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Physiology

# STUDY OF CHANGES IN REFRACTIVE ERRORS DURING DIABETES CONTROL

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**ABSTRACT** **Objective:** We aimed to observe changes in refractive errors in diabetic patients during diabetic treatment.
**Methods:** 150 diabetic patients attending private eye clinic were included in this study. Three groups of 50 patients each of normal, moderate and high F-BSL were formed. Fasting plasma glucose (F-BSL) levels were measured along with refractive errors. Two measurements were taken, initially and after four weeks.
**Results:** 1st visit F-BSL 238.75 ± 34.1 mg/dl reduces to 112 ± 15.9 mg/dl after 4 weeks .This is statistically significant ( P<0.05). 1st visit refraction -2.46 ± 3.27 D changes to -0.52 ± 2.54 D on hyperopic side. This is also statistically significant ( P<0.05).
**Conclusions:** During anti-diabetic treatment Refractive error changes are seen in patients with high plasma glucose levels over the period of 1 month.

**KEYWORDS :** Diabetes mellitus, Fasting plasma glucose , Hyperopia, Refractive error

## INTRODUCTION

The prevalence of diabetes has increased exponentially reaching epidemic proportions worldwide. This is probably due to changing lifestyle as there is increasing obesity and reduced activity levels. World Health Organization has stated that diabetes is more likely to be found in low and middle-income countries. In the year 2000, the total number of diabetics in India stood at 31.7 million and is expected to rise by more than 100% in the year 2030 to account for 79.4 million. It currently affects an estimated 143 million people worldwide and the number is growing rapidly. The most prominent work culture perpetuated in the country, which includes sitting for hours in one position and eating fast food with little or no physical activity, is a major contributor to diabetes in the working age group [1,19]. Diabetic patients suffer from various ocular disorders such as cataract, ischemic optic nerve neuropathy and retinal vasculopathy [1–3] . Diabetes may cause fluctuation in the refractive state of the eye. Both myopic shifts [2,3] and hyperopic shifts [4,5]have been reported in diabetic patients. Some studies also reported that there was no influence of diabetes mellitus on ocular refraction [6,7]. The refractive power of the eyes depends on the anterior and posterior cornea curvature, corneal thickness, anterior chamber depth (ACD), lens thickness (LT) and curvature, axial length (AL), as well as the refractive index of the cornea, aqueous, lens and vitreous [3] . The refraction would become less myopic or more hyperopic while the plasma glucose concentration decreased rapidly[3-5,7-12]. The changes in the surface curvature and the refractive index of the lens due to osmotic forces were thought to be the main cause[2,3,5,9,11,13-17]. So this study was done to find out changes in refractive errors during diabetes control.

## MATERIALS AND METHODS

A Clinic based observational study was done in private eye clinic in Pune, Maharashtra, India from 2018 to May 2019. Diabetic patients with normal anterior, posterior segment and patients with good vision were included in the study. Diabetic patients with ocular diseases prior surgical history or prior history of trauma were excluded from the study. Three groups of diabetic patients were formed – 1) Normal glucose level (70-110 mg/dl) 50 patients 2) slightly high glucose level (110-150 mg/dl) 50 patients 3) high glucose level (more than 150 mg/dl) 50 patients. Known as well as newly diagnosed 150 diabetic patients attending private eye clinic were included. All the patients had undergone complete ocular examination including visual acuity, refraction, slit- lamp examination and fundus examination. For refraction, spherical equivalent of the eye is calculated and average of both eyes considered as refraction of that patient in diopters. Venous fasting plasma glucose levels were measured in each patient. Two measurements were taken: initially and after four weeks. The difference between the initial and end glucose levels as well as refractive errors were evaluated. Informed consent was taken in all the patients involved in the study and confidentiality was maintained. Data were collected and analyzed using Microsoft Excel and Epi info software. Paired T test applied.

## RESULTS

150 diabetic patients examined in private eye clinic. Out of which 98(65.33%) were males and 52(34.66%) were females. There were 16(10.66%) (9 males, 7 females) patients of Type 1and 134(89.33%)(89 males, 45 females) patients of Type 2 diabetes.(Table 1)

**(Table 1) Male, Female and Type-I, Type-2 distribution of 150 diabetes patients.**

| | Type – I Diabetes | Type - II Diabetes | Total |
|---|---|---|---|
| Male | 9 | 89 | 98 |
| Female | 7 | 45 | 52 |
| Total | 16 | 134 | 150 |

Three groups were formed according to the fasting blood glucose level.

