

## Original Research Article

# Study of HbA1C levels in patients with type 2 diabetes mellitus in relation to diabetic retinopathy in Indian population

Lokesh S.<sup>1\*</sup>, Shivaswamy S.<sup>2</sup>

<sup>1</sup>Department of General Medicine, Vydehi Institute of Medical Sciences and Research Center, Whitefield, Bengaluru, Karnataka, India

<sup>2</sup>Department of General Medicine, Community Health center, Begur, Chamarajanagara, Karnataka, India

**Received:** 22 October 2018

**Revised:** 27 October 2018

**Accepted:** 01 November 2018

### \*Correspondence:

Dr. Lokesh S.,

E-mail: Lokeshsdoc@gmail.com

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### ABSTRACT

**Background:** In the recent years diabetes mellitus (DM) has emerged as a major public health problem worldwide with potential to develop vascular and neuropathic complications. HbA1c has got an important role in monitoring the treatment and risk of developing micro and macrovascular complications. Present study is done to determine the prevalence of diabetic retinopathy (DR) in association with raise in HbA1c and also to correlate the severity of Diabetic retinopathy with the levels of HbA1c.

**Methods:** In this descriptive observational study 50 diabetes mellitus patients with visual disturbances who attended the Department of General medicine and Department of Ophthalmology between January 2012 to December 2012 at Vydehi institute of medical sciences and research centre are selected. All the patients were subjected to the relevant investigations along with dilated retinal examination and slit lamp examination. The results were tabulated according to the severity of retinopathy and other clinical variables.

**Results:** In this study majority of the patient were in the age group of 61-70 years and 68% were male patients. Mean duration of diabetes mellitus was  $9.8 \pm 5.34$  years. Also 54% of them had coexisting hypertension. Present study showed the presence of diabetic retinopathy in 64% of patients, out of which 24% of them had mild DR and 14% had moderate DR.

**Conclusions:** Present study showed as the HbA1c level increases severity of the diabetic retinopathy also increases. And also, patients who had microalbuminuria and longer the duration of diabetes higher the chances of microvascular complications. Hence HbA1c can be used as a useful tool to assess the long-term control of diabetes mellitus and hence the development of diabetic retinopathy.

**Keywords:** Diabetes mellitus, Macular edema, Retinopathy

### INTRODUCTION

Diabetes mellitus (DM) nothing but the disorder of glucose homeostasis, has been known to mankind from the time immemorial. Worldwide about 415 million people are suffering from DM, which is expected to increase to 642 million by 2040.<sup>1</sup>

HbA1c also called glycated haemoglobin is considered as the best available biochemical parameter to assess the long-term metabolic control in patients with DM. HbA1c levels are closely associated with the response to treatment and the risk of developing complications and hence it provides the evidence based marker with which we can assess the chances of developing diabetic

complications. It provides information about overall control of glucose in the previous 6-8 weeks.<sup>2</sup>

Important burden of the DM is due to the development of complications. Many studies like Brussels study and Wisconsin study have shown robust relationship with levels of HbA1c and duration of DM and the development of complication.<sup>3,4</sup>

Diabetic retinopathy (DR) is one of the most frequent causes of blindness in the west which occurs due to the disturbances in retinal blood flow.<sup>5</sup>

Present study is undertaken to determine the prevalence of diabetic retinopathy in association with raised HbA1c levels and also to correlate the levels of HbA1c with the severity of Diabetic retinopathy.

## METHODS

This is Descriptive Observational study. All the patients admitted in the department of General medicine and attending outpatient department of General medicine and department of Ophthalmology of Vydehi institute of medical sciences and research centre, Bengaluru during the period of January 2012 to December 2012, who are fitting into the inclusion criteria were included in the study.

### Inclusion criteria

All patients with Type 2 diabetes mellitus with visual impairment

### Exclusion criteria

- Patients with Type 1 diabetes mellitus
- Gestational diabetes mellitus
- Patients on long term steroids
- Patients with dense cataracts and corneal opacities which prevented visualization of posterior segment.

Fifty patients with Type 2 diabetes mellitus with blurring of vision, attending the medical wards and outpatient Medical and Ophthalmology Departments of Vydehi Institute of Medical Sciences and Research Centre, Bengaluru between January 2012 to December 2012 were selected, based on inclusion and exclusion criteria. Diabetic patients were diagnosed according to American Diabetes Association (ADA) criteria. And also based on their optic fundus findings diabetic retinopathy were divided into NPDR (Non-proliferative diabetic retinopathy) and PDR (Proliferative diabetic retinopathy).

