

THE INFLUENCE OF GLYCEMIC CONTROL ON DIABETIC RETINOPATHY PROGRESSION AND TREATMENT OUTCOMES: A PROSPECTIVE OBSERVATIONAL STUDY

Authors

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ABSTRACT

Background

Diabetic retinopathy (DR) is one of the most common microvascular complications of diabetes mellitus and remains a leading cause of preventable blindness worldwide. Poor glycemic control has been identified as a major risk factor for the onset and progression of diabetic retinopathy and may significantly influence treatment outcomes.

Objective

To evaluate the influence of glycemic control on the progression of diabetic retinopathy and its impact on treatment outcomes among diabetic patients.

Methods

A prospective observational study was conducted in the Department of Ophthalmology, Vijaya Hospital, Nellore, from November 2024 to April 2025. Eighty-three patients diagnosed with diabetic retinopathy who met the inclusion criteria were enrolled. Data were collected through patient interviews, structured questionnaires, and review of electronic medical records. Glycemic control was assessed using HbA1c

levels, and treatment outcomes were evaluated based on visual acuity improvement, hospital stay, and patient satisfaction. Statistical analysis was performed using SPSS software.

Results

Among 83 patients, 61.4% were above 60 years of age and 71% were males. More than half of the patients (50.6%) had diabetes for more than 15 years. HbA1c levels between 8–9% were observed in 46.9% of patients, while only 18% maintained HbA1c below 7%. Non-proliferative diabetic retinopathy was diagnosed in 95.1% of patients. Patients with normal glycemic control demonstrated better visual outcomes, with significant or moderate visual improvement observed in 60 patients compared to 14 patients among poorly controlled patients. Better glycemic control was associated with shorter hospital stays, higher treatment satisfaction, and improved visual recovery.

Conclusion

Optimal glycemic control plays a crucial role in delaying diabetic retinopathy progression and enhancing treatment outcomes. Early intervention, regular monitoring, patient education, and multidisciplinary care are essential for improving long-term visual prognosis and quality of life among diabetic patients.

Keywords

Diabetic Retinopathy, Glycemic Control, HbA1c, Diabetes Mellitus, Visual Acuity, Anti-VEGF Therapy, Laser Photocoagulation, Treatment Outcomes.

1. INTRODUCTION

Diabetes mellitus is a chronic metabolic disorder characterized by persistent hyperglycemia resulting from defects in insulin secretion, insulin action, or both. It has become one of the most significant public health challenges worldwide due to its increasing prevalence and associated complications. According to the World Health Organization, diabetes affects hundreds of millions of individuals globally and contributes substantially to morbidity, disability, and mortality¹. The American Diabetes Association classifies diabetes into Type 1 diabetes mellitus, Type 2 diabetes mellitus, gestational diabetes mellitus, and specific types due to other causes².

The global burden of diabetes continues to rise rapidly due to urbanization, sedentary lifestyles, unhealthy dietary habits, obesity, and aging populations^{3–5}. Type 2 diabetes mellitus accounts for approximately 90–95% of all diabetes cases and is associated with significant macrovascular and microvascular complications⁵. Genetic predisposition, environmental factors, lifestyle modifications, and medication-related factors also contribute to disease development^{6–15}.

Among the microvascular complications, diabetic retinopathy (DR) is one of the most common and vision-threatening disorders affecting diabetic patients. Diabetic retinopathy results from chronic hyperglycemia-induced damage to retinal blood vessels, leading to vascular permeability, capillary occlusion, retinal ischemia, and pathological neovascularization^{21,22}. The disease progresses from non-proliferative diabetic retinopathy (NPDR) to proliferative diabetic retinopathy (PDR), with increasing risk of visual impairment and blindness^{23–25}.

The prevalence of diabetic retinopathy has increased substantially due to the growing number of diabetic patients worldwide. Studies indicate that approximately one-third of individuals with diabetes develop some

form of diabetic retinopathy during their lifetime²⁶. Chronic hyperglycemia triggers biochemical pathways involving oxidative stress, inflammation, advanced glycation end-products, and vascular endothelial growth factor (VEGF), which contribute significantly to retinal damage²⁸⁻³⁰.

