

Original Article

Association of Diabetic Retinopathy with Duration of Type 2 Diabetes Mellitus and Glycemic Control

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Abstract

Background: Diabetic Retinopathy (DR) is one of the most prevalent micro vascular complications that occur in diabetes mellitus patients & it causes variety of lesion within the retina which leads to blindness. Duration of DM and increased HbA1c level has been identified as a cause of development of DR by previous studies. This current study aimed to determine the relationship of duration of DM & HbA1c with diabetic retinopathy. **Objective:** To evaluate the association between the duration of DM & HbA1c with retinopathy. **Materials and methods:** A cross-sectional study was conducted at BIRDEM general hospital from July 2021 to June 2022. According to the inclusion criteria, 100 subjects aged over 30 years were selected. After obtaining informed written consent from the study subjects a structured questionnaire was completed to collect data which includes personal identification, demographic history, drug history and history of duration of DM & other systemic diseases. Collected data were analyzed by using SPSS (20). Data was analyzed by parametric test (Independent student t test), Chi-Square Test. **Results:** The study showed a rising prevalence of DR with duration of DM. It was seen that when the duration of DM was 5 years the prevalence of DR was only 2% & when the duration was more than 10 years the prevalence of DR was 72%. HbA1c (%) was also significantly higher in diabetic retinopathy patients (12.40 ± 3.01) comparing without diabetic retinopathy patients (8.74 ± 2.73). **Conclusion:** In this study we found that the DR patients had significantly longer duration history of DM and significantly higher FBG, HbA1c level ($p < 0.001$).

Keywords: Diabetic retinopathy, Hyperglycemia, Glycosylated hemoglobin

Introduction: Diabetes mellitus (DM) is one of the most common chronic metabolic disorders which affects nearly every organ of a body and responsible for a great socioeconomic burden on patients and their families. It is a major public health problem, affecting more than 300 million individuals worldwide, with significant morbidity and mortality.¹ When the bodies normal cells become completely resistant or less responsive to insulin the type 2 diabetes mellitus develops. These lower levels of insulin lead to hyperglycemia which causes damage to microvascular bed, contributing to complications including diabetic

retinopathy, diabetic neuropathy, diabetic nephropathy, and some metabolic disorders.^{2,3}

Although diabetes mellitus has so many complications, DR is the most serious microvascular complications and leading cause of blindness globally. Some recent study predicts that the number of people with DR will become 191 million by 2030.⁴ DR is characterized by altered structure of retinal endothelial vessels and disrupted blood-retinal barrier, resulting in ischemic changes that lead to the formation of new vessels in retina and its consequences.⁵

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Long-term diabetes increases the risk of developing DR. In previous study, prevalence of diabetic retinopathy was 9.44% among individuals with diabetes less than 5 years, whereas the prevalence raised to 76.47% for a period of 20-25 years.⁶ A study of Fath et al. showed a significant correlation between the severity of DR and the duration of DM. Persons having diabetes for a long period of time will increase the severity of diabetic retinopathy. The longer a person suffers from diabetes causes toxic condition to the retina, which lead to nerve damage and vascular death in retina.^{7,8} Diabetic retinopathy will worsen in people with long standing diabetes which increase the risk of sight-loss. Previous studies results showed a link between diabetes duration with diabetic retinopathy.⁹

According to the American Diabetes Association's guidelines, diabetes was detected as follows (1) Typical symptoms with random plasma glucose levels above 11.1 mmol/l; or (2) fasting plasma glucose levels of more than 7 mmol/l.¹⁰ By fulfilling either of these criteria individuals were considered as diabetes mellitus. Based on American Diabetic Association guidelines (ADA), HbA1c is the gold standard laboratory investigation for diagnosing diabetes as well as monitoring glycemic control of roughly over the previous three months. Previous studies have established a strong relation between HbA1c and development of DR. HbA1c offers several advantages over fasting blood glucose such as patient do not need to fast more than 12 hours and day to day perturbations during short term stress and illness.¹¹

Worldwide several studies were done separately on duration of DM & HbA1c in DR patient. But there is no such study done before in Bangladesh on relationship between duration of diabetes mellitus & HbA1c levels with DR patients. The findings of this study may promote early detection to prevent further progression of the disease.