All patients in the study underwent a full clinical evaluation. Clinical history and physical examination findings were recorded with particular attention to duration, use of oral hypoglycemic agents or Insulin, other comorbidities like Hypertension, IHD.

All patients underwent biochemical tests, like complete blood counts, fasting blood sugars, post prandial blood sugars, HbA1C levels, renal function tests. A thorough ophthalmic examination were carried out including visual acuity assessment, Slit lamp examination and fundoscopic examination.

### Statistical analysis

Descriptive and inferential statistical analysis has been carried out in the present study. Results on continuous measurements are presented on mean and the results on categorical measurement are presented in number (%). Chi-square/ fisher exact test has been used to find the significance of study parameters and P value <0.05 was taken as significance.

## RESULTS

In this study majority of the patients were in the age group of 61-70years which accounted for 38% followed by in the age group of 41-50years in which 28% of patients of type 2 diabetes mellitus were seen. 68% were males and 32% were females. Mean duration of diabetes mellitus was  $9.80 \pm 5.39$  years. 94% patients were on oral hypoglycaemic agents and 24% of patients were on both oral hypoglycaemic agents and insulin. 54% of patients had coexisting hypertension. In the present study 34% of patients had HbA1c of <8.0, 30% had HbA1c between 8.0-10.0 and 36% of patients had HbA1c of more than 10.0%.

Totally 64% of patients had DR of varying severity. The frequency of DR was lowest in the group who had HbA1c <8.0 about 41.1% (7 out of 17). In the group who had HbA1c between 8.0-10, 73.3% (11 out of 15) of patients had DR and in the group with HbA1c >10 had highest frequency of DR that is 77.77% (14 out of 18). We can see that as the values of HbA1c increases percentage of DR is also increasing.

Majority of them had mild diabetic retinopathy accounting for 24% followed by moderate diabetic retinopathy in 14%. 10% of the patients had proliferative diabetic retinopathy (Table 1).

**Table 1: Incidence of diabetic retinopathy based on severity.**

Diabetic retinopathy severity	No. of patients	Percentage
Mild DR	12	24%
Moderate DR	7	14%
Severe DR	4	8%
Very severe DR	1	2%
Early PDR	3	6%
High risk PDR	2	4%
Macular edema	1	2%

**Table 2: Correlation of diabetic retinopathy with respect to clinical variables.**

Clinical variables	Diabetic retinopathy		p-value
	Absent (n=18)	Present (n=32)	
<b>Gender</b>			
Male	13 (73%)	20 (62.5%)	0.538
Females	5 (27%)	12 (37.5%)	
<b>Duration of DM</b>			
1-5	4 (23%)	3 (9.4%)	0.186
6-10	10 (55.5%)	16 (50%)	
11-15	4 (22.2%)	7 (21.8%)	
>11 Years	0 (0%)	6 (18.7%)	
<b>Microalbuminuria</b>			
No	17 (94.5%)	12 (37.5%)	<0.001
Yes	1 (5.5%)	20 (62.5%)	

Table 2 shows correlation diabetic retinopathy in relation to duration of diabetes mellitus, gender and

microalbuminuria. Majority of the patients in the present study i.e. 50 % of patients had the duration of DM of 6-10 years. Overall 40% of patients had microalbuminuria. Among them majority of the patients that is 62.5% of patients had Diabetic retinopathy compared to 37.5% of patients had DR who did not have microalbuminuria, which was statistically significant with P value <0.001.

Table 3 shows Severity of diabetic retinopathy in relation to value of HbA1c. In this study, data shows that severe form of DR (including severe NPDR, PDR and CME) are more commonly distributed among the patients with higher HbA1c as compared to lower HbA1c group. However milder form of DR (including mild and moderate NPDR) are more in patients with HbA1c <10.0 compared to the patients with HbA1c >10.0 32% of patient had fasting blood sugars more than 200, 48% of patients had fasting blood sugars in the range of 126-199 and 20% had Fasting blood sugars less than 126. 80% of patients had PPBS more than 200.

