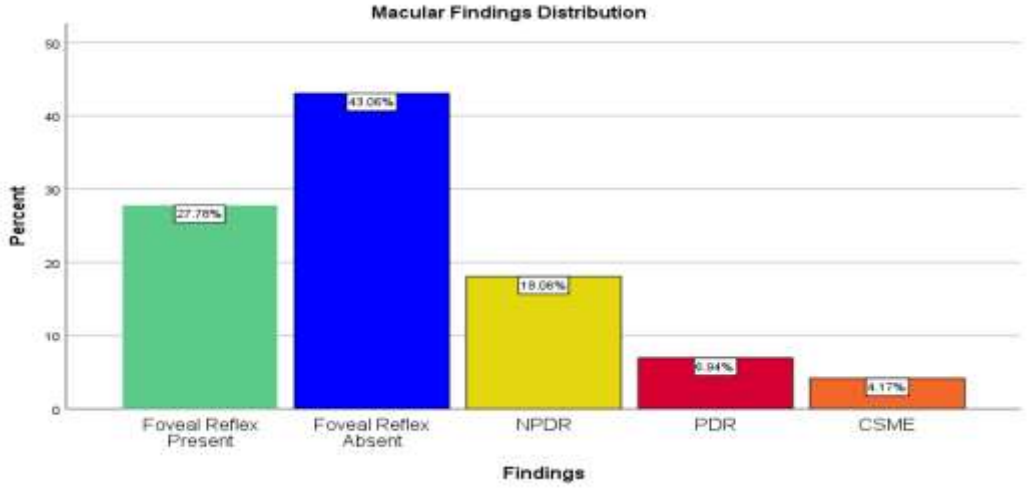

Figure 3 Macular Findings in Hemodialysis Patients

Hypertensive retinopathy changes are noted in 77.7% eyes. Grade 1 Hypertensive Retinopathy is noted in 47.2% eyes, followed by grade 2 and grade 3 hypertensive retinopathy noted in 19.4% and 11.1% eyes, respectively. (Figure 4)

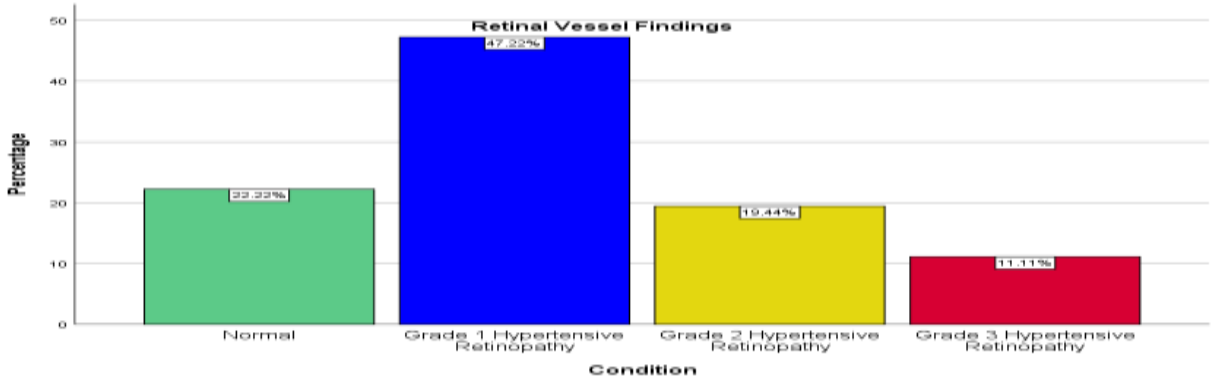

Figure 4 Retinal Vessel Changes in Hemodialysis Patients

DISCUSSION

HD involves removing excess body water and metabolic waste. As a result, body fluid volume, solute concentration, and osmotic pressure decrease after the procedure of HD. HD patients frequently harbour systemic comorbidities such as diabetes mellitus and hypertension, which are independently associated with significant ocular morbidity. The dynamic, hemodynamic and osmotic fluctuations associated with dialysis further exacerbate these risks, resulting in a higher prevalence of retinal vascular disease, macular alterations, glaucoma, cataract progression, and ocular surface disorders. Recent evidence indicates that diabetes-related retinopathy, hypertensive vascular changes, and dry eye disease occur more commonly and with greater severity in HD populations compared to non-dialysis counterparts (12)(13)(14). These findings suggest that ocular manifestations in HD patients are not isolated complications but instead reflect a convergence of systemic vascular stress, metabolic dysregulation, and treatment-related physiological shifts. Our study evaluated the spectrum of ocular findings among patients undergoing HD, focusing on both anterior and posterior segment changes. Our findings highlight that ocular morbidity in this population is multifactorial, closely linked with systemic comorbidities such as diabetes mellitus and hypertension, and compounded by the chronic metabolic alterations associated with CKD.

