

Relationship between Refractive Error and Diabetes Mellitus

Shubhnav Jain¹, Chetanya Prakash Gupta²

ABSTRACT

Purpose: To investigate the change in the refractive status of patients who were recently diagnosed with diabetes mellitus.

Methods: The study was performed in the patients recently diagnosed with diabetes using various biochemical tests and clinical examinations. Fasting plasma glucose (FPG) levels were measured along with the refractive errors initially and after 4 weeks. The difference between the two was evaluated.

Results: The average values of the initial measurement were as follows: FPG level—396 mg/dL, refractive value—+2.0 D. The average values after 4 weeks were as follows: FPG level—202 mg/dL, refractive value—+0.50 D.

Conclusion: Refractive error is affected in patients with newly diagnosed diabetes mellitus.

Keywords: Diabetes mellitus, Fasting plasma glucose, Refractive error.

Journal of Mahatma Gandhi University of Medical Sciences & Technology (2018): 10.5005/jp-journals-10057-0074

INTRODUCTION

Diabetes mellitus is a complex metabolic disorder that involves the small blood vessels, often causing widespread damage to tissues, including eyes and kidneys (end-stage renal disease, ESRD).^{1,2}

It is one of the systemic diseases that has ocular manifestation. Patients with diabetes mellitus can develop various ocular disorders including glaucoma, keratopathy, oculomotor nerve paralysis, non-arteritic anterior ischemic optic neuropathy, and retinal vasculopathy.

Hyperglycemia is the most frequently observed sign of diabetes and is an important source of diabetic complication in body and eye. The ocular complications generally arise approximately 20 years after the onset of the disease. The loss of the normal homeostatic mechanisms, which maintain blood glucose within a narrow physiological range, renders the diabetic individual susceptible to wide excursions in blood glucose and the intermittent hazard of metabolic extremes.

Transient refractive changes have been reported during the hyperglycemic period and also during falling blood glucose level during intensive glycemic control. Studies have reported a shift in the hyperopic direction during periods of hyperglycemia.^{3,4}

In cases of acute increase or reduction of the blood glucose level in diabetic patients, transient cataracts are also reported.

The ability to identify these manifestations and the condition causing them will place the clinician in a better position to manage, often counsel or refer for the appropriate treatment.

METHODS

The study included 100 adult patients with a new diagnosis of diabetes mellitus who did not have retinopathy. Patients had been diagnosed using laboratory biochemical tests and clinical examinations. The age and sex of the patients were recorded. Informed consent was taken.

Each patient was monitored for 4 weeks. Measurements and evaluations were made simultaneously for fasting plasma glucose (FPG) levels and refractive error. Measurements were taken at the beginning and end of this period (4 weeks). The difference between the first and second refractive measurements was evaluated. All patients were tested for blurred vision. The data were statistically

^{1,2}Department of Ophthalmology, Mahatma Gandhi Medical College and Hospital, Mahatma Gandhi University of Medical Sciences and Technology, Jaipur, Rajasthan, India

Corresponding Author: Chetanya Prakash Gupta, Department of Ophthalmology, Mahatma Gandhi Medical College and Hospital, Mahatma Gandhi University of Medical Sciences and Technology, Jaipur, Rajasthan, India, Phone: +91 9530389447, e-mail: drcpg2004@yahoo.co.in

How to cite this article: Jain S, Gupta CP. Relationship between Refractive Error and Diabetes Mellitus. *J Mahatma Gandhi Univ Med Sci Tech* 2018;3(2):61–62.

Source of support: Nil

Conflict of interest: None

evaluated using the paired sample *t* test. For all analyses, $p < 0.05$ was considered significant.

RESULTS

A total of 100 newly diagnosed type 2 diabetes mellitus patients were taken of which 70 were males and 30 females. The refraction values and FPG levels were measured twice in all patients. The average values of the initial measurements were as follows: FPG level: 396 mg/dL; average refractive value: +2.0 D (Diopter). The average end-of-period measurements were as follows: FPG: 202 mg/dL; average refractive value: +0.50 D (Table 1). All the 100 patients were reported with blurred vision during initial measurements (Table 2).

The percentage change of average FPG levels was 48.98% between two measurements. The percentage change of average refractive values was 75%. These changes were statistically significant ($p < 0.05$) (Table 1).

The average values of the initial measurements of males were as follows: FPG level: 391 mg/dL; average refractive value: +2.0 D. The average end-of-period measurements were as follows: FPG: 196 mg/dL; average refractive value: +0.50 D (Table 3).

The average values of the initial measurements of females were as follows: FPG level: 401 mg/dL; average refractive value: +2.0 D. The average end-of-period measurements were as follows: FPG: 208 mg/dL; average refractive value: +0.50 D (Table 3).

Table 1: Comparison of blood sugar level and refractive error

Process	The measurements		The change (%)
	Initially (mean)	After 4 weeks (mean)	
FPG level	396 mg/dL	202 mg/dL	48.98
Refractive error	+2.0 D	+0.50 D	75

Table 2: Improvement of visual disturbances before and after treatment

Process	Measurements	
	Initially (mean)	After 4 weeks (mean)
Blurred vision	100 patients	0
Visual acuity (UCVA)	6/18	6/9

Table 3: Sexwise comparison of blood sugar level and refractive error

Process	Males		Females	
	Initial (mean)	After 4 weeks	Initial (mean)	After 4 weeks
FPG level	391 mg/dL	196 mg/dL	401 mg/dL	208 mg/dL
Refractive error	+2.0 D	+0.50 D	+2.0 D	+0.50 D

Blurred vision in all the patients in the first condition was eliminated with the use of corrective lenses after 4 weeks. The disappearance of blurred vision was statistically significant ($p < 0.05$). There was improvement in the vision in all the patients by the end of 4 weeks (Table 2).

