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Clinical Profile and Visual Outcomes of Patients with Diabetic Retinopathy Attending a Secondary-Level Hospital: A Prospective Observational Study

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Abstract

Background:Diabetic retinopathy remains a leading cause of preventable visual impairment among working-age adults, and timely detection at secondary-level facilities can improve outcomes. ***Objectives:*** To describe the clinical profile of diabetic retinopathy and to evaluate short-term visual outcomes following routine care in a secondary-level hospital. ***Methods:*** A prospective observational study was conducted over six months (May 2025–October 2025) at Malla Reddy Institute of Medical Sciences, Suraram, Hyderabad, Telangana. One hundred consecutive patients with diabetic retinopathy underwent standardized ophthalmic evaluation including best-corrected visual acuity (logMAR), slit-lamp biomicroscopy, dilated fundus assessment, and optical coherence tomography when indicated. Retinopathy was graded into non-proliferative and proliferative categories with macular edema assessment. Patients received treatment per institutional protocol (anti-VEGF therapy, laser photocoagulation, or observation with metabolic optimization) and were followed for three months. ***Results:*** Participants were predominantly middle-aged with long-standing diabetes and frequent coexisting hypertension. Most presented with reduced vision, while one-fifth were detected on screening. Non-proliferative disease was more common than proliferative disease, and macular edema affected about one-third. Mean visual acuity improved at three months, with nearly half achieving clinically meaningful improvement, and most remaining stable. ***Conclusion:*** In this secondary-level setting, diabetic retinopathy commonly occurred in patients with longer diabetes duration and was frequently symptomatic. Routine, protocol-based treatment achieved short-term visual stabilization or improvement in most patients, supporting the value of structured assessment and timely intervention.

Keywords: Diabetic retinopathy; non-proliferative diabetic retinopathy; proliferative diabetic retinopathy; diabetic macular edema; anti-VEGF; laser photocoagulation; visual outcome.

INTRODUCTION

Diabetic retinopathy (DR) is a microvascular complication of diabetes mellitus and remains a major cause of avoidable vision loss globally. Contemporary meta-analyses estimate that DR affects a substantial proportion of individuals with diabetes and that the overall burden will continue to rise as diabetes prevalence increases and survival improves [1,2]. Vision-threatening forms severe non-proliferative DR, proliferative DR (PDR), and diabetic macular edema (DME) drive most functional disability, reduce productivity, and increase health-system costs [1–3].

In India, population-based data indicate a sizable prevalence of DR among people with diabetes, highlighting the need for scalable screening and treatment pathways [4]. Reports from public-sector and primary-care linked programs further emphasize the association of DR with longer diabetes duration, hyperglycemia, and hypertension risk factors that are common and often suboptimally controlled in routine practice [5]. Secondary-level hospitals occupy a critical position between community screening and tertiary vitreoretinal services, particularly in regions where referral delays and access barriers can lead to advanced disease at presentation.

Clinical outcomes in DR depend on disease stage at diagnosis and the timely application of evidence-based interventions. The Early Treatment Diabetic Retinopathy Study (ETDRS) established the role of focal/grid photocoagulation for clinically significant macular edema and clarified the benefits of timely photocoagulation strategies for retinopathy progression [6,7]. In the anti-vascular endothelial growth factor (anti-VEGF) era, randomized trials have demonstrated meaningful improvements in vision for center-involving DME, with outcomes influenced by baseline visual acuity and treatment intensity [8,9]. In parallel, systemic

optimization remains essential; large trials have shown that intensive glycemic control and selected lipid interventions can reduce retinopathy progression, while blood pressure control contributes to risk reduction in routine care settings [10,11].

Despite this evidence base, real-world profiles and outcomes vary across care levels because of differences in patient mix, follow-up adherence, and treatment availability. Prospective data from secondary-level hospitals are particularly informative for program planning, as these facilities frequently manage moderate disease, initiate DME therapy, and coordinate referral for advanced PDR or tractional complications.

Objectives: The present study aimed (i) to describe the demographic and systemic profile and retinopathy spectrum among patients with DR attending a secondary-level hospital and (ii) to evaluate short-term visual outcomes at three months following routine, protocol-based management.

MATERIALS AND METHODS

Study design and setting: This prospective observational study was conducted at Malla Reddy Institute of Medical Sciences, Suraram, Hyderabad, Telangana, India, over a six-month period (May 2025 to October 2025). The study was performed in accordance with the tenets of the Declaration of Helsinki.

Study population and sampling: A total of 100 consecutive patients diagnosed with diabetic retinopathy (clinical diagnosis on dilated fundus examination) were enrolled from the ophthalmology outpatient services. Enrollment was patient-based; if both eyes were affected, the patient contributed once to demographic and systemic variables, while visual outcome assessment used the better-seeing eye for functional categorization.