The anterior segment analysis revealed a predominance of cataract changes (56.9%), primarily nuclear sclerosis, with pseudophakia present in 13.2% of cases. These results are consistent with recent studies, which have documented accelerated cataractogenesis in dialysis patients, largely attributed to oxidative stress, uremia, and systemic comorbidities. The relatively high proportion of pseudophakia in our cohort also reflects the increased need for cataract surgery in this population(15) (16).

Posterior segment findings were particularly significant, with DR seen in 25% of eyes (18.1% NPDR and 6.9% PDR) and clinically significant macular oedema (CSME) in 4.2%. These figures are comparable to the prevalence reported in a study from India by Kaushik et.al. (17), which found a 23.33% prevalence of DR related conditions among hemodialysis patients. However, our findings differ slightly from those of Kameda et.al. (18), who reported higher rates of advanced DR in a Japanese cohort, likely reflecting differences in baseline diabetes control and duration of dialysis.

Hypertensive retinopathy was another notable finding, present in 77.7% of eyes, with Grade 1 changes being most common. This high prevalence underscores the interplay between systemic hypertension and microvascular alterations in the retina. Similar results were observed by Chillo et.al.(19), who reported that nearly two-thirds of dialysis patients showed hypertensive retinal changes. These vascular changes are important not only as ocular morbidity but also as potential indicators of systemic vascular burden.

The cup-to-disc ratio (CDR) analysis indicated that most patients had a normal CDR, with only 6.9% showing a ratio >0.5. Although this suggests that glaucomatous optic neuropathy was uncommon in our group, ongoing monitoring is essential because dialysis-related fluctuations in intraocular pressure have been observed in previous studies (20)(21).

Strengths of our study include a well-defined cohort with comprehensive ophthalmic evaluation and detailed documentation of both anterior and posterior segment findings. The sample size of 144 eyes provides a reliable overview of ocular changes in this population. However, several limitations must be acknowledged. First, the cross-sectional design limits our ability to establish causal associations between dialysis duration and ocular findings. Second, a lack of detailed systemic biochemical parameters, such as HbA1c or serum phosphate, restricts deeper correlation with ocular outcomes. Third, being a single-centre study, the findings may not be generalizable across diverse patient populations.

CONCLUSION

Our study reinforces the high prevalence of ocular comorbidities among patients undergoing hemodialysis, particularly cataract, diabetic retinopathy, and hypertensive retinopathy. These findings emphasise the importance of regular ophthalmic screening in this vulnerable population, as early detection and management can prevent significant visual morbidity. Future longitudinal, multicenter studies integrating systemic biochemical data and dialysis duration could provide further insights into the pathophysiological links between renal disease and ocular health.

REFERENCES

1. Khwaja A. KDIGO Clinical Practice Guidelines for Acute Kidney Injury. Nephron Clinical Practice. 2012 Aug 7;120(4):c179–84.
2. Protsyk O, Lacorzana J. The effects of hemodialysis on the eye. Indian Journal of Ophthalmology. 2025 Apr

