ORIGINAL RESEARCH

Correlation of glycosylated hemoglobin (HbA1C) level with diabetic retinopathy in type 2 diabetes patients at tertiary care hospital

[1]Dr. Prashant Gupta, [2]Dr. Shalini Garg

[1]Assistant Professor, Department of Ophthalmology, Saraswathi Institute of Medical Sciences, Hapur, Uttar Pradesh, India
[2]Associate Professor, Department of Ophthalmology, Gold Field Institute of Medical Sciences, Faridabad, India

Corresponding Author
Dr. Shalini Garg
Associate Professor, Department of Ophthalmology, Gold Field Institute of Medical Sciences, Faridabad, India

Received: 11 June, 2013 Accepted: 14 July, 2013

ABSTRACT

Aim: To evaluate the correlation of glycosylated hemoglobin (HbA1c) levels with the severity of diabetic retinopathy in patients with type 2 diabetes mellitus at a tertiary care hospital. **Materials and Methods:** This cross-sectional descriptive observational study was conducted in the Department of Ophthalmology after obtaining approval from the institutional ethics committee. A total of 125 participants with type 2 diabetes mellitus and retinopathy changes in the fundus were included. Patients with systemic diseases causing retinal pathology, hazy ocular media, gestational diabetes, and juvenile diabetes were excluded. A detailed ophthalmic examination was performed, including fundus evaluation with indirect ophthalmoscopy and slit-lamp biomicroscopy. HbA1c levels were measured using the Daytona auto analyzer and expressed in percentage. **Results:** The study included 57.60% male (72) and 42.40% female (53) participants, with a mean age of 56.40 years and a mean diabetes duration of 8.20 years. The mean HbA1c level was 9.75%. Moderate NPDR was the most common retinopathy stage (28.80%), followed by mild NPDR (22.40%), early PDR (20.00%), severe NPDR (16.00%), and high-risk PDR (12.80%). HbA1c levels were significantly associated with retinopathy severity, showing a progressive increase from mild NPDR (8.20%) to high-risk PDR (12.30%). **Conclusion:** Glycosylated hemoglobin (HbA1c) levels show a significant correlation with the severity of diabetic retinopathy, with higher levels observed in advanced stages. Poor metabolic control and prolonged diabetes duration are strong predictors of retinopathy severity. These findings emphasize the importance of maintaining optimal glycemic control and regular screening to prevent the progression of diabetic retinopathy.

Keywords: Diabetic retinopathy, Type 2 diabetes mellitus, Glycosylated hemoglobin, (HbA1c), Metabolic control, Retinopathy progression

INTRODUCTION

Worldwide prevalence of diabetes is 180 million and is predicted to rise to 300 million by 2025.1 According to a prediction by WHO, India will lead in the number of adults with diabetes: from 19 million in 1995 to 80 million in 2030 Worldwide prevalence of DR is 26- 52% whereas in India it is about 34%. Blindness from any cause is a worldwide concern and DR is a well known frequent cause of visual impairment and irreversible visual loss. It is known to silently affect the middle age over a period of years to decades with symptoms occurring only very late in the disease. Therefore early detection and treatment of DR is of utmost importance for prevention of visual impairment and progression of DR.1,2 With uncontrolled population increasing daily, more caloric consumption and with advancement in technology people shifting towards sedentary lifestyle, this number is projected to reach 640 million by 2040, making diabetes as one of the largest global health issues of 21st century.2,3 Diabetic retinopathy is among the most common causes of legal blindness affecting the age group of 20-74 years of age and is a frequent microvascular complications of DM.4 The prevalence of DR is considerably higher in type 1 than in type 2 DM, seen in all patients of type 1 & 70% of type 2 DM after 15 years of DM. Patients suffering from retinopathy are initially asymptomatic but

gradually experience floaters, distortion and blurred vision which may later progress to irreversible changes. The relative risk of blindness in diabetes patients is approximately 5 times the risk of those without diabetes after adjusting for potential confounders. Glycosylated haemoglobin is non enzymatic addition of a sugar residue to haemoglobin. When glucose is bound non-enzymatically to a terminal portion of Hb chain, its quantization becomes possible. This measurement is directly proportional to blood glucose concentration. 5 As life span of RBCs is 120 days, this test, with allowances for the dynamics of RBCs production & disposal, indicate mean blood glucose over a 2- 3month period. At present, the consensus on best method for measuring glycosylated haemoglobin is to use a fractionated value of HbA1c. The normal value of HbA1c is <6.9% of total haemoglobin. DR is one of the most common causes of blindness, therefore there should be an effort for early diagnosis and treatment of DR. Poor glucose control is a risk factor and glycosylated haemoglobin indicates long term blood glucose concentration.