Glycemic control remains the cornerstone of diabetes management. Glycated hemoglobin (HbA1c) serves as an important indicator of long-term blood glucose control and has been strongly associated with the risk and progression of diabetic retinopathy. Several landmark studies have demonstrated that intensive glycemic control significantly reduces the incidence and progression of diabetic retinopathy and other microvascular complications^{17,18}.

Although advances in ophthalmic therapies such as laser photocoagulation, anti-VEGF injections, and vitrectomy have improved visual outcomes, optimal glycemic control continues to play a vital role in enhancing treatment effectiveness and preventing disease progression. Understanding the relationship between glycemic control and treatment outcomes is essential for developing comprehensive management strategies aimed at preserving vision and improving quality of life among diabetic patients.

Therefore, the present study was undertaken to evaluate the influence of glycemic control on diabetic retinopathy progression and treatment outcomes among patients attending a tertiary care hospital.

2. AIM OF THE STUDY

To evaluate the influence of glycemic control on the progression of diabetic retinopathy and its impact on treatment outcomes among diabetic patients attending a tertiary care hospital.

3. OBJECTIVES OF THE STUDY

1. To assess the demographic and clinical characteristics of patients diagnosed with diabetic retinopathy.
2. To evaluate glycemic control among diabetic retinopathy patients using HbA1c levels.
3. To determine the association between glycemic control and severity of diabetic retinopathy.
4. To assess visual acuity improvement following treatment among patients with varying glycemic control levels.
5. To evaluate treatment outcomes including patient satisfaction and duration of hospital stay.
6. To identify factors influencing maintenance of optimal glycemic control among diabetic retinopathy patients.
7. To assess patient awareness regarding the importance of glycemic control in preventing disease progression.

4. MATERIALS AND METHODS

Study Design

A prospective observational study was conducted to evaluate the influence of glycemic control on diabetic retinopathy progression and treatment outcomes.

Study Site

The study was carried out in the Department of Ophthalmology, Vijaya Hospital, Nellore, Andhra Pradesh, India.

Study Duration

The study was conducted over a period of six months from November 2024 to April 2025.

Study Population

Patients diagnosed with diabetic retinopathy attending the ophthalmology department during the study period were considered for enrollment.

Sample Size

A total of 83 patients who satisfied the eligibility criteria were included in the study.

Inclusion Criteria

- Patients aged 18 years and above.
- Patients diagnosed with diabetic retinopathy.
- Patients willing to participate and provide informed consent.
- Patients with available HbA1c reports and treatment records.

Exclusion Criteria

- Patients unwilling to participate.
- Patients with other retinal diseases unrelated to diabetes.
- Patients with incomplete medical records.
- Critically ill patients unable to respond to the questionnaire.

Data Collection Procedure

Data were collected using:

- Structured patient interview questionnaire.
- Review of electronic medical records.
- Laboratory reports including HbA1c values.
- Ophthalmological examination records.

Information collected included demographic details, duration of diabetes, HbA1c levels, blood glucose monitoring practices, dietary habits, physical activity, diabetic retinopathy status, treatment modalities, visual acuity outcomes, hospital stay, and patient satisfaction.

Assessment of Glycemic Control

Glycemic control was assessed using glycated hemoglobin (HbA1c) values.

Patients were categorized as:

- Good glycemic control: HbA1c <7%
- Moderate glycemic control: HbA1c 7–8%
- Poor glycemic control: HbA1c >8%

Outcome Measures

Primary Outcomes:

- Progression and severity of diabetic retinopathy.
- Improvement in visual acuity following treatment.

Secondary Outcomes:

- Duration of hospital stay.
- Treatment satisfaction.
- Patient perception regarding glycemic control and treatment effectiveness.

Ethical Considerations

The study was conducted according to the ethical principles of the Declaration of Helsinki. Prior permission was obtained from the hospital authorities. Written informed consent was obtained from all study participants before enrollment. Confidentiality of patient information was strictly maintained throughout the study.