24;73(5):648.
3. Website [Internet]. Available from: https://doi.org/10.4103/ijo.ijo_1450_23
4. Mansour DE, El-Bayomi AM, El-Azab AM. Abnormal Ocular Findings in Chronic Renal Failure Patients on Hemodialysis. The Egyptian Journal of Hospital Medicine. 2018 Jul 1;72(11):5640–6.
5. Nair SV, Balasubramanian K, Ramasamy A, Thamizhselvam H, Gharia S, Periasamy S. Effect of low dialysate sodium in the management of intradialytic hypertension in maintenance hemodialysis patients: A single-centre Indian experience. Hemodialysis International. 2021 Jul 1;25(3):399–406.
6. Kesavamoorthy G, Singh AK, Sharma S, Kasav JB, Mohan SK, Joshi A. Burden of Diabetes Related Complications Among Hypertensive and Non-Hypertensive Diabetics: A Comparative Study. J Clin Diagn Res. 2015 Sep;9(9): LC10–4.
7. Ismayılov AS, Guclu OA, Erol HA. Ocular manifestations in hemodialysis patients and short-term changes in ophthalmologic findings. Therapeutic Apheresis and Dialysis. 2021 Apr 1;25(2):204–10.
8. Mukherjee S, Nazm N, Ghosh MK, Potdar A, Bothra P. Ophthalmic Manifestations of Chronic Kidney Disease. Journal of Contemporary Clinical Practice. 2025 Jul 20;11:575–80.
9. Shanti Y, Hamayel H, Yasin A, Shanab AA, Hroub O, Hamdan Z, et al. Epidemiology of Common Ocular Manifestations among Patients on Haemodialysis in the West Bank, Palestine. Sultan Qaboos University medical journal [Internet]. 2023 Feb [cited 2025 Aug 25];23(1). Available from: https://pubmed.ncbi.nlm.nih.gov/36865416/
10. Lahme L, Storp JJ, Marchiori E, Esser E, Eter N, Mihailovic N, et al. Evaluation of Ocular Perfusion in Patients with End-Stage Renal Disease Receiving Hemodialysis Using Optical Coherence Tomography Angiography. Journal of Clinical Medicine [Internet]. 2023 Jun 3 [cited 2025 Aug 25];12(11). Available from: https://pubmed.ncbi.nlm.nih.gov/37298031/
11. Vision Impairment in CKD Patients: Epidemiology, Mechanisms, Differential Diagnoses, and Prevention. American Journal of Kidney Diseases. 2019 Jun 1;73(6):846–57.
12. He K, Liu S, Shi J, Zhang P, Chen L, Wang B, et al. The effect of long-term hemodialysis on diabetic retinopathy observed by swept-source optical coherence tomography angiography. BMC Ophthalmology. 2024 Aug 9;24(1):1–11.
13. Li W, Zhou Q, Ni J, Pan X, Li M, Hua F, et al. Retinal and choroidal blood flow changes in dialysis patients assessed by wide-field swept-source optical coherence tomography angiography. Front Med. 2025 May 14;12:1524503.
14. Tat TT, Duc KN, Hong PP, Sa HN, Trung KN, Thu HNT, et al. Dry Eye and Some Related Factors in Patients with Type 2 Diabetic Nephropathy: A Cross-Sectional Study in Vietnam. OPTH. 2024 May 6;18:1217–24.
15. Huang CY, Lee JI, Chang CW, Liu YH, Huang SP, Chen SC, et al. Chronic kidney disease and its association with cataracts–A cross-sectional and longitudinal study. Front Public Health. 2022 Dec 7;10:1029962.
16. Liu YT, Hung TY, Lee YK, Huang MY, Hsu CY, Su YC. Association between Chronic Kidney Disease and Risk of Cataract: A Nationwide Retrospective Cohort Study. Am J Nephrol. 2017 May 20;45(6):524–31.
17. Kaushik DS, Ashwini KV, Angraje S. A cross-sectional study to evaluate ocular manifestations in end-stage renal disease patients attending a tertiary care centre. The Pan-American Journal of Ophthalmology [Internet]. 2024 Dec;6(3). Available from: https://journals.lww.com/10.4103/pajo.pajo_98_24
18. Kameda Y, Hanai K, Uchigata Y, Babazono T, Kitano S. Vitreous haemorrhage in diabetes patients with proliferative diabetic retinopathy undergoing hemodialysis. Journal of Diabetes Investigation. 2020 May 1;11(3):688–92.
19. Chillo P, Ismail A, Sanyiwa A, Ruggajo P, Kamuhabwa A. Hypertensive retinopathy and associated factors among nondiabetic chronic kidney disease patients seen at a tertiary hospital in Tanzania: a cross-sectional study. IJNRD. 2019 May 1;12:79–86.
20. Liakopoulos V, Demirtzi P, Mikropoulos DG, Leivaditis K, Dounousi E, Konstas AGP. Intraocular pressure changes during hemodialysis. International Urology and Nephrology. 2015 Jul 4;47(10):1685–90.
21. Utility of fundus fluorescein angiography and efficacy of ranibizumab intravitreal therapy in peripheral retinal vascular abnormalities of a diabetic patient: A case report. TEXILA INTERNATIONAL JOURNAL OF PUBLIC HEALTH [Internet]. 2025 Mar 28;13(01). Available from: https://www.texilajournal.com/public-health/article/3025-utility-of-fundus