Eligibility criteria: Adults (≥18 years) with diabetes mellitus and evidence of diabetic retinopathy were included. Patients with media opacities precluding fundus evaluation, concurrent retinal vascular occlusions, advanced glaucoma, uveitis, or other retinal disorders likely to confound vision assessment were excluded. Patients unwilling for follow-up were also excluded.

Clinical assessment and grading: All participants underwent best-corrected visual acuity (BCVA) assessment using Snellen charts and conversion to logMAR for analysis, slit-lamp biomicroscopy, intraocular pressure measurement, and dilated fundus examination with indirect ophthalmoscopy and slit-lamp biomicroscopy using a non-contact lens. DR was categorized into non-proliferative (mild, moderate, severe) and proliferative disease using standard clinical criteria aligned with ETDRS concepts [6,7]. Macular status was assessed clinically and with optical coherence tomography (OCT) when indicated; clinically significant macular edema (CSME) was recorded as present/absent based on established ETDRS definitions [6].

Treatment protocol and follow-up: Management followed routine institutional practice. Patients with center-involving macular edema and vision impairment received intravitreal anti-VEGF injections, while those with PDR or high-risk features received pan-retinal photocoagulation (PRP). Focal/grid laser was performed for suitable DME patterns. Patients with mild changes and no treatable macular edema were observed with counseling on metabolic control. Follow-up visits were scheduled up to three months after baseline, and additional visits occurred as clinically required. Safety monitoring included documentation of any injection- or laser-related adverse events.

Outcome measures: The primary outcome was change in BCVA (logMAR) from baseline to three months. Secondary outcomes included the proportion achieving ≥2 Snellen-line improvement, stability, or deterioration, and the distribution of DR severity and CSME at presentation.

Statistical analysis: Data were summarized using mean ± standard deviation (SD) for continuous variables and frequency (percentage) for categorical variables. Associations between severe NPDR/PDR and selected risk factors (diabetes duration >5 years, HbA1c ≥8%, and hypertension) were evaluated using chi-square tests. A p-value <0.05 was considered statistically significant. Analyses were performed using standard statistical software.

Ethical considerations: Institutional ethics approval was obtained prior to study initiation. Written informed consent was obtained from all participants, and confidentiality was maintained throughout data handling and reporting.

RESULTS

A total of 100 patients with diabetic retinopathy were evaluated during the study period. Baseline demographic and systemic characteristics are summarized in Table 1. The cohort had a mean age of 56.8 ± 9.4 years, with most patients in the 51–60-year group (42%). Males constituted 58% of participants. Diabetes duration exceeded 5 years in 64%, and systemic hypertension was present in 48%.

Table 1. Baseline Demographic and Systemic Characteristics (n = 100)

Variable	Category	n	% / Mean ± SD
Age (years)	38–50	22	22%
	51–60	42	42%
	61–70	28	28%
	>70	8	8%
Mean age (years)	—	—	56.8 ± 9.4
Sex	Male	58	58%
	Female	42	42%
Duration of diabetes	≤5 years	36	36%
	>5 years	64	64%
Mean duration (years)	—	—	9.6 ± 5.2
Systemic hypertension	Present	48	48%
	Absent	52	52%

Clinical presentation and retinopathy spectrum are presented in Table 2. Diminished vision was the predominant complaint (62%), whereas 20% were asymptomatic and detected during evaluation. Mean baseline BCVA was 0.54 ± 0.28 logMAR. NPDR was more frequent than PDR (72% vs 28%), and CSME was present in 34%. Bilateral involvement was documented in 76% of patients.

Table 2. Clinical Presentation and Diabetic Retinopathy Profile (n = 100)

Variable	Category	n	% / Mean ± SD
Presenting complaint	Diminished vision	62	62%
	Blurring with floaters	18	18%
	Asymptomatic	20	20%
Baseline BCVA (logMAR)	Mean ± SD	—	0.54 ± 0.28
DR severity	Mild NPDR	24	24%
	Moderate NPDR	30	30%
	Severe NPDR	18	18%
	Proliferative DR (PDR)	28	28%
Clinically significant macular edema	Present	34	34%
Bilateral involvement	Yes	76	76%

On risk factor analysis (Table 3), severe NPDR/PDR was significantly associated with diabetes duration >5 years ($p < 0.01$), HbA1c ≥8% ($p = 0.02$), and coexisting hypertension ($p = 0.04$).

