Hyperglycemia Induced Refractive Error, When to Prescribe Spectacles

Rakesh Sharma[1], Gursimran Kaur[2], Nidhi Tiwari[3],

ABSTRACT

Introduction: Refractive changes in hyperglycemia are known to occur so blood sugar estimation should be done in patients over 40 yrs age having frequent change in glasses number especially in diabetics. Present research aimed to study refractive error produced by hyperglycemic state and also to find out number of days such patient need to wait for stabilization in the refractive index of crystalline lens for final prescription of glasses number after attaining normal blood sugar levels.

Material and methods: During March to Aug 2016, in Mayo institute of medical sciences, we enrolled 52 eyes of 26 patients with complaints of blurring of vision and deranged blood sugar levels i.e. F>150 mg/dl and PP>250 mg/dl, there was no cataract or minimal cataract present in our cases in this prospective study. Patients with type 2 DM on oral hypoglycemic drugs were enrolled, no age restriction were applied. All the patients underwent standard refraction under cycloplegia (itrop plus e/d) by shin Nippon automated refractomeater. Axial length, keratometry, were evaluated by Sonomed pac scan plus. Patients were followed up weekly for changes in Autoref reading, keratometry and axial length.

Results: Our study population of 26 patients comprised of 20 males and 6 females.Mean age of patients was 50.5 years (range 41 yrs to 60 yrs).comparing the refractive status by autoref reading on enrollment and after 1 week or as soon as they achieved normal blood sugar levels. 12 patients (24 eyes) 45% showed hypermetropic shift range (+ 1.5±0.6 D). 14 patients (28 eyes) 55% did not show any significant change in the variants evaluated.

Conclusion: Long term hyperglycemia produces hypermetropic shift in diabetic patients. It takes approx 30 days±6 days after achieving glycemic control for the lens to attain refractive stability so it is best to defer refraction for this period, so that glasses work for longer duration.

Keywords: Hyperglycemia, Glucose, lens, refractive error

INTRODUCTION

Metabolism in lens is such that it maintains its transparency, synthesis of new lens fibers and repair of its tissues occurs smoothly. Glucose in lens enters from aqueous by diffusion (along concentration gradient) and facilitated diffusion, because of low oxygen concentration in the lens majority of energy production is by anaerobic glycolysis.

During hyperglycemia[1,2] sorbitol pathway becomes more active than glycolysis thus causing various reversible[3,4] or irreversible changes in the lens structures. These changes are especially important when refractive examination of patients is being done. It has been observed in various studies that suggested that the predominant cause of the refractive changes in hyperglycemia is a change in its refractive index of lens[5,6] due to alteration in the metabolism and accumulation of sorbitol[7] and water in the lens. This study aimed at estimating the duration ophthalmologist should wait after achievement of normal blood sugar levels for prescription of the spectacle numbers

MATERIAL AND METHODS

This prospective study was conducted during march to July 2016, in Mayo institute of medical sciences, We enrolled 52 eyes of 26 patients with deranged blood sugar levels i.e. F>150 mg/dl and PP>250 mg/dl, there was no cataract or minimal cataract present in our cases. All Patients with type 2 DM on oral hypoglycemic drugs with complaints of blurring of vision were enrolled, no age restriction were applied. All the patients underwent standard refraction under cycloplegia (tropicamide 1% with phenylephrine 10%) by shin Nippon automated refractomeater and fundus evaluation to rule out visual loss due to diabetic retinopathy.

Axial length, keratometry, were evaluated by Sonomed pac scan plus. Patients were followed up weekly for changes in Auto refractomeater reading, keratometry and axial length. Number of days to reach a stable refractive error reading on autoref after attaining normal blood sugar levels was also estimated. Weekly fasting and PP blood sugar levels were also estimated.

