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Original Research Article

Correlation between Visual Acuity and Central Macular Thickness in Various Optical Coherence Tomography Patterns of Diabetic Macular Edema: An Observational Study.

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Abstract:

Aim: To study the incidence of different patterns of diabetic macular edema and their association with visual acuity and central macular thickness using optical coherence tomography (OCT).

Method:144 eyes of 72 patients with type 2 diabetes were enrolled in the study seen between May 2023 and October 2023. Best corrected visual acuity, anterior segment examination, indirect ophthalmoscopy, slit lamp biomicroscopy, Optical Coherence Tomography (OCT) and central macular thickness (CMT) were assessed. Diabetic macular edema (DME) was classified based on OCT scans into:spongiform edema, cystoid macular edema (CME), subretinal fluid, vitreomacular traction and taut posterior hyaloid.

Results: In this observational study,144 eyes of 72 eyes with type 2 diabetes were enrolled. Spongiform edema was most common type found (41.7% in right eye) and (30.6%in left eye) followed by cystoid macular edema (23.6% in right eye) and (12.5% in left eye), while the subretinal fluid was present in (4.2% in right eye and 2.8% in left eye) and vitreomacular traction (2.8% in right eye).

Conclusion: Spongiform edema was the most common morphological subtype of DME patterns when compared with cystoid macular edema.cystoid macular edema showed increased macular thickness correlated with reduced visual acuity.

Keywords: Diabetic Macular Edema, Optical Coherence Tomography, Visual Acuity, Central Macular Thickness.

Introduction

Diabetes is a complex metabolic illness defined by chronic hyperglycemia, which causes microvascular and macrovascular problems. Diabetes can be classified into two types: immune mediated (type 1) and non-immune mediated (type 2) [1]. Globally, type 2 diabetes (T2D) is on an epidemic scale. According to data from the International