

Association of Ocular Biometric Parameters in Type 2 Diabetes Mellitus Patients with Diabetic Retinopathy at a Tertiary Care Hospital in Rajasthan: A Prospective Observational Study

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Conflict of interest: Nil

Abstract

Background: Diabetic retinopathy causes loss of visual acuity associated with longer duration & poorly controlled diabetes. Still there is no single consensus on its pathogenesis. This study is aimed to evaluate the association of ocular biometric parameters in Type 2 diabetes mellitus patients with diabetic retinopathy at a tertiary care hospital in Rajasthan.

Material & Methods: This prospective observational study recruited 140 patients in the age range of 30-80 yrs who came to the outpatient department of our Hospital with diagnosis of type 2 diabetes mellitus from March 2022 to September 2022. Study group (n=70) included type 2 diabetes mellitus with diabetic retinopathy while control group (n=70) included patients with no diabetic retinopathy. All patients underwent complete ocular examination involving Best Corrected Visual Acuity using an Autorefractometer. Fundus examination was done using a +90 diopter lens. All the Refractive errors were grouped as Myopia, Hypermetropia or Emmetropia (on the basis of Spherical equivalent). Individual eyes of patients in both the groups fulfilling the inclusion criteria were assessed. Axial length (AL), corneal curvature (CC) and anterior chamber depth (ACD) were measured using an optical biometer and three readings were measured and average reading was put to statistical analysis. Diabetic retinopathy was graded into mild, moderate, severe and proliferative.

Results: The baseline characteristics were comparable with no statistically significant difference. The HbA1C levels were statistically significant higher in study group (11.03 ± 1.42) than in control group (8.4 ± 2.85) ($p < 0.05$). There was statistically significant higher duration of diabetic years in study group (15.42 ± 6.25). Mean spherical equivalent, mean axial length, mean Anterior chamber depth & mean Corneal curvatures in patients with Myopia, Emmetropia, Hypermetropia were not statistically significant in the two groups (p -value > 0.05). The difference in spherical equivalent with respect to severity of retinopathy was non-significant ($p > 0.05$). The mean AL showed a progressive decrease with increase in DR severity. The mean anterior chamber depth decreased significantly with the increasing severity of DR which was found to be statistically significant (p value < 0.05).

Conclusion: No association between spherical equivalent and corneal curvature noted with the diabetic retinopathy. Longer Axial length and anterior chamber depth noted in control group & with milder diabetic retinopathy, thus seem to have a protective influence in developing progressive forms of the disease.

Keywords: Ocular Biometric, Type 2 Diabetes Mellitus, Diabetic Retinopathy, Spherical Equivalent.

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Introduction

Diabetes mellitus is a major metabolic disorder accounting for more than 90% of all diabetics. Diabetics are 25 times more likely to have progressive loss of vision. [1] Diabetic retinopathy (DR) poses a heavy financial & social burden on the community. Without a check on its incidence, DR may affect more than 190 million by 2030 with loss of vision loss to 56 million. [2] DR is a major microvascular complication in diabetic patients with significant macular edema.

Pierro L et al 1999 have suggested myopia to have a protective effect on DR. [3] Two components are involved in myopia i.e. structural (Axial length (AL) and Anterior chamber depth (ACD) & refractive (Corneal curvature (CC) and Spherical equivalent (SE)). No complete consensus has been proved regarding the significant factor affecting the association of refractive errors and DR.[4] Miao He 2020 in a comprehensive review addressed AL to be of utmost importance.[5] Man RE 2012, showed deeper ACD & longer AL might be related to lesser grades to DR. Lack of awareness prevents diabetics from reaching ophthalmologists in early stages. [6]

A Singapore Indian Eye Study by Pan et al 2013 observed no association between refractive error and DR/VTDR.[7] Also a prospective cohort study by Man R et al concluded SE and refractive error status were not associated with DR onset or progression.[6]

Bazzazi N 2017, conducted a study on 116 individuals with anisometropia and concluded that with comparable variables of age, duration of diabetes, ethnicity etc., high myopia could delay the onset of DR & protective effect was significantly associated with higher myopia.[8] Jiang et al 2012 observed shallower ACD to be significantly associated with increased risk

for onset & progression of DR and macular edema. [9] In the Singapore Malay Eye Study every 1mm increase in ACD associated with a reduction in risk of middle DR and vitreous DR by 68% and 86%, respectively. [7]

Thus this prospective observational study was designed to assess the association of ocular biometric parameters in Type 2 diabetes mellitus patients with diabetic retinopathy at a tertiary care hospital in Rajasthan.