Table 3. Association Between Risk Factors and Severity of Diabetic Retinopathy

Risk factor	Severe NPDR/PDR (n = 46)	Mild/Moderate NPDR (n = 54)	p-value
Duration >5 years	38	26	<0.01
HbA1c ≥8%	32	24	0.02
Hypertension	28	20	0.04

Table 4. Treatment Modalities and Visual Outcomes at 3-Month Follow-up (n = 100)

Variable	Category	n	% / Mean ± SD
Treatment given	Anti-VEGF injections	38	38%
	Pan-retinal photocoagulation	26	26%
	Focal/Grid laser	18	18%
	Observation	18	18%
Mean BCVA at 3 months (logMAR)	—	—	0.41 ± 0.25
Visual outcome	≥2 lines improvement	46	46%
	Stable vision	40	40%
	Deterioration	14	14%
Change in mean BCVA	—	—	$p < 0.001$

Treatment patterns and three-month outcomes are shown in Table 4. Anti-VEGF injections were administered to 38% of patients, PRP to 26%, focal/grid laser to 18%, and observation with metabolic optimization to 18%. Mean BCVA improved significantly to 0.41 ± 0.25 logMAR at three months ($p < 0.001$). Clinically meaningful improvement (≥2 Snellen lines) was achieved by 46%, stability by 40%, and deterioration by 14%. No major treatment-related sight-threatening adverse events were recorded during the follow-up interval.

DISCUSSION

This prospective observational study from a secondary-level hospital describes a predominantly middle-aged cohort with long-standing diabetes and a substantial burden of symptomatic presentation. The age distribution and male predominance are consistent with patterns seen in population-based and service-linked datasets in India, where working-age and early elderly groups contribute a large proportion of DR caseloads [4,5]. The high frequency of diabetes duration beyond five years and concomitant hypertension underscores the central role of cumulative glycemic exposure and vascular comorbidity in DR development and progression [11].

Non-proliferative disease was the most common category in this cohort, while nearly one-third had proliferative disease. Such staging is clinically important because the transition to PDR markedly increases the risk of severe visual loss and frequently requires definitive PRP or surgical referral. ETDRS evidence supports appropriately timed photocoagulation strategies to reduce the risk of severe visual loss, particularly as high-risk proliferative features emerge [6,7]. In our setting, PRP was used for PDR, while focal/grid laser was used selectively for DME patterns, reflecting the continued relevance of laser as an effective and durable modality when delivered with appropriate indications [6,12].

Macular edema affected approximately one-third of patients, aligning with the recognized contribution of DME to functional impairment and the observed predominance of diminished vision as the presenting complaint. Randomized trials have established intravitreal anti-VEGF therapy as a cornerstone for center-involving DME, with meaningful visual gains and anatomic improvement; these benefits have been reproduced across multiple comparative and protocol-driven studies [8,9]. In the current cohort, anti-VEGF therapy was the most frequently deployed intervention and was accompanied by a significant mean improvement in BCVA over three months, with nearly half achieving clinically meaningful improvement. Although the short follow-up precludes inference on durability, these findings mirror the early functional gains reported in pivotal trials and reinforce the feasibility of anti-VEGF delivery at secondary-level facilities when supported by appropriate training and follow-up systems [8,9].

The observed associations between severe NPDR/PDR and diabetes duration, higher HbA1c, and hypertension are biologically plausible and concordant with landmark evidence. Meta-analytic data highlight duration of diabetes and poor glycemic and blood pressure control as major modifiable determinants of DR [13]. UKPDS demonstrated a continuous relationship between glycemia and microvascular risk, supporting the importance of sustained glycemic optimization [11]. Similarly, large interventional studies suggest that intensive glycemic control and selected lipid strategies can reduce retinopathy progression in type 2 diabetes, particularly when applied before advanced retinopathy is established [10,14]. These systemic levers remain vital complements to ocular therapy, especially in resource-constrained environments where missed follow-up can limit ocular treatment intensity.

From a service perspective, the finding that one-fifth of patients were asymptomatic highlights the value of opportunistic screening and structured referral pathways. Given projected growth in global DR burden through 2045, integrating systematic screening, triage, and evidence-based therapy into secondary-level care is likely to be increasingly necessary to reduce avoidable vision loss.

Limitations

The study was conducted at a single secondary-level center with a modest sample size, limiting external generalizability. Disease severity grading relied on routine clinical documentation, and standardized severity scales were not applied uniformly, restricting detailed correlation between stage and visual outcomes. Diagnostic investigations, including OCT, were not performed in all participants. The short follow-up period limited assessment of long-term vision trajectories, recurrence of macular edema, and durability of treatment response.

CONCLUSION

This prospective observational study demonstrates that diabetic retinopathy in a secondary-level hospital predominantly affects middle-aged individuals with long-standing diabetes and frequent hypertension. Non-proliferative disease constituted the majority, but a clinically important proportion presented with proliferative changes and macular edema. Routine, protocol-based management primarily anti-VEGF therapy for macular edema and PRP for proliferative disease resulted in significant short-term improvement in mean visual acuity, with most patients achieving either meaningful gains or stable vision at three months. Strengthening opportunistic screening, standardized grading, and coordinated systemic risk-factor

management at secondary-level facilities can help reduce avoidable visual impairment due to diabetic retinopathy.

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