STATISTICAL ANALYSIS

Statistical analysis was done by calculating mean and SD of the days to achieve stable refractive error

RESULTS

Hyperglycemia causes alteration of lens metabolism there is accumulation of sorbitol and water in the substance of lens causing changes in the refractive index of the lens. The refractive index gradients in the normal lens have been studied in several ways but the most useful measurements appear to be those made using magnetic resonance imaging which shows a smooth increase in index from the lens surface to the center due to more compaction of lens fibers towards the center of lens. Age-dependence of the lenticular refractive index-gradients suggests that changes in refraction can also be age related.

Our study enrolled 26 case (52 eyes) for the study the subjects were 41 to 60 years of age, as after this age significant cataract also occurs. 20 were males and 6 were females.

Range of refractive error at the time of enrollment was -2 to+2.5 D spherical and -1.5 to+1.25 cylindrical. 12 patient (24 eyes) showed a hypermetropic shift (46%) in the range of (+1.5±0.6).

[1]Associate Professor, [2]Assistant Professor, [3]Senior Resident, Mayo Institute of Medical Sciences, Barabanki, U.P, India

Corresponding author: Dr Rakesh Sharma, H. no 592/115 D Rajeev Nagar, Telibagh, Lucknow 226025, U.P, India

How to cite this article: Rakesh Sharma, Gursimran Kaur, Nidhi Tiwari. Hyperglycemia induced refractive error, when to prescribe spectacles. International Journal of Contemporary Medical Research 2016;3(11):3303-3305.

S. No	Autoref 1st day	Ar 1st week	Ar 2nd week	Ar 3rd week	Ar 4th week	Ar 5th week	Days to ref stablity
1	+2.5/+0.75	+2.0/+0.75	+1.75/+0.50	+2.0/+0.50	+1.5/+0.50	+1.5/+0.50	28 days
2	+1,75/0.25	+1.50	+1.50	+1.50	1.25	+1.25	28 days
3	+1.0/+1.0	1.0/1.0	0.75/0.75	0.75/0.50	0.50/.50	0.50/.50	28days
4	+2.5/+1.25	+1.75/+1.0	+1.75/+0.50	+1.5/+0.50	+1.5/+0.50	+1.5/+0.50	21days
5	+1.25	+1.25	1.0	0.75	0.75	0.75	21 days
6	+2.50/+0.50	+2.0/+0.50	+2.25/+0.50	+2.25	1.50	+1.0	28 days
7	+1.0/+1.0	+1.0/+1.0	+0.50/0.50	+0.50/+0.25	+0.50	+0.50	28 days
8	+0.50 /0.25	+0.25	00	00	00	00	14 days
9	1.25/0.50	0.75/0.50	0.75	0.75	0.50	0.50	28 days
10	+1.50	0.75	0.75	0.50	0.50	0.50	21days
11	0.75 cyl	0.75 cyl	0.75 cyl	0.50 cyl	0.50 cyl	0.50 cyl	21 days
12	+1.0/+0.75	0.50/0.50	0.50/0.25	0.50/0.25	0.50/0.25	absent	14 days
	In myopes						
13	-2.0/0.75	-1.25/0.50	-1.25/0.50	-1.0/0.50	1.00/0.50	1.00/0.50	28 days
14	-1.75/-1.0	-1.25/0.50	-1.25/0.50	-0.75/0.50	0.50/0.50	0.50/0.50	28 days
15	-0.75/-0.25	-0.50/-.50	-0.50	-0.50	-0.50	-0.50	14 days
16	-1.50/-1.50	-1.0/-1.25	-1.0/0.75	-1.25/0.75	-1.0/0.75	-1.0/0.75	28 days
Average =24 days							

Table-1: Refractive error of patients on enrollment and subsequent visits

4 patients (8 eyes) showed myopic shift in the range of (-1.00 ±0.50). 10 patients did not show any correlation and significant refractive changes.

There was no significant change in axial length and keratometric values during the study. Initiation of adequate drug treatment resulted in normalization of hyperglycemia. It took 24±7 days for the refractive shift to stabilize following normal blood sugar levels.

