

Association of glycosylated haemoglobin levels and intraocular pressure in diabetics and normal subject

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Abstract

Background and Objective: The fluid pressure inside our eye is called as intra-ocular pressure (IOP). The intraocular pressure is determined by the balance between the production of the aqueous humour (the clear fluid inside the eye) and the drainage of the aqueous humour, mainly through the trabecular meshwork which is located in the anterior chamber angle. The IOP can be influenced by different systemic factors such as hypertension atherosclerotic diseases, body mass index, and diabetes. In India, as of now, there are over 35 million people with diabetes, a number that is predicted to increase to around 80 million by 2030. Diabetes mellitus is an important ocular risk factor. The Studies have shown that diabetes causes increase in IOP. To rule out this correlation present study was undertaken. **Material and Methods:** The study was carried out on 80 subjects of which 40 control group and 40 case group (diabetic) patients of age group 30-60 years having raised HbA1c levels. The screening laboratory tests included estimation of fasting (Fbs) and post prandial plasma glucose levels (PPbs) and (HbA1C) levels. Proper technique of measuring IOP was explained to the Patient and intra-ocular pressure was measured by using a Schiottz tonometer in supine position using a topical anaesthetic. Results were statically analyzed by "Z" correlation coefficient test. **Results:** our result show significant increase in IOP in patient with increase HbA1c as compared to normal subjects **Conclusion:** Our study indicates an association between hyperglycaemia and elevated IOP and that poor glycemic control may contribute to increase IOP levels in long term diabetic patients.

Keyword: HbA1c, Diabetes, IOP.

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INTRODUCTION

The fluid pressure inside our eye is called as intra-ocular pressure (IOP). The intraocular pressure is determined by the balance between the production of the aqueous humour (the clear fluid inside the eye) and the drainage of the aqueous humour, mainly through the trabecular meshwork which is located in the anterior chamber angle. An abnormally high IOP reading indicates that either the

eye is producing too much fluid, or that it is not draining properly¹. The IOP can be influenced by different systemic factors such as hypertension atherosclerotic diseases, body mass index, and diabetes. This variation can be explained by the numerous factors affecting IOP. Previous studies have shown that the factors associated with elevated IOP include smoking, older age, gender, blood pressure, family history of glaucoma, pulse rate, diabetes (elevated glycosylated haemoglobin) myopia, alcohol usage, race (African), nuclear sclerosis, body mass index (BMI) and iris colour²⁻⁴. Although diabetes is associated with higher IOP values in most population studies, the underlying mechanisms are still unclear⁵. Recent studies have suggested that changes in corneal biomechanics (increased corneal hysteresis) in diabetic eyes would lead to overestimated IOP measurements⁶⁻⁷. Diabetes mellitus is a group of metabolic diseases which is characterized by hyperglycaemia, resulting from defects in insulin secretion, insulin action, or both. The chronic hyperglycaemia in diabetes is associated with the

long-term damage, dysfunction, and the failure of various organs, especially the eyes, kidneys, nerves, heart, and blood vessels, causing severe systemic complications such as retinopathy, neuropathy and nephropathy⁸. In India, as of now, there are over 35 million people with diabetes, a number that is predicted to increase to around 80 million by 2030⁹. Diabetes mellitus is an important ocular risk factor. It has emerged as a major cause of vision loss and visual disability, not only in the developed countries, but also in the developing countries. Diabetes, besides its other ocular manifestations, also affects the intra-ocular pressure¹⁰. A recent study also found that the IOP of eyes in patients with uncontrolled diabetes was significantly higher than the IOP of eyes in patients with controlled diabetes¹¹. The purpose of this study is to observe the intraocular pressure behaviour in diabetes mellitus which are clinical entities proven to be related to a higher risk of glaucoma development.

MATERIAL AND METHODS

The present study was conducted in the Department of physiology MGM Medical College Aurangabad and was carried out on 40 control group and 40 case group (diabetic) patients of age group 30-60 years having HbA1c levels more than 5.5. After taking written consent, proper history and general examination was done and patients were screened for blood investigation. The body mass index was calculated by using the formula, BMI = Weight in Kg/Height in meters². The screening laboratory tests included estimation of fasting (Fbs) and post prandial plasma glucose levels (PPbs) and (HbA1C) levels. Proper technique of measuring IOP was explained to the Patient and intra-ocular pressure was measured by using a Schiottz tonometer in supine position using a topical anaesthetic.

- Our Inclusion criteria- having diabetes and normotensive are included in the study.
- Subjects with systemic hypertension, a family history of glaucoma, a habit of smoking, alcoholism, pregnancy, refractive errors, ocular infection or inflammation or the usage of ocular drugs within the previous three months, a history of ocular surgery, the usage of any medications that would affect the IOP, a history of cardiac diseases and a history of endocrinal diseases or any other major medical problems were excluded from the study.

Results were statically analyzed by “Z” correlation coefficient test.

OBSERVATION AND RESULTS

A total of 80 patients (40 case group 1 and 40 control group 2 (diabetic)) were included. The results are shown

in Tables 1-4 and the age range of the subjects was 30-60 years.