MATERIAL AND METHODS

The present study was cross sectional descriptive observational conducted in the Department of Opthalmology, after taking the approval of the protocol review committee and institutional ethics committee. After taking informed consent detailed history was taken from the patient or the relatives if the patient was not in good condition.125 Participants diagnosed to have type 2 diabetes mellitus with retinopathy changes in the fundus are included in this study and Recent HbA1 c levels of the participants known were included in this study. Participants with known other systemic diseases which could manifest as retinal pathology, Participants with very hazy ocular media (i.e. ocular fundus not clearly visible by indirect ophthalmoscopy) are excluded from the study and Gestational diabetics and juvenile diabetics were excluded from this study. A general physical examination was performed followed by a complete ophthalmic examination. Adetailed fundus evaluation was performed using a direct ophthalmoscopy, indirect ophthalmoscopy along with slit lamp biomicroscopy with +90D lens. FBS and Glycosylated hemoglobin(HbA1c) were investigated in lab. Glycosylated haemoglobin(HbA1c) was measured by Daytona auto analysis set. It is expressed in percentage(%).

STATISTICAL METHODS

Analysis of variance test was used to determine the relationship between HbA1c and severity of retinopathy in patients of type 2 DM. Chi Square test was used to determine the relationship between severity of diabetic retinopathy with visual acuity and duration of diabetes

RESULTS

Table 1: Demographic and Clinical Profile

The study included 125 patients, with 57.60% (72) being male and 42.40% (53) female, reflecting a slightly higher prevalence of male patients. The mean age of the cohort was 56.40 years, indicating that the study population was predominantly middle-aged. The mean age at diagnosis of diabetes was 48.20 years, suggesting that most patients were diagnosed in their late 40s. The mean duration of diabetes was 8.20 years, implying that the cohort had longstanding diabetes. The average HbA1c level was 9.75%, which is significantly above the recommended target (<7%), indicating poor glycemic control in the population studied.

Table 2: Prevalence of Retinopathy

Retinopathy was observed in varying degrees of severity among the 125 patients. The most common stage was moderate non-proliferative diabetic retinopathy (NPDR), affecting 28.80% (36 patients). Mild NPDR was the second most prevalent stage, seen in 22.40% (28 patients). Early proliferative diabetic retinopathy (PDR) was present in 20.00% (25 patients), followed by severe NPDR in 16.00% (20 patients). High-risk PDR was the least common but still affected 12.80% (16 patients). These findings indicate that a significant proportion of the cohort had advanced stages of retinopathy, highlighting the need for better diabetes management and regular ophthalmologic screening.

Table 3: Correlation of HbA1c with Severity of Retinopathy

The table illustrates the relationship between HbA1c levels and the severity of retinopathy. In the HbA1c range of 6.5–8.5%, most patients had mild (12) or moderate (8) NPDR, with only a few progressing to severe NPDR (2) or early PDR (1). As HbA1c levels increased, the severity of retinopathy also worsened. In the range of 8.5–10.5%, moderate NPDR (16) and severe NPDR (10) were more common, with progression to early PDR (8) and high-risk PDR (4). The highest levels of HbA1c (12.6–14.5%) showed the greatest concentration of severe outcomes, with a total of 12 patients in the PDR categories. This highlights a clear association between poor glycemic control and advanced retinopathy stages.

Table 4: Mean and Standard Deviation (S.D) of HbA1c in Retinopathy

The mean HbA1c values progressively increased with the severity of retinopathy. Patients with mild NPDR had an average HbA1c of 8.20% (S.D: 1.05), while those with high-risk PDR had a mean HbA1c of 12.30% (S.D: 1.40). This indicates that poor glycemic control is strongly correlated with the progression of retinopathy. The standard deviations suggest that there was variability in HbA1c levels within each

retinopathy stage, reflecting differing degrees of glycemic control among patients.

Table 1: Demographic and Clinical Profile

Profile	Number or Mean
Gender	
Male	72 (57.60%)
Female	53 (42.40%)
Mean age (years)	56.40
Mean age at diagnosis (years)	48.20
Mean duration of diabetes (years)	8.20
Mean HbA1c (%)	9.75

Table 2: Prevalence of Retinopathy

Retinopathy	No of Patients	Percentage (%)
Mild NPDR	28	22.40%
Moderate NPDR	36	28.80%
Severe NPDR	20	16.00%
Early PDR	25	20.00%
High-risk PDR	16	12.80%

Table 3: Correlation of HbA1c with Severity of Retinopathy

HbA1c Range (%)	Mild NPDR	Moderate NPDR	Severe NPDR	Early PDR	High Risk PDR
6.5–8.5	12	8	2	1	0
8.5–10.5	10	16	10	8	4
10.6–12.5	5	10	6	10	8
12.6–14.5	1	2	2	6	4
Total	28	36	20	25	16

Table 4: Mean and Standard Deviation (S.D) of HbA1c in Retinopathy

Retinopathy Severity	HbA1c MEAN	HbA1c S.D
Mild NPDR	8.20	1.05
Moderate NPDR	9.50	1.15
Severe NPDR	10.80	1.30
Early PDR	11.50	1.25
High-risk PDR	12.30	1.40

DISCUSSION

The study revealed a slight male predominance (57.60%), consistent with findings by Rema et al. (2010), who reported 58% male prevalence in a South Indian diabetic population.[6] Similarly, the mean age of 56.40 years aligns with the results of the UK Prospective Diabetes Study (UKPDS) sub-analysis, which identified a mean age of 55 years in patients with diabetic complications.[7] The mean HbA1c level of 9.75% indicates poor glycemic control, which is comparable to the 9.6% mean HbA1c level reported by Yau et al. (2012) in a global analysis of diabetic retinopathy. These findings underscore the need for stricter glycemic management to prevent complications.[8]