Statistical Analysis

The collected data were entered into Microsoft Excel and analyzed using Statistical Package for Social Sciences (SPSS) software. Descriptive statistics including frequency, percentage, mean, and standard deviation were used to summarize the data. Results were presented using tables and graphical representations. Associations between glycemic control and treatment outcomes were evaluated using appropriate statistical methods, and a p-value less than 0.05 was considered statistically significant.

5. RESULTS

Table 1. Distribution of Patients Based on Age

S.NO	AGE GROUP (YEARS)	NUMBER OF PATIENTS	PERCENTAGE (%)
1	19–30 Years	-	-
2	31–45 Years	3	3.6%
3	46–60 Years	29	34.9%
4	>60 Years	51	61.4%
TOTAL		83	100%

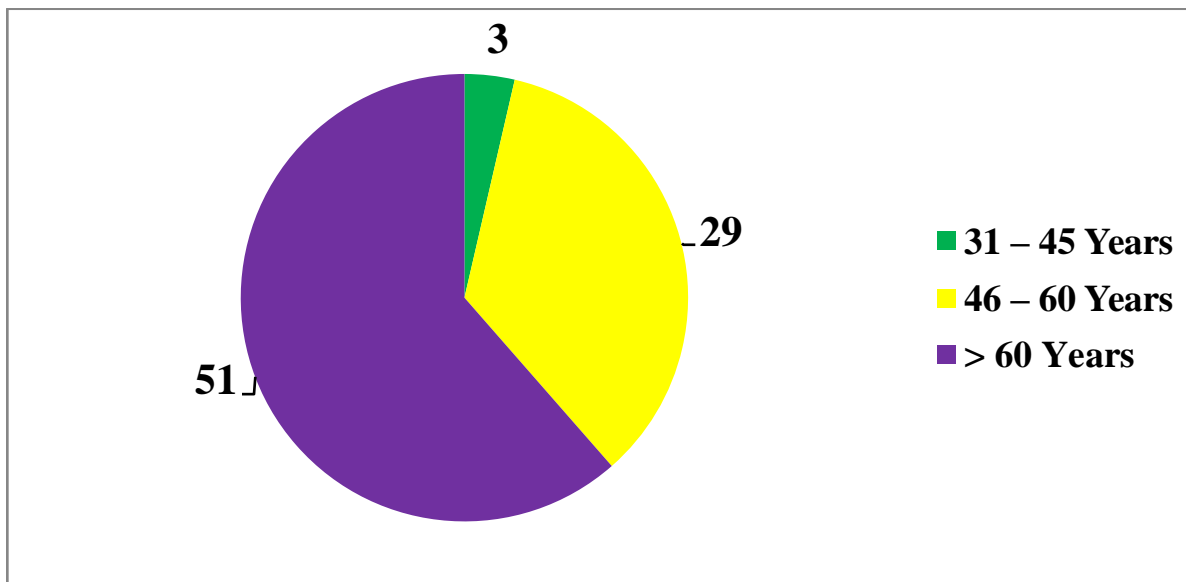


Table 2. Distribution of Patients Based on Gender

S.NO	GENDER	NUMBER OF PATIENTS	PERCENTAGE (%)
1	Male	59	71%
2	Female	24	28.9%
TOTAL		83	100%

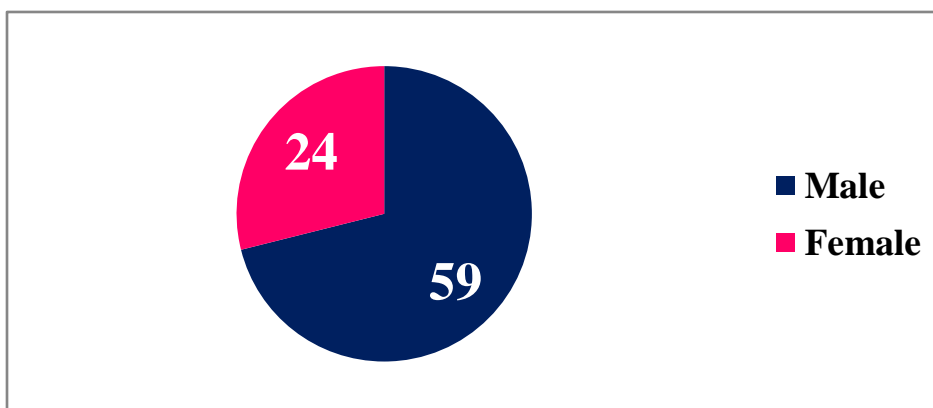


Table 3. Distribution of Patients Based on Years Diagnosed with Diabetes

S.NO	DIAGNOSED WITH DIABETES (YEARS)	NUMBER OF PATIENTS	PERCENTAGE (%)
1	Less than 5 Years	-	-
2	5–10 Years	7	8.4%
3	11–15 Years	34	40.9%
4	>15 Years	42	50.6%
TOTAL		83	100%

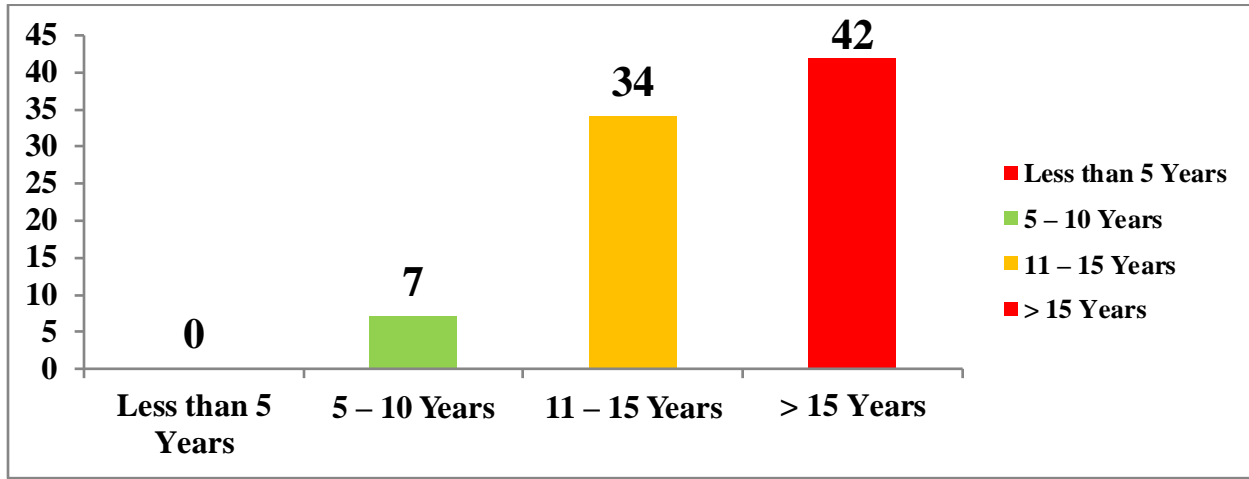


Table 4. Distribution of Patients Based on HbA1c Levels

S.NO	HbA1c Levels	NUMBER OF PATIENTS	PERCENTAGE (%)
1	<7%	15	18%
2	7-8%	21	25.3%
3	8-9%	39	46.9%
4	>9%	8	9.6%
TOTAL		83	100%

