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A STUDY OF MACULAR THICKNESS USING OCT IN DIABETIC PATIENTS WITH AND WITHOUT DIABETIC RETINOPATHY

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ABSTRACT

Background Diabetes mellitus is one of the leading causes of blindness[1]. Diabetic retinopathy is the most common ocular complication of diabetes with 5% of diabetics progressing to severe visual loss of 5/200 or less[2].Macular oedema is one of the important signs in patients with diabetic retinopathy which progresses to complete blindness. Therefore, early diagnosis of the disease can prevent the progression of disease.

Objective The purpose of this study is to evaluate and compare the thickness of the macula in diabetic patients with and without diabetic retinopathy using optical coherence tomography (OCT)

Methods 100 Patients with diabetes presenting to the Department of Ophthalmology, Regional Eye Hospital, Kurnool from june 2017 to june 2018 were included in the study. Patients were divided into 4 groups: Controls(NDM), Diabetics without retinopathy(NDR),Nonproliferative diabetic retinopathy(NPDR) and Proliferative diabetic retinopathy(PDR).A written and informed consent was taken from all the patients. Full ophthalmological evaluation was done and the fast macular OCT scan was done that divides the macula into 9 sectors. The mean ± standard deviation of macular thicknesses by area were analyzed and compared.

Results The average macular thickness in the present study is 278.46µm and it is statistically significant across the groups. The macular thickness is increased in both NPDR and PDR groups 290.24±42.69 µm, 305.96±40.49 µm respectively. The increase in thickness may be due to associated CSME.

Conclusion Macular thickness was significantly more ($p<0.01$) in the PDR group when compared to NDM group, NPDR group to NDR group and PDR group to NDR group. It was not statistically significant in NDM group versus NDR group, NDM group versus NPDR group and NPDR group versus the PDR group

KEYWORDS : Diabetes, Diabetic Retinopathy,macular Thickness, Ocular Coherence Tomography

INTRODUCTION

Diabetes mellitus results in considerable morbidity and mortality affecting about 180 million people worldwide. Diabetic retinopathy (DR) is a major complication of diabetes and the leading cause of decreased vision in working-age people.[3]

The vascular disruption of DR is characterized by abnormal vascular flow, disruption in permeability and closure or non-perfusion of capillaries. Microvascular leakage and microvascular occlusion are the two main pathological processes leading to the changes in DR. The earliest change seen in diabetes before the development of retinopathy is the breakdown of the blood retinal barrier (BRB). Aldose reductase present in the pericytes alters the cellular metabolism, resulting in the loss of pericytes. This disrupts the autoregulation and leads to the breakdown of BRB and leakage of plasma.Loss of pericytes also leads to saccular outpouching of the capillary walls known as microaneurysms. These microaneurysms tend to gradually enlarge, thickening and hyalinization of the walls take place, which eventually leads to auto occlusion by the encroachment of the thickened wall into the lumen. Other factors responsible for microvascular occlusion are capillary endothelial cell damage and proliferation; change in red blood cells leading to defective oxygen transport and increased stickiness and aggregation of platelets.

A new non-invasive imaging modality Optical Coherence Tomography (OCT) has been used in the diagnosis and treatment of a variety of macular diseases. This technique shows strong correlation between central foveal thickness and visual acuity. OCT is used to quantitatively measure macular thickness for diagnosis and management of macular oedema and also to detect subclinical macular thickening in Diabetic Retinopathy.

The principle of ocular imaging with OCT is based upon measuring the time delay of the light reflected from each optical interference (A-scan) when a pencil of light enters the eye. A series of A-scans across the structure permits a cross-sectional construction of a plane through the anterior or posterior segment of the eye. OCT uses low coherence interferometry in which the light source is split between that entering the eye and a reference path. A broad bandwidth near infra-red light beam (820nm) is projected on to the retina. The light gets reflected from the boundaries between the microstructures and also gets scattered differently from with different optical properties.

The Zeiss OCT 3 can make from 128 to 768 axial samples (A-scans) in a single "scan pass". Each A-scan has 1024 data points and is 2mm long (deep). When all the A-scans are combined into one image, the image has a resolving power of about 10µ vertically and 20µ horizontally.

METHODS

The present study was a prospective observational study conducted on patients coming to the Department of Ophthalmology, Regional Eye Hospital, Kurnool from june 2017 to June 2018.

Inclusion criteria –Patients with diabetes mellitus.(Diabetes mellitus was diagnosed on the basis of the diabetes diagnostic criteria of the World Health Organization[4]),Age > 40 years

Exclusion Criteria –Recent ocular surgery (1month),Patients <40years of age, Thyroid dysfunction,Long-term steroid users,High myopia,Media opacities like cataract,Diabetic retinopathy with tractional retinal detachment post retinal retinal surgery patients.

In this study patients were divided into 4 groups:

- Controls (normal patients without Diabetes)-25 patients (50 eyes)
- Diabetics without retinopathy (NDR group)-25 patients (50 eyes)
- Nonproliferative diabetic retinopathy (NPDR group)- 25 patients (50 eyes)
- Proliferative diabetic retinopathy (PDR group)- 25 patients (50 eyes)

The subjects were informed about the study. Demographic data was recorded for each subject as per protocol. All cases underwent complete ophthalmological examination including best corrected visual acuity, anterior segment examination and posterior segment examination was performed using a +90 dioptre lens. OCT scanning was performed using Zeiss Cirrus HD – OCT 500. Macular thickness

measurements were obtained after pupil dilatation using tropicamide 1% and phenylephrine hydrochloride 2.5%. The OCT software generated a topographical map of the macula as defined by the Early Treatment of Diabetic Retinopathy Study (ETDRS). Foveal or central macular thickness is defined as the average thickness in the central 1 mm diameter. The fovea was measured thrice and average was calculated.