**Table 3: Correlation of severity of diabetic retinopathy with the levels of HbA1c.**

Diabetic retinopathy	No. of patients (n=50)	HbA1c			p-value
		<8.0 (n=17)	8.0-10.0 (n=15)	>10.0 (n=18)	
Mild NPDR	14 (28%)	3 (17.6%)	6 (40%)	5 (27.8%)	0.390
Moderate NPDR	7 (14%)	1 (5.9%)	4 (26.7%)	2 (11.1%)	0.309
Severe NPDR	4 (8%)	1 (5.9%)	1 (6.7%)	2 (11.1%)	1.000
Very severe NPDR	1 (2%)	0 (0%)	0 (0%)	1 (5.6%)	1.000
PDR Early	3 (6%)	2 (11.8%)	0 (0%)	1 (5.6%)	0.633
High risk PDR	2 (4%)	0 (0%)	0 (0%)	2 (11.1%)	0.322
Macular edema	1 (2%)	0 (0%)	0 (0%)	1 (5.6%)	1.00

**Table 4: Correlation of frequency of diabetic retinopathy with levels of hba1c.**

HbA1c levels	No. of patients having retinopathy	Percentage of patients who had retinopathy
<8.0	7/17	41.17%
8.0-10.0	11/15	73.33%
>10.0	14/18	77.77%

## DISCUSSION

The exponential rise in the prevalence of diabetes and hence its complications has been a cause of great concern to health care providers worldwide. Prevalence of diabetic retinopathy varies widely among different ethnicity. It ranges from 29% seen in Blue mountain eye study to 50.3% in the Winconsin epidemiologic study of diabetic retinopathy.<sup>6,7</sup>

Among the Indian studies Chennai urban Rural Epidemiological study (CURES) showed an overall

prevalence of diabetic retinopathy of 17.6%.<sup>8</sup> Present study showed overall prevalence of 64% which is almost more than 3 times compared to CURES study. This may be due to the selection of diabetic patients who already had blurring of eyes.

Many landmark trials like diabetic control and complication trial (DCCT) have showed strong relationship between HbA1c and the development and progression of DR.<sup>9</sup>

As we can see in Table 4, present study shows lower frequency of DR in patients with lower HbA1c group and we can see increase in frequency of DR as the HbA1c increases. UKPDS land mark trial also tells that Intensive blood-glucose control by either sulphonylureas or insulin substantially decreases the risk of microvascular complications in patients with type 2 diabetes.<sup>10</sup>

A study done by Leske et al, in Barbodose eye study, they found that every 1% increase in HbA1C from baseline was associated with a >2-fold risk of DR, upto 4 years of follow up which was correlating with the present

study in telling the linear relationship of HbA1c levels with the development of DR.<sup>11</sup> Many other epidemiological studies also confirm that uncontrolled sugars which is assessed by HbA1c is important risk factor for DR.<sup>12,13</sup>

In the present study majority of the patient who developed DR were males accounting for 62.2% and 37.5% were females. This was correlating with the study done by Niveditha H et al, and Gadkari SS et al.<sup>14,15</sup>

In this study 40% of patients had microalbuminuria of which majority of them had diabetic retinopathy which was statistically significant with p value <0.001. Study done by Manaviat MR et al, at Iran also conclude that microalbuminuria may be a marker for the risk of proliferative retinopathy development.<sup>16</sup>

Microalbuminuria is also recognized as an independent risk factor for the development of coronary artery disease. Many studies like Dinneen SF et al, have shown positive correlation between microalbuminuria and the coronary artery diseases especially in patients with diabetes mellitus.<sup>17</sup> As the microalbuminuria indicates renal involvement and with its correlation with coronary artery disease and retinopathy, authors can consider microalbuminuria as an indicator of generalized vascular involvement in the form of endothelial dysfunction.

## CONCLUSION

From this study authors conclude that, as the HbA1c levels increases diabetic retinopathy also increase both in terms of frequency as well as severity. Hence it is advisable to include HbA1c as the screening tool in the evaluation of diabetes mellitus, so that we can predict the development of diabetic retinopathy and treat them in early stages.

*Funding: No funding sources*

*Conflict of interest: None declared*

*Ethical approval: The study was approved by the Institutional Ethics Committee*

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**Cite this article as:** Lokesh S, Shivaswamy S. Study of HbA1C levels in patients with type 2 diabetes mellitus in relation to diabetic retinopathy in Indian population. *Int J Adv Med* 2018;5:1397-401.