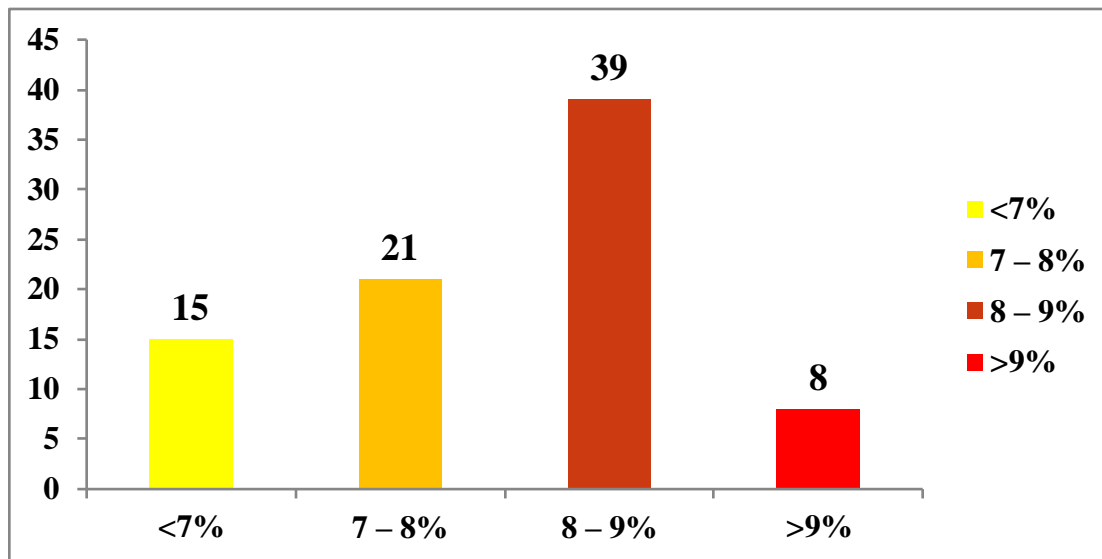


Table 5. Distribution of Patients After Receiving Treatment

IMPROVEMENT IN VISUAL ACUITY	NORMAL GLYCAEMIC LEVEL	ABNORMAL GLYCAEMIC LEVEL	TOTAL
Significant improvement	8	5	13 (15.6%)
Moderate improvement	52	9	61 (73.4%)
No improvement	2	7	9 (10.8%)
Worsening of vision	0	0	0
TOTAL	62	21	83

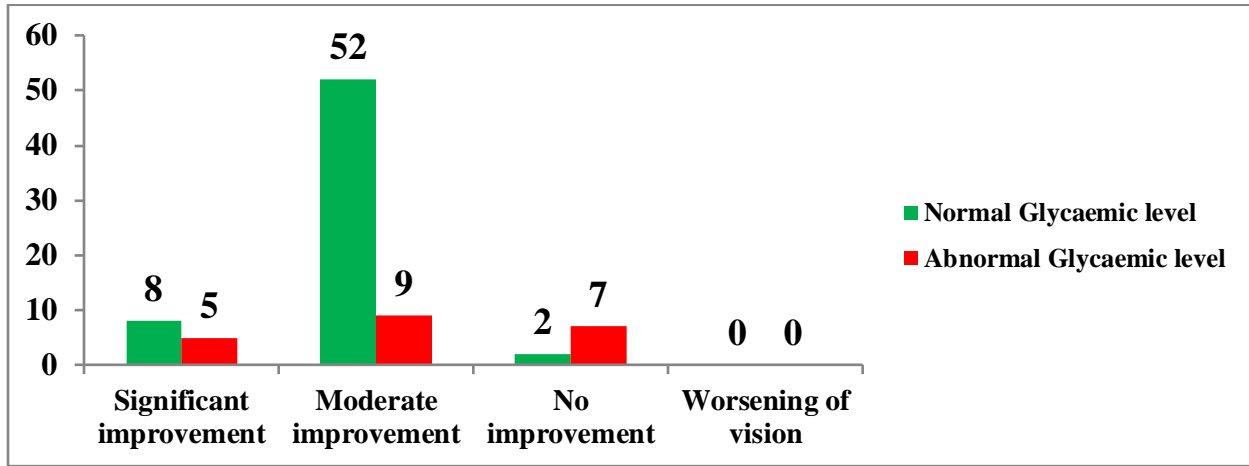
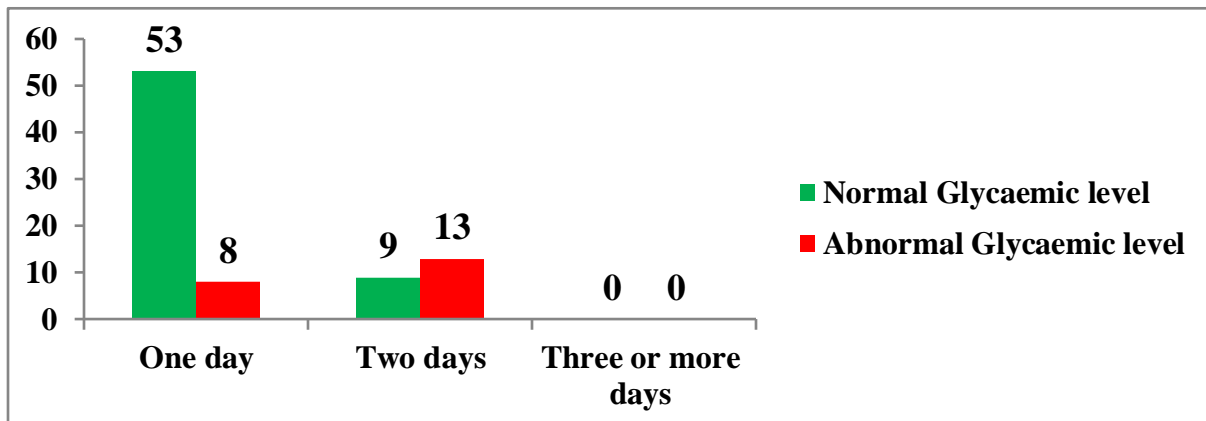