Data observed in the study are analyzed using computer software. The statistical analysis was done as follows: First, the descriptive statistics were computed. Range, mean and standard deviation (SD) were estimated for quantitative variables. One – way ANOVA was done to evaluate the correlation of the diabetic groups and controls with the variables included in the study, like nerve fiber layer thickness, macular thickness, best corrected visual acuity. Statistical significance was considered whenever $p<0.05$.

RESULTS

In our study, the mean age of subjects in four groups i.e., in control group was 62 ± 9.71 years, in no diabetic retinopathy group was 60.6 ± 9.94 years, in nonproliferative diabetic retinopathy group was 60.92 ± 10.09 years, in proliferative diabetic retinopathy group was 60.8 ± 10.44 years.

The mean duration of diabetes in patients belonging to no diabetic retinopathy group was 10.48 ± 5.29 years, in patients belonging to nonproliferative diabetic retinopathy group was 10.52 ± 4.83 years, in patients belonging to proliferative diabetic retinopathy group was 12.32 ± 4.94 years.

In our study best corrected visual acuity in no diabetes mellitus group is 0.84(0.21), in no diabetic retinopathy group is 0.83(0.24), in nonproliferative diabetic retinopathy group is 0.62(0.29) and in proliferative diabetic retinopathy group is 0.48(0.29).

In our study, the mean macular thickness in patients belonging to control group was 267.86 ±17.39µm, in patients belonging to no diabetic retinopathy group was 249.76 ± 28.94µm, in patients belonging to nonproliferative diabetic retinopathy group was 290.24± 42.69µm, in patients belonging to proliferative diabetic retinopathy group was 305.96 ±40.49µm.

Table 1: Age distribution

Age	NDR	NPDR	PDR	CONTROL	
41- 50	3	3	5	4	15
51- 60	9	9	7	6	31
61 – 70	9	6	7	10	32
>70	4	7	6	5	22
TOTAL	25	25	25	25	100

Table 2: Gender distribution

Gender	NDR	NPDR	PDR	CONTROL	
Males	13	15	16	12	56
Females	12	10	9	13	44
	25	25	25	25	100

Table 3: Best corrected visual acuity

Group	Mean±SD	F value	Significance
NDM	0.84(0.21)	22.474	<0.001
NDR	0.83(0.24)		
NPDR	0.62(0.29)		
PDR	0.48(0.29)		

Table4: Macular thickness across groups

Group	Mean ± SD	F value	Significance
NDM	267.86 (17.39)	26.70	<0.001
NDR	249.76 (28.94)		
NPDR	290.24 (42.69)		
PDR	305.96 (40.49)		

Table 5:Between-group comparison of macular thickness

Group	Comparison between groups	Mean difference	P value
NDM	NDR	18.1	0.048
	NPDR	22.38	0.07
	PDR	38.10	<0.001
NDR	NPDR	40.48	<0.001
	PDR	56.20	<0.001
NPDR	PDR	15.72	0.127

DISCUSSION

The average macular thickness in our study is 278.46 micrometers and it is statistically significant across the groups. The paired comparison of macular thickness in no diabetes mellitus (NDM) group and proliferative diabetic retinopathy (PDR) group was statistically significant ($p<0.001$) i.e. macular thickness is increased in PDR group compared to NDM group. The paired comparison of macular thickness in no diabetic retinopathy (NDR) group and nonproliferative diabetic retinopathy (NPDR) group was statistically significant ($p<0.001$) i.e. macular thickness is increased in NPDR group compared to NDR group. The paired comparison of macular thickness in No diabetic retinopathy (NDR) group and proliferative diabetic retinopathy (PDR) group was statistically significant ($p<0.001$) i.e. macular thickness is increased in PDR group compared to NDR group. The macular thickness is increased in both PDR group (305.96+ 40.49 micrometers) and NPDR group (290.24 + 2.69 micrometers). The increase in thickness is due to associated CSME.

Hee MR et al[5] have reported similar results, finding differences in central foveal thickness between normal eyes and eyes with diabetic retinopathy and no significant differences in average thickness between eyes with nonproliferative and proliferative diabetic retinopathy. However, they did not compare diabetic eyes with no diabetic retinopathy (NDR) with normal eyes in healthy control subjects.

In the study conducted by **Mohammad A.M. El-Hifnawy et al.**, the macular thickness in all quadrants in the diabetic patients, whether with NPDR or without retinopathy, was not statistically significantly different from the control group except for the superior quadrant where the macular thickness in the diabetic patients without DR was significantly less than that of the control group. The macular thickness in patients with NPDR was significantly more than that of the diabetic patients without retinopathy in all quadrants, which may indicate subclinical and sub-OCT macular edema. [6]

Conclusion

Optical coherence tomography has emerged as a useful imaging technique by providing new high-resolution cross-sectional information about various pathological features of the macula. Optical coherence tomography allows us to quantify retinal thickness in diabetic retinopathy with excellent reproducibility. OCT is able to detect sight threatening macular edema with great reliability.

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