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Original Research Article

The Relationship Between Glycosylated Haemoglobin (Hba1c) Levels and Diabetic Retinopathy in Type 2 Diabetes: A Cross-Sectional Study

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Abstract

Aim: Association of glycosylated hemoglobin (HbA1C) level with diabetic retinopathy in type 2 diabetes patients at tertiary care hospital in Bihar region. **Methods:** The present study was cross sectional descriptive observational conducted in the Department of Ophthalmology, Patna Medical College and Hospital, Patna, Bihar, India for 1 year. Participants diagnosed to have type 2 diabetes mellitus with retinopathy changes in the fundus are includedin this study. Results: The present study constituted 15% mild NPDR, 19% moderate NPDR, 50% severe NPDR, 12% PDR and 4% high risk PDR. The above table reveals that there were 93.33% of mild NPDR cases, 55% of moderate NPDR cases and 14.29% of PDR cases in 6.5% - 8.5% range of HbA1c.Whereas in HbA1c range of 8.6 % - 10.5%, mild and moderate NPDR cases reduced to 6.67% and 30% respectively and severe NPDR cases increased to 55.10%. Early PDR cases raised from 50% in 6.5% - 8.5% range of HbA1c to 25% in 8.6 % -10.5%. And high-risk PDR cases raised from 25% to 50% when HbA1c raises from 6.5% - 8.5% to 8.6 %- 10.5%. This revealed an increasing trend of severity of retinopathy with raise in HbA1c levels. The means of HbA1c in each level of severity of diabetic retinopathy. The mean of HbA1c in mild NPDR was 8.01±0.52. In moderate NPDR it was 9.02±1.66. In severe NPDR 10.25±1.77. In Early PDR 9.22±1.25 and in High-risk PDR 9.69±2.36. **Conclusion:** 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.

Keywords: HbA1c, Diabetic Retinopathy, Metabolic Disorders.

Introduction

According to WHO, Diabetes Mellitus refers to a group of metabolic disorders that share the phenotype of hyperglycemia and is defined as when a person has more > 2 readings of fasting plasma glucose of 126 mg/dl or 2-hour post-prandial glucose level >200 mg/dl or glycosylated haemoglobin (HbA1c) > 6.5%. This prolonged hyperglycemia is result from the defect in insulin secretion, insulin action or both DM is classified into 2 categories[1]: Type 1 is an Insulin dependent diabetes mellitus (IDDM) accounting for about 10% of DM cases and Type 2 which is non-insulin dependent diabetes mellitus (NIDDM) accounting for about 90% of cases.

Data from the 2015 International Diabetes Federation Atlas report that DM affects 415 million people globally.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]. India is considered as world capital of Diabetes. According to WHO, India has about 70 million people living with diabetes in 2015, increasing to 98 million by 2030[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[5,6].

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[7].

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[8]. 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 Ophthalmology, Patna Medical College and Hospital, Patna, Bihar, India for 1 year. after taking the approval of the protocol review committee and institutional ethics committee.

Inclusion criteria

- Participants diagnosed to have type 2 diabetes mellitus with retinopathy changes in the fundus are included in this study.
- Recent HbA1 c levels of the participants known.

Exclusion criteria

- 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.
- Gestational diabetics and juvenile diabetics.

- Undergone laser photocoagulation therapy.
- Participants not accepting the informed consent

Methodology

A general physical examination was performed followed by a complete ophthalmic examination. A detailed 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

Table1: Demographic and clinical data of study population

Parameters	Observation
Total number included	100
Male /female	60/40
Mean age (years)	62.09±7.22
Mean age at diagnosis (years)	47.5±6.33
Mean duration of diabetes (years)	16.33±6.98
Mean HbA1c(%)	8.98±1.88

The above table shows the demographic data of 100 patients included in our study. The mean age of participants in this study was 62.09 ± 7.22 and out of the 100 participants, M:F ratio was 1.5:1. The mean age of 100 patients at diagnosis was 47.5± 6.33 and mean duration of diabetic age was 16.33 ± 6.98. The mean of Glycosylated haemoglobin (HbA1c) in the study population was 8.98 ± 1.88.

Table 2: Gender distribution

Gender	Total	M: F
Male	60	1.5:1
Female	40	
Total	100	

There were 60 males and 40 females in our study group, revealing a male predominance in our recruited studypopulation. The male: female ratio was 1.5: 1.

Table 3: Prevalence of retinopathy

Retinopathy	No of patients	Percentage (%)
Mild NPDR	15	15
Moderate NPDR	19	19
Severe NPDR	50	50
Early PDR	12	12
High risk PDR	4	4

The present study constituted 15% mild NPDR, 19% moderate NPDR, 50% severe NPDR, 12% PDR and 4% high risk PDR. Out of 100 retinopathy patients studied severe and very severe NPDR accounted for nearly half the patients while the other half consisted of early PDR, mild and moderate NPDR, the latter being higher than the former.