Material & Methods

This prospective observational study recruited 140 patients in the age range of 30-80 yrs who came to the outpatient department of our Hospital with diagnosis of type 2 diabetes mellitus from March 2022 to September 2022. 70 patients having type 2 diabetes mellitus with DR constituted the study group. 70 patients having no DR constituted the control group.

Patients with comorbid illnesses, mental illness, history of coronary artery bypass graft, thrombolytic therapy and renal transplant, any history of ocular surgeries, retinal laser, intraocular injection, macular edema, glaucoma surgery, cataract surgery or laser myopia surgery, abnormal refractive media (severe cataract, corneal ulcer, pterygium or corneal turbidity), poor fixation & conditions affecting fundus image quality were excluded. The study protocol was approved by the institutional ethical committee & written informed consent taken from all patients.

All patients underwent complete ocular examination involving Best Corrected Visual Acuity using an Autorefractometer. Spherical equivalent was defined as the sum of sphere and half negative cylinder. Fundus examination was done using a +90 diopter lens.

All the Refractive errors were grouped as Myopia, Hypermetropia or Emmetropia (on the basis of Spherical equivalent):

Myopia S.E. ≤ -0.5 D

Emmetropia SE > -0.5 to $< +1.00$ D

Hypermetropia S.E. $\geq +1.00$ D

Individual eyes of patients in both the groups fulfilling the inclusion criteria were assessed. AL, CC and ACD were measured using an optical biometer. Three readings of AL, ACD & CC were measured and average reading was put to statistical analysis.

DR was graded into mild, moderate, severe and proliferative (according to the International Clinical Diabetic Retinopathy Disease Severity Scale).[10]

Statistical analysis

The tabulated data was statistical analyzed using SPSS version 22.0 for Windows (IBM Corp, India). Quantitative data are presented as mean \pm SD or proportions.

Intergroup comparisons were made using Student's paired *t*-test. P-value 0.05 at 90% confidence interval was considered to be statistically significant. Values were expressed as numbers (n) and percentage(%).

Results

In the present study, the baseline characteristics were comparable with no statistically significant difference. The mean age of study group was 56.87 ± 6.34 yrs while in control group it was 55.22 ± 8.65 yrs ($p > 0.05$). Among 140 eyes of 70 patients in study group, 55 had mild non-progressive diabetic retinopathy (NPDR), 5 had moderate NPDR, severe NPDR and 17 had Progressive DR (PDR). The HbA1C levels (%) (mean \pm SD) were statistically significant higher in study group (11.03 ± 1.42) than in control group (8.4 ± 2.85) ($p < 0.05$). There was statistically significant higher duration of diabetic years in study group (15.42 ± 6.25) as compared to control group (8.71 ± 7.47).

Table 1:

Spherical equivalent (mean \pm SD)	Study Group	Control Group	P value
Myopia	-1.43 ± 1.07	-1.21 ± 0.94	> 0.05
Emmetropia	0.35 ± 0.36	0.23 ± 0.34	> 0.05
Hypermetropia	1.68 ± 0.54	1.73 ± 0.64	> 0.05
Axial length (mean \pm SD)	22.67 ± 0.78	23.17 ± 0.89	> 0.05
Anterior chamber depth (mean \pm SD)	3.01 ± 0.39	3.09 ± 0.37	> 0.05
Corneal curvature (average k) (d)	44.28 ± 1.29	44.23 ± 1.31	> 0.05

Table 2:

Spherical equivalent	Mild NPDR	Moderate NPDR	Severe NPDR	PDR	P value
Myopia	-1.41 ± 1.15	-1.75 ± 1.21	-1.14 ± 0.62	-1.24 ± 0.61	> 0.05
Emmetropia	0.27 ± 0.31	0.43 ± 0.28	0.38 ± 0.36	0.39 ± 0.39	> 0.05
Hypermetropia	1.51 ± 0.45	2.12 ± 0.78	1.53 ± 0.34	1.6 ± 0.57	> 0.05
Axial length (mean \pm SD)	23.21 ± 0.79	23.08 ± 0.89	22.46 ± 0.68	21.21 ± 0.9	< 0.05
Anterior chamber depth (mean \pm SD)	3.13 ± 0.42	3.05 ± 0.36	2.91 ± 0.30	2.89 ± 0.5	< 0.05
Corneal curvature (average k) (d)	44.31 ± 1.45	44.28 ± 1.24	44.49 ± 1.45	44.17 ± 1.39	> 0.05