DISCUSSION

Hyperglycemia causes transient refractive changes in diabetic patients. Type 2 diabetes mellitus usually begins after the age of 40.

The refractive power of the eye depends on the anterior and posterior corneal and lens surface curvatures, the corneal thickness, the anterior chamber depth, lens thickness, and the axial length of the eye as well as the refractive indices of the cornea, aqueous humor, lens, and vitreous body. Transient refractive changes are common during periods of hyperglycemia or falling blood glucose during intensive glycemic control. Thus, in the analysis of pathophysiology of refractive changes in diabetes, all the abovementioned parameters need to be considered.

Acute changes in the plasma glucose level cause either myopia or hyperopia. The change in the refractive index of the lens is responsible for the refractive changes. According to studies, osmotic changes lead to changes in lens hydration. Hyperglycemia stimulates sorbitol production in the lens. Subacute rise in glucose levels in the aqueous humor could result in increased production of sorbitol in the lens and overhydration of the lens. On the other hand, an acute rise in external glucose levels causes dehydration of the lens *in vitro*. This causes change in the refractive index of the lens.

Dyke et al. concluded that hyperglycemia produced myopia, and that lowering the blood sugar resulted in hyperopia.⁵

Grant et al. suggested that the change in vision that accompanied chronic changes in glucose paralleled the degree of change in glucose concentration.⁶ This agrees with the result of our study.

Kristian et al. investigated the effect of glycemic control on hyperglycemia-induced temporary changes in refractive error in type 1 diabetic patients without retinopathy.⁷ This study is also parallel to our study in terms of investigating the hyperglycemia associated with diabetes mellitus.

Okanoto et al. reported myopia at hyperglycemic levels and on decrease in the blood sugar level hyperopic shift was seen, which was contrary to our study.⁸

Bozkurt et al. demonstrated the mechanisms by which elevated glucose affects cellular metabolism.⁸

Tatsuyuki et al. studied blurred vision in diabetes mellitus patients. The refractive changes in diabetic patients are unknown; they range from 5 to 50% in untreated or uncontrolled patients.⁹

Giusti hypothesized that the sorbitol production with overhydration of the lens remains the best pathophysiologic account for the phenomenon.¹⁰ He concluded that hyperopic changes are highly dependent on the magnitude of plasma glucose concentrations, and rapid correction of hyperglycemia is strictly correlated with complete recovery of refraction.

The exact biological basis of refractive changes in the eyes of people with diabetes has yet to be established, and the mechanism of the relationship between plasma glucose concentration and refractive change in person with diabetes remains to be determined.

CONCLUSION

In diabetic patients, refraction is affected by blood glucose; therefore, monitoring of this value is important. It is recommended that eyeglasses should not be prescribed for 4 weeks in patients who are newly diagnosed with diabetes mellitus.

REFERENCES

1. Ali A, Iqbal F, et al. Prevalence of microvascular complications in newly diagnosed patients with type 2 diabetes. *Pak J Med Sci* 2013;29(4):899–902. DOI: 10.12669/pjms.294.3704.
2. Hayrullah Y, Mehmet B, et al. The effects of dialysers on some blood biochemical parameters in hemodialysis patients. *A J P P Sci* 2011;5(22):2513–2516. DOI: 10.5897/AJPP11.690.
3. Wiemer NG, Eekhoff EM, et al. Refractive properties of the healthy human eye during acute hyperglycemia. *Graefes Arch Clin Expt Ophthalmol* 2007;34:112–115.
4. Somnmez B, Bozkurt B, et al. Effect of Glycemic control on refractive changes in diabetic patients with hyperglycemia. *Cornea* 2005;24(5):531–537. DOI: 10.1097/01.icc.0000151545.00489.12.
5. Schneck ME, Fortune B, et al. Acute effects of blood glucose on chromatic visually evoked potentials in persons with diabetes and in normal persons. *Invest Ophthalmol Vis Sci* 1997;38(5):800–810.
6. Grant G, Arnold V, et al. Relationship of Serum Glucose Concentration to Changes in Refraction. From the Division of Endocrinology, University of California. *Diabete* 1976;25(1):29–31.
7. Kristian K, Michael L, et al. Effect of Short-Term Hyperglycemia on Multifocal Electroretinogram in Diabetic Patients without Retinopathy. *Invest Ophthalmol Vis Sci* 2004;45(10):3812–3819. DOI: 10.1167/iiov.03-1260.
8. Okanoto F, Sone H, et al. Refractive changes in diabetic patients during extensive glycemic control. *Br J Ophthalmol* 2000;84:1097–1102. DOI: 10.1136/bjo.84.10.1097.
9. Tatsuyuki I, Maseumi M, et al. *Diabetes Care* 1992;15(7):938–939. DOI: 10.2337/diacare.15.7.938.
10. Giusti C. Transient hyperopia refractive changes in newly diagnosed juvenile diabetes. *Swiss Med J* 2003;133:200–205.