Table 4: Correlation of HbA1c with severity of Retinopathy

HbA1c range (%).	Severity of retinopathy				
	Mild NPDR	Moderate NPDR	Severe NPDR	Early PDR	High Risk PDR
6.5-8.5	14	11	7	5	1
8.5-10.5	1	6	27	6	2
10.6-12.5	0	1	12	1	1
12.6-14.5	0	2	3	0	0
Total	**15**	**20**	**49**	**12**	**4**

The above table reveals that there were 93.33% of mild NPDR cases, 55% of moderate NPDR cases and 14.29% of PDR cases in 6.5% - 8.5% range of HbA1c.Whereas in HbA1c range of 8.6% - 10.5%, mild and moderate NPDR cases reduced to 6.67% and 30% respectively and severe NPDR cases increased to 55.10%. Early PDR cases rose from 50% in 6.5% - 8.5% range of HbA1c to 25% in 8.6 % -10.5%. And high-risk PDR cases rose from 25% to 50% when HbA1c rises from 6.5% - 8.5% to 8.6 %- 10.5%. This revealed an increasing trend of severity of retinopathy with raise in HbA1c levels.

Table 5: Mean and standard deviation (S.D) of HbA1c in retinopathy

Retinopathy Severity	HbA1c	
	MEAN	S. D
MILD NPDR	8.01	0.52
MODERATE NPDR	9.02	1.66
SEVERE NPDR	10.25	1.77
Early PDR	9.22	1.25
High Risk PDR	9.69	2.36

The table shows the means of HbA1c in each level of severity of diabetic retinopathy. The mean of HbA1c in mild NPDR was 8.01±0.52. In moderate NPDR it was 9.02±1.66. In severe NPDR 10.25±1.77.In Early PDR 9.22±1.25 and in High-risk PDR 9.69±2.36. Therefore, as the severity of retinopathy increased, the mean HbA1c for that level of severity also increased.

Discussion

The present study was conducted as a descriptive observational study to determine the correlation of HbA1c levels with diabetic retinopathy. The present study included 100 cases of retinopathy which constituted 15% mild NPDR, 19% moderate NPDR, 50% severe NPDR, 12% PDR and 4% high risk PDR. Lokesh S et al. reported prevalence of DR as 64%, in Blue Mountain study[9] it was 29% while the prevalence rate was 50.3% in Wincons in epidemiologic study[10]. Chennai urban Rural Epidemiological study (CURES) showed an overall prevalence of diabetic retinopathy of 17.6%[11]. Out of 100 retinopathy patients studied severe & very sever NPDR accounted for nearly half the patients while the other half consisted of

PDR, mild and moderate NPDR, the latter being higher than the former. Regardless of the severity of retinopathy, 23% cases had CSME. A south Indian study by Mohan R. reported an overall prevalence of 14 per cent, NPDR 6%, while 4% had macular oedema and 4% had PDR[12]. A Chennai study revealed the prevalence of DR was 34.1%. The prevalence included 30.8% with NPDR, 3.4% with PDR and 6.4% had DME[13]. The differences in the findings could be attributed to variable population Characteristics as age of onset, diabetic duration, treatment and its adherence. Our study revealed that means values of HbA1c in non-proliferative types of diabetic retinopathy have indisputable difference. The standard deviation of each level being considerably small made the difference more relevant. One way distribution of HbA1c in our study among the levels of retinopathy revealed significant non homogeneity and further revealed that the transition from mild to severe NPDR was statistically highly significant and that from moderate to severe NPDR was significant. Two-way distribution of retinopathy among ranges of HbA1c revealed significant association with the severity of retinopathy. The glycemic status of the patients in this study was studied by measuring HbA1C levels. When the HbA1C values were compared in the groups with increasing severity of retinopathy, increasinglevels of HbA1C were noted showing a significant correlation. Therefore, it was noted that poor glycemic control led to the worsening of the retinopathy. The Diabetes Control and Complications Trial (DCCT) and the U.K. Prospective Diabetes study(UKPDS) were two randomized clinical trials which conclusively showed the efficacy of glycemic control in preventing diabetic retinopathy.

These studies mentioned that glycemic control was protective for all levels of retinopathy and there was no glycemic threshold below which a reduction in microvascular complications was not observed[14-16]. Comparison of the means of HbA1c in patients with and without CSME revealed statistically significant association of CSME with HbA1c. High glycosylated hemoglobin (HbA1c) level is a well-known risk factor for diabetic macular edema. In addition, the DCCT had demonstrated that intensive treatment to maintain blood glucose levels at a normal range reduced the risk of clinically significant macular edema at the rate of 23%[17,18].

Conclusion

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 type II diabetes mellitus.

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