DISCUSSION

Changes in the shape and refractive index of the lens have been assumed to play a important role in refractive changes in diabetes. Therefore, in the present study, the refractive error of the diabetic eye, as well as the shape of the cornea and axial length of eye were measured during the presence of symptoms of blurred vision and hyperglycemia in order to explain the mechanisms underlying blurred vision in patients with DM and hyperglycemia. It was seen that amount of hyperopia is proportionate to the increase in blood glucose levels. It could be hypothesized that longer phases of elevated blood glucose levels resulted in higher glucose levels in the aqueous humour and is necessary to induce formation of higher sorbitol levels in the lens which could then cause tissue swelling. Therefore, it may be that, in the present study, a higher and more prolonged blood glucose level was needed to induce a larger amount of Refractive Error. Although several previous studies have hypothesized that DM affects the refractive index of the lens, we too found evidence in the present study of changes in the equivalent refractive index caused by hyperglycemia.

Mwale C et al. reported 1–3 D of hyperopia in 23 diabetes patients with acute hyperglycaemia, but no changes in lens thickness measured with ultrasound biometry.[8] Moreover, Li HY et al. found hyperopia of a maximum of 3.8 D, with no changes in lens thickness.[9] Finally, Tai et al reported hyperopia of a maximum of 2 D, but could not determine any change in ocular tissues.[10]

I In majority of the cases (46%) there was a hyper metropic shift present which was contributed in majority by change in refractive index of lens as axial length and keratometric measures did not show any significant changes during the study, So, it takes approximately 24±7 days for the lens to retain its refractive status after attaining normal blood sugar levels therefore the refractive correction of patients should be delayed by 24±7 days post normalization of blood sugar.

CONCLUSION

We observed significant though short lived changes in refractive error, but no changes in the geometry of the cornea (keratometry) and axial length were found in the present study. This is in agreement with the results of several other studies, in which no changes were found in ocular biometry.

REFERENCES

1. Lin SF, Lin PK, Chang FL, et a1. Transient hyperopia after intensive treatment of hyperglycemia in newly diagnosed diabetes Ophthalmologica. 2009;223:68-71.
2. Okamoto F, Sone H, Nonoyama et al. Refractive changes in diabetic patients during intensive glycaemic contro1. Br J Ophthalmol. 2000;84:1097-1102.
3. Saito Y, Ohmi G, Kinoshita S, et al. Transient hyperopia with ChinJInternMed, October2010, Vo1. 49, No. 10 lens swelling at initial therapy in diabetes. BrJ Ophthalmol. 1993;77:145-148.
4. Sonmez B, Bozkurt B, Atmaca A, et al. Efect of glycemic control on refractive changes in diabetic patients wi th hyperglycemia Cornea. 2005;24:531-537.
5. Giustic Transient hyperopic refractive changes in newly diagnosed juvenile diabetes. SwissMedWkly. 2003; 133:200-205.
6. Wiemer NG, Dubbelman M, Kostense PJ, et a1. The influence of diabetes mellitus type 1 and 2 on the thickness, shape, and equivalent refractive index of the human crystalline lens. Ophthalmology. 2008;115:1679-1686.
7. Kinoshita JH, Merola LO, Satoh K et a1. Osmotic changes caused by the accumulation of dulcitol in the lenses of rats fed with galactose. Nature. 1962;194:1085-1087.
8. Mwale C, Karimurio J, Njuguna M. Refractive errors in type 2 diabetic patients. East Afr Med J. 2007;84:259-63.

9. Li HY, Luo GC, Guo J, Liang Z. Zhonghua Nei Ke Za Zhi. The effects of glycemic control on ophthalmic refraction in diabetic patients. 2010;49:855-8.
10. Rani PK, Raman R, Rachapalli SR, Kulothungan V, Kumaramanickavel G, Sharma T. Prevalence of refractive errors and associated risk factors in subjects with type 2 diabetes mellitus. Ophthalmology. 2010;117:1155-62.

Source of Support: Nil; **Conflict of Interest:** None

Submitted: 16-10-2016; **Published online**: 03-12-2016