Table 1: Distribution of patients according to Gender and Age-Group;

		Case-Group [n=40]	Control-Group [n=40]
Gender	Male	20 [50.0%]	20 [50.0%]
	Female	20 [50.0%]	20 [50.0%]
Age-Group	30-40	18 [45.0%]	04[10.0%]
	41-50	12 [30.0%]	09[22.5%]
	51-60	10 [25.0%]	27[67.5%]

Out of 40 patients in each group there were 20 male and 20 females respectively in each i.e. case and control group. In case group I there were 18 patients in 30-40 age group, 12 patients in 41-50 age group and 10 patients were in 51-60 age group. In control group II there were 04 patients in 30-40 age group, 09 patients in 41-50 age group and 27 patients were in age 51-60 group.

Table 2: Comparison of Mean IOP level between case and control Groups

IOP	Case-Group Mean± SD	Control-Group Mean± SD	Z- value	P-vale
Right Eye	18.65±1.41	11.73±1.51	21.18	P<0.0001 Significant
Left Eye	18.60±1.49	11.79±1.56	20.65	P<0.0001 Significant

IOP was significantly increased in case Group I in both eyes.

Table 3: Correlation of HbA1c level with IOP of both eyes between case and control groups

	Case-Group		Control-Group	
	r-value	P-value	r-value	P-value
Right IOP Level vs. HbA1c	0.633	P<0.0001 Significant	0.074	P=0.649 Not Significant
Left IOP Level vs. HbA1c	0.597	P<0.0001 Significant	0.051	P=0.755 Not Significant

In case group 1 the correlation between IOP levels versus Hba1c in the right eye was 0.633 and in the left eye was 0.597 which was found to be significant. In control group 2 the correlation between IOP and Hba1c in right eye was 0,074 and left eye was 0.051 which was also found to be non significant.

DISSCUSSION

Diabetes mellitus is a group of metabolic diseases which is characterized by hyperglycaemia, resulting from defects in insulin secretion, insulin action, or both. The

chronic hyperglycaemia in diabetes is associated with the long-term damage, dysfunction, and the failure of various organs, especially the eyes, kidneys, nerves, heart, and blood vessels, causing severe systemic complications such as retinopathy; neuropathy and nephropathy. The fluid pressure inside our eye is called as intra-ocular pressure (IOP). In our study patients were divided in to two groups: Group I (case group n=40 patients) and Group II (control group n=40 patients). Out of 40 patients there were 20 male and 20 females in each group respectively. In Group I there were 18 patients in 30-40 age group, 12 patients in 41-50 age group and 10 patients were in 51-60 age group. In Group II there were 04 patients in 30-40 age group, 09 patients in 41-50 age group and 27 patients were in age 51-60 group. In Group I the mean IOP was found to be 18.65 ± 1.41 and 18.60 ± 1.49 in right and left eye respectively and in Group II the mean IOP was 11.73 ± 1.51 and 11.79 ± 1.56 in right and left eye respectively. Our results showed a significant increase in IOP. In case group I the correlation between IOP levels versus HbA1c in the right eye was 0.633 and in the left eye was 0.597 which was found to be significant, whereas in control group II the correlation between IOP and HbA1c in right eye was 0.074 and left eye was 0.051 was non significant. Our study matches with the study conducted by Anandha Lakshimi *et al*¹², Luis Guilherme *et al*¹³, Farnaz Siddiqui *et al*¹⁴, Maggie B. Hymowitz¹⁵. Larsen and colleagues^{13,16} found lower IOP values during severe hypoglycaemia. The exact mechanism by which high glucose level in patients with diabetics increases IOP is still unclear. Davies *et al*¹⁵ have reported that the glucose level in aqueous humour of patients with diabetics were significantly higher (3.2mmvs 7.8mm) as compared to glucose levels in non diabetics persons. High glucose levels can induced excess extracellular matrix (ECM) synthesis by trabecular meshwork cells leading to accumulation of ECM and decreases aqueous outflow^{17,18}. Trabecular meshwork represent a specialized tissue composed of various ECM components including fibronectin, laminin and collagen IV^{18,19,20}. The composition of these ECM components in the trabecular meshwork can influence the meshwork ultra structure and function including maintenance of outflow facility. The trabecular meshwork cells grown in high glucose conditions up regulates mRNA and protein synthesis of fibrolactin and the excess deposition of fibrolactin may be a common biochemical link that on one hand contributes to the development of thickened vascular basement membranes in diabetics microangiopathy and on other hand alters the structural contents, compromises resiliency, reduces cellularity, blocks the aqueous outflow in the trabecular meshwork and leads to increased IOP leads to the development of POAG in persons with

diabetics.^{18,20,21} besides increased IOP is associated with death of retinal ganglion cells^{22,23} and leads to optic neuropathy which progressively damages optic nerve head due to mechanical compression causing progressive loss of optic nerve fibre and visual field loss. Some research believe that there are genetic factors associated in family history of diabetics²⁴. secondly that a diabetic person could have and autonomic dysfunction which would lead to an increased IOP²⁵ however some authors believe that elevated blood glucose results in the induction of an osmotic gradient which leads to fluid shift into the intra ocular space²⁶. Thus it shows poor glycemic control in subject with diabetics mellitus are at high risk for development of increase in IOP and POAG to OAG.

CONCLUSION

Our study indicates an association between hyperglycaemia and elevated IOP and that poor glycemic control may contribute to increase IOP levels in long term diabetic patients. The study may require further investigations in a large number of subjects.

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