Objective:

The aim of this study was to evaluate the relationship between duration of DM & HbA1c level in patients with type 2 diabetes who have retinopathy.

Methods:

This cross-sectional study was conducted at the Department of Biochemistry & Department of Ophthalmology, BIRDEM General Hospital, Dhaka from July 2021 to June 2022. In this study, overall number of study participants was 100. Patients with type 2 diabetes without any ocular issues (n=50) were categorized as Group II & patients having diabetic retinopathy (n=50) were categorized as group I.

DR was diagnosed by Fundus photography at Ophthalmology Department. Patients aged over 30 years with body mass index (BMI) less than 35 kg/m² from both male & female were the inclusion criteria of this study. Patients with type-1 DM, any visual abnormality or eye disease other than DR, patients with any acute and chronic complications such as nephropathy, cerebrovascular or cardiovascular disease, severe infection, smoking, alcoholism, pregnancy, lactation, or those taking any drugs, were excluded. A semi-structured questionnaire which included the age, sex, socioeconomic status, and educational level of the individuals was administered to collect data. A complete medical history was taken which includes onset and duration of DM, any treatment was taking for DM or any ocular diseases and other systemic co-morbid disease.

With maintaining all the aseptic precautions, after an overnight fasting of 8-10 hours, 5 ml venous blood was drawn from each participant. From this 5 ml of blood sample, 2 ml blood was delivered in a fluoride test tube for estimation of fasting blood glucose (FBG) & remaining 3 ml blood was taken in an EDTA tube to assess HbA1c levels.

Immediately after centrifugation FBG was measured in Hexokinase method by an auto analyzer named Beckman Coulter Au-480, and HbA1c was assessed in high-performance liquid chromatography (HPLC) method by BIO-RAD Variant TM II Turbo at Clinical Biochemistry Department, BIRDEM General Hospital, Dhaka.

Results and Observations

Out of total 100 participants, 62% of the study subjects were male, 40% were from rural areas, all were educated and 48% of participants had been suffering from diabetes for >10 years. It was also observed that 27% had given a positive answer regarding physical exercise (Table-1). Figure 2

represents that among the 100 diabetic patients, 50 were suffering from diabetes mellitus without diabetic retinopathy (Group- I) and another 50 were diagnosed with diabetic retinopathy (Group -II). No significant difference was seen in between both groups in terms of age, sex, or socioeconomic factors such as their income, educational qualifications etc. Chi-square analysis revealed a significant association between the presence of diabetic retinopathy and duration of DM. Individuals with diabetes duration of 0-5 years, the percentage was 2% in DR and 36% in patient (Table-2) without diabetic retinopathy. When the duration was > 10 years, the diabetic retinopathy patients showed a higher percentage (72%) than those without diabetic retinopathy (24%).

Table-3 showed Significant association between glycemic status (FBS & HbA1c) and diabetic retinopathy ($p= 0.001$). The mean value of HbA1c was significantly higher in group I than in group II and the difference was statistically significant.

Table-1: Baseline characteristics of study population (n=100)

Characteristics		Frequency (n)	Percentage (%)
Sex	Male	62	62%
	Female	38	38%
Residence	Urban	39	39%
	Suburban	21	21%
	Rural	40	40%
Education	Primary	10	10%
	Secondary	14	14%
	HSC	36	36%
	Graduate	40	40%
Physical exercise	Yes	27	27%
	No	63	63%
Duration of DM	0-5 years	19	19%
	6-10 years	33	33%
	More than 10 years	48	48%

Results are expressed as frequency (n) and percentage (%)