Blood glucose level and refraction were done on 1st visit and 2nd Visit.(after 4 weeks.)

**(Table 2) Group wise F-BSL Changes in 1st and 2nd Visit and there Significance.**

| | No. of Patients | 1st Visit F-BSL | 2nd Visit F-BSL | P value |
|---|---|---|---|---|
| Group I 70-110 mg/dl | 50 | 87.25 ± 8.34 | 85.75 ± 7.66 | > 0.05 |
| Group II 110-150 mg/dl | 50 | 143 ± 11.74 | 108 ± 9.5 | < 0.05 |
| Group III >150 mg/dl | 50 | 238.75 ± 34.1 | 112 ± 15.9 | <0.05 |

Table-2 shows, in group I, F-BSL is very slightly reduced from 87.25 to 85.75 mg/dl which has no significance (P value > 0.05). In group II, F-BSL is reduced from 143 to 108 mg/dl which is significant (P value < 0.05). In group III, F-BSL is reduced from 238 to 112 mg/dl which is significant (P value < 0.05).

**(Table 3) Group wise Refraction Changes in 1st and 2nd Visit and there Significance.**

| | No. of Patients | 1st Visit Ref-D | 2nd Visit Ref-D | P value |
|---|---|---|---|---|
| Group I 70-110 mg/dl | 50 | -0.66 ± 2.39 | -0.50 ± 2.33 | > 0.05 |
| Group II 110-150 mg/dl | 50 | -1.05 ± 3.12 | -0.95 ± 2.98 | >0.05 |
| Group III >150 mg/dl | 50 | -2.46 ± 3.27 | -0.52 ± 2.54 | <0.05 |

Table-3 Shows, in group I and group II, refraction in Diopters changes from -0.66 to -0.50

and -1.05 to -0.95 respectively, which has no significance (P value > 0.05). But in group III, change in refraction from -2.46 to -0.52 is very significant (P value < 0.05).

## DISCUSSION

It has been reported that decreasing plasma glucose level causes hyperopic change .However, some investigators have observed both myopic and hyperopic changes in diabetic eyes [1,3-5] .The mechanism of alteration in blood glucose concentration leading to refractive change in diabetics is not yet clear[13-18]. The present study investigated the clinical course of the refractive change of 150 diabetic eyes during glycemic control. This study revealed that during treatment of hyperglycemia in diabetic patients, a transient hyperopic change of 0.5 diopter or more developed in all eyes. Hyperopic change gradually returned to the baseline value within four weeks in most patients[5,8,9]. After receiving hypoglycemic treatment, some diabetic patients complain of blurred vision because of refractive change and new glasses are prescribed. However, new glasses will not fit after 4 weeks[5,8,9]. So doctors should explain the refractive change is transient and the prescription of new glasses should be delayed. In the present study, patients who had a higher BSL had a larger maximum hyperopic change. There was a definite positive correlation between the maximum hyperopic change during glycemic control. These results indicate that the degree of hyperopia is highly dependent on the rate of plasma glucose reduction and the degree of hyperglycemia. No significant correlation was observed in patients having normal glucose levels or slightly high glucose levels over the period of 4 weeks. Lens abnormalities have been suggested as a cause of refraction error in diabetic patients[10-14]. Excess glucose in the lens is converted to sorbitol during hyperglycemia. Sorbitol is poorly permeable and accumulates in the lens. When blood glucose reduces, the difference in osmotic pressure results in the influx of water from the aqueous humour into the lens, causing lenticular swelling . However, an increase in lens thickness would promote myopic changes through increase of refractive power, which seems to be contradictory with the observation of hyperopic changes when plasma glucose reduces[3,4,7]. The hypothesis is that lens cortex hydration following the influx of water from the aqueous humour results in the decrease of refractive power, which might be involved in the development of transient hyperopic change. Overall, a transient hyperopic change occurred in diabetic patients during glycemic control. The degree of hyperopia is highly dependent on the BSL level before treatment and the rate of plasma glucose reduction over the 4 weeks treatment. It might be the mechanism that lens cortex hydration results in the decrease of refractive power, not that the morphology of lens changes[3,4,8,10,12,13,17,18]. Our results were in consistent with most of the researches so far.

## CONCLUSIONS

In diabetic patients refraction is affected by blood glucose levels. Particularly diabetic patients with high blood glucose levels showed hyperopic changes over the period of 4 weeks.

We recommend that eyeglasses should not be prescribed for 4 weeks in patients who are newly diagnosed with diabetes mellitus.

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