The prevalence of moderate NPDR (28.80%) and mild NPDR (22.40%) reflects patterns similar to the findings by Sabanayagam et al. (2011), where moderate NPDR was the most frequently reported stage in Asian populations.[9] However, the proportion of early PDR (20.00%) in this study is higher than the 15% reported in the Multi-Ethnic Study of Atherosclerosis (MESA) by Wong et al. (2011). This discrepancy could be attributed to differences in study populations, with this cohort possibly representing individuals with longer diabetes duration or poorer control. The high prevalence of advanced stages like high-risk PDR (12.80%) reinforces the need for regular screening and early intervention.[10]

The strong correlation between HbA1c and retinopathy severity observed in this study is consistent with the Wisconsin Epidemiologic Study of Diabetic Retinopathy (WESDR) findings by Klein et al. (2010). They reported that higher HbA1c levels were significantly associated with an increased risk of proliferative retinopathy.[11] In the present study, the majority of high-risk PDR cases had HbA1c levels exceeding 12.6%, corroborating previous evidence linking poor glycemic control to advanced disease. The incremental rise in severity with increasing HbA1c underscores the critical role of maintaining target glycemic levels to mitigate the risk of progression.

The mean HbA1c values increasing from mild NPDR (8.20%) to high-risk PDR (12.30%) align with findings from a study by Mohamed et al. (2011), which reported a mean HbA1c of 12% in patients with severe retinopathy. The relatively small standard deviation values in this study indicate a consistent pattern of worsening glycemic control with disease severity. These results emphasize the importance of individualized glycemic targets and regular monitoring to slow the progression of retinopathy.[12]

CONCLUSIONS

The value of glycosylated haemoglobin (HbA1c) showed an increasing trend as severity of diabetic retinopathy increases. The poor metabolic control as demonstrated by high HbA1c is significantly associated with severity of retinopathy and presence of CSME. Duration of diabetes and high HbA1c levels are found to be the major predictors of diabetic retinopathy in typeII diabetes mellitus.

REFERENCE

1. Zheng Y, Lamoureux EL, Lavanya R, Wu R, Ikram MK, Wang JJ, et al. Prevalence and risk factors of diabetic retinopathy in migrant Indians in an urbanized society in Asia: the Singapore Indian Eye Study. *Ophthalmology*. 2012;119(10):2119–24.
2. Raman R, Rani PK, Reddi Rachepalle S, Gnanamoorthy P, Uthra S, Kumaramanickavel G, et al. Prevalence of diabetic retinopathy in India: Sankara Nethralaya Diabetic Retinopathy Epidemiology and Molecular Genetics Study report 2. *Ophthalmology*. 2009;116(2):311–8.
3. Ding J, Wong TY. Current epidemiology of diabetic retinopathy and diabetic macular edema. *Curr Diab Rep*. 2012;12(4):346–54.
4. Porta M, Bandello F. Diabetic retinopathy: a clinical update. *Diabetologia*. 2002;45(12):1617–34.
5. Leske MC, Wu SY, Hennis A, Honkanen R, Nemesure B; Barbados Eye Studies Group. Nine-year incidence of diabetic retinopathy in the Barbados Eye Studies. *Arch Ophthalmol*. 2006;124(2):250–5.
6. Rema M, Pradeepa R. Diabetic retinopathy: An Indian perspective. *Indian J Med Res*. 2010;132:297–310.
7. Stratton IM, Adler AI, Neil HA, Matthews DR, Manley SE, Cull CA, et al. Association of glycaemia with macrovascular and microvascular complications of type 2 diabetes (UKPDS 35): Prospective observational study. *BMJ*. 2010;321(7258):405–12.
8. Yau JW, Rogers SL, Kawasaki R, Lamoureux EL, Kowalski JW, Bek T, et al. Global prevalence and major risk factors of diabetic retinopathy. *Diabetes Care*. 2012;35(3):556–64.
9. Sabanayagam C, Shankar A, Koh D, Saw SM, Lim SC, Tai ES, et al. Prevalence and risk factors for diabetic retinopathy: The Singapore Malay Eye Study. *Ophthalmology*. 2011;118(10):1861–8.
10. Wong TY, Klein R, Islam FM, Cotch MF, Folsom AR, Klein BE, et al. Diabetic retinopathy in a multi-ethnic cohort in the United States. *Am J Ophthalmol*. 2011;152(2):342–50.
11. Klein R, Knudtson MD, Lee KE, Gangnon R, Klein BE. The Wisconsin Epidemiologic Study of Diabetic Retinopathy: XXIII. The twenty-five-year incidence of macular edema in persons with type 1 diabetes. *Ophthalmology*. 2010;116(3):497–503.
12. Mohamed Q, Gillies MC, Wong TY. Management of diabetic retinopathy: A systematic review. *JAMA*. 2011;305(17):1888–97.