In the present study, mean spherical equivalent in patients with Myopia, Emmetropia, Hypermetropia were not statistically significant in the two groups p value > 0.05 . Also, the mean AL, mean

ACD & mean CC were not statistically significant in the two groups p value > 0.05 . (Table 1)

The mean spherical equivalent was comparable in all the grades of diabetic

retinopathy. The difference in spherical equivalent with respect to severity of retinopathy was non-significant ($p > 0.05$). The mean AL in the mild NPDR was comparable to mean AL in control group. The mean AL showed a progressive decrease with increase in DR severity. (Table 2) The mean ACD decreased significantly with the increasing severity of DR which was found to be statistically significant (p value < 0.05). No statistically significant difference in CC was observed between different grades of DR (p value > 0.05). (Table 2)

Discussion

In the present study, the baseline characteristics were comparable with no statistically significant difference. The mean age of study group was 56.87 ± 6.34 yrs while in control group it was 55.22 ± 8.65 yrs ($p > 0.05$). Among 140 eyes of 70 patients in study group, 55 had mild NPDR, 5 had moderate NPDR, severe NPDR and 17 had PDR. The HbA1C levels & duration of diabetic years were statistically significant higher in study group than in control group ($p < 0.05$). Similar results were noted by Utaal et al 2020 study, Raman R et al 2009 & Xie XW et al 2008. This supports the fact that longer duration of uncontrolled diabetes results in DR.

In the present study, mean spherical equivalent in patients with Myopia, Emmetropia, Hypermetropia were not statistically significant in the two groups (p value > 0.05). (Table 1) Similar findings were observed in Utaal et al 2020 study. [11] Bazzazi N et al 2017 stated myopia to have a protective effect against DR. [8]

In the present study, the mean spherical equivalent was comparable in all the grades of diabetic retinopathy. The difference in spherical equivalent with respect to severity of retinopathy was non-significant ($p > 0.05$) (Table 2). Lim LS et al 2010 concluded patients with myopia having longer AL & deeper ACD were

least likely to develop DR but was unsure if these relations were with respect to axial myopia or SE. Thus SE is not likely to be significant variable in development and progression of DR. [12]

Also, the difference in the mean AL, mean ACD & mean CC were not statistically significant in the two groups (p value > 0.05). (Table 1). Similar results noted by Utaal et al 2020. [11] This can be explained as majority of the patients in study group were with mild NPDR (55/70).

The mean AL in the mild NPDR was comparable to mean AL in control group. The mean AL showed a progressive decrease with increase in DR severity. (p value < 0.05) (Table 2) Similarly Utaal et al. 2020 reported a progressive reduction in the mean AL with increasing severity of DR. [11] Previous literature has reported several mechanisms explaining the protective effects of elongated axis. An increase in AL causes a decrease in blood flow, with resultant reduction in leakage of blood components acting as proliferants. Also, a reduction in retinal function is seen in the outer retina in longer AL eyes with reduced metabolic demand & decreased production of inflammatory cytokines. Also, posterior vitreous detachment promotes neovascular proliferation & improved oxygen diffusion across the liquefied vitreous. [13]

The mean ACD decreased significantly with the increasing severity of DR which was found to be statistically significant (p value < 0.05). Thus, increased depth of ACD was negatively correlated with increasing grades of DR. The results are in accordance with Utaal et al. [11], Lim LS 2010 [12].

No statistically significant difference in Corneal curvature was observed between different grades of DR (p value > 0.05). (Table 2) Similar results were noted by Utaal et al 2020 [11] & Man RE 2012. [6, 14]

Conclusion

Thus the present study concludes no association of spherical equivalent and corneal curvature with the onset & progression of diabetic retinopathy. Axial length and anterior chamber depth seem to offer protection against progression to the severe forms of diabetic retinopathy.

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