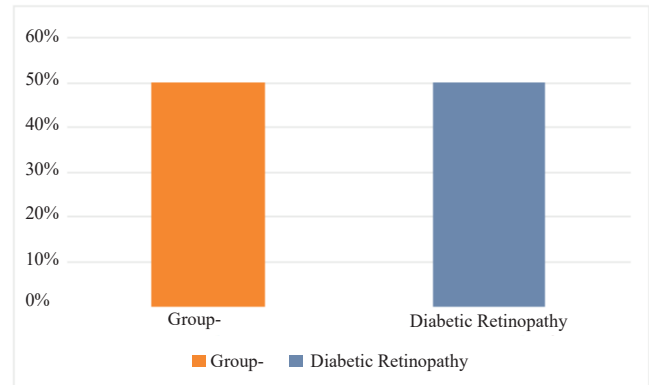


Fig-1: Distribution of study population

Table-2: Association of duration of diabetes with group-I & group -II

Duration of Diabetes	Patients without DR (Group-I)		Patients with DR (Group-II)		(P-value)
	Frequency (n)	Percentage (%)	Frequency (n)	Percentage (%)	
0-5	18	36	1	2	0.001
6-10	20	40	13	26	
>10	12	24	36	72	

Table-3: Association of Glycemic status with group-I & group-II

Variables	Patients without DR (Group I) Mean± SD	Patients with DR Group II Mean± SD	p value
FBS	11.21± 3.64	8.61± 2.13	0.000
HbA1c	12.40± 3.01	8.74 ± 2.73	0.001

Discussion

As far as we aware, no research has conclusively determined the relationship of duration of DM, FBG and HbA1c in DR patients. This study reveals that both FBG and HbA1c (%) were higher among the DR patients. This finding was similar with Lima et al. (2016) who found them higher in DR patients than without DR. Raised HbA1c level indicates a prolonged and uncontrolled glycemic state, which is a major contributor to diabetes complications mainly DR.¹¹

Frequency distribution of base line characteristics showed most of the participants were from rural area (40%). In the whole study 10% participants were primarily educated, 40% graduated and no one was uneducated.

In this current study, we found that when the duration of diabetes was ≤ 5 years, group I had 2% and group II had 36% patients. When the duration was 6–10 years, group I received 26% and group II received 40% of the patients. Group I had the highest patient rate at 72% compared to group II at 24%, when the duration was > 10 years. The results indicated a relation in between longer diabetic duration & incidence of diabetic retinopathy.

Similarly, our study also revealed that compared with the non-diabetic retinopathy group, the longer duration of diabetes was seen in diabetic retinopathy group.¹² Our findings are also in agreement with other studies stated that hyperglycemia and oxidative stress increased with prolong duration of DM which leads to diabetes complications.^{13,14,15}

Diabetic retinopathy occurs as a chronic complication of diabetes. Chronic and uncontrolled diabetes has been revealed as a key factor for chronic complications. In our study, mean fasting blood glucose in group I and Group II were 11.21 ± 3.64 and 8.61 ± 2.13 mmol/l respectively. It was also revealed that fasting blood glucose was significantly higher in group I than group II ($p < 0.001$). Similar study found a significantly higher ($p < 0.01$) fasting blood glucose among participants cases with retinopathy than without retinopathy.¹³

HbA1c (%) was also higher same as the fasting blood glucose in diabetic retinopathy patients (12.40 ± 3.01) comparing without diabetic retinopathy (8.74 ± 2.73). These findings were in concordance with a study in which there was higher HbA1c in diabetic retinopathy patients than without diabetic retinopathy.¹³ Higher HbA1c levels in diabetic retinopathy patients represent a prolonged and uncontrolled glycemic state, which is a leading contributor to diabetes complications.¹¹

This study may not represent the whole population of the country hence the samples were taken from only one tertiary care hospital. The participants in this study could not be excluded who were undergoing various therapeutic interventions for diabetes & its related complications.

Conclusion

Based on the findings of this present study, a significant association was observed between duration of diabetes and prevalence of DR ($p < .001$)

and as well as between HbA1c and DR ($p < .001$). Poor glycemic control revealed increased risk of developing DR & it was found statistically significant. Therefore, we can say all the patients suffering from diabetes mellitus of 10 years or longer duration with poor glycemic control should be regularly screened for diabetic retinopathy. Starting early screening preferably at the time of diagnosis, consistent follow-up along with good glycemic control will help to prevent the sight-threatening diabetic retinopathy.

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