Table 6. Distribution of Patients Based on Hospital Stays

HOSPITAL STAYS	NORMAL GLYCEMIC LEVEL	ABNORMAL GLYCEMIC LEVEL	TOTAL
One day	53	8	61
Two days	9	13	22
Three or more days	00	00	00
TOTAL	62	21	83



6. DISCUSSION

The present prospective observational study evaluated the influence of glycemic control on diabetic retinopathy progression and treatment outcomes among 83 diabetic patients. The findings demonstrated a significant association between glycemic control and visual outcomes following treatment.

Table 1 shows the age-wise distribution of study participants. The majority of patients belonged to the age group of >60 years (61.4%), followed by 46–60 years (34.9%). Only 3.6% of patients were in the 31–45 years age group, indicating that diabetic retinopathy was more prevalent among older individuals with long-standing diabetes.

Table 2 presents the gender distribution of the study population. Male patients constituted the majority of the sample (71%), whereas females accounted for 28.9%. This finding suggests a higher representation of males among patients receiving treatment for diabetic retinopathy in the present study.

Table 3 depicts the duration of diabetes among study participants. More than half of the patients (50.6%) had diabetes for over 15 years, while 40.9% had diabetes for 11–15 years. The findings indicate that longer duration of diabetes may be associated with an increased occurrence and progression of diabetic retinopathy.

Table 4 illustrates the glycemic control status of the patients. Nearly half of the participants (46.9%) had HbA1c levels between 8–9%, while only 18% maintained HbA1c levels below 7%. The predominance of elevated HbA1c levels highlights the role of poor glycemic control in the development and progression of diabetic retinopathy.

Table 5 summarizes treatment outcomes according to glycemic control status. Moderate improvement in visual acuity was observed in the majority of patients (73.4%), particularly among those with normal glycemic levels. Patients with abnormal glycemic levels showed comparatively lower improvement rates and a higher proportion of no improvement, emphasizing the importance of maintaining optimal glycemic control for better treatment outcomes.

Table 6 shows the duration of hospital stay among patients based on glycemic status. Most patients (61 out of 83) required only a one-day hospital stay, predominantly those with normal glycemic levels. In contrast, a greater proportion of patients with abnormal glycemic levels required two days of hospitalization, suggesting that poor glycemic control may contribute to prolonged hospital stays and increased healthcare utilization.

7. CONCLUSION

The present study demonstrates that glycemic control plays a pivotal role in influencing diabetic retinopathy progression and treatment outcomes. Patients with well-controlled blood glucose levels exhibited better visual improvement, shorter hospital stays, and higher satisfaction with treatment. Poor glycemic control was associated with adverse clinical outcomes and increased risk of disease progression.

Regular monitoring of HbA1c, patient counseling, adherence to diabetic diet, lifestyle modifications, and timely ophthalmologic interventions are essential components of comprehensive diabetic retinopathy management. A multidisciplinary approach involving ophthalmologists, diabetologists, pharmacists, and diabetes educators can significantly improve visual prognosis and quality of life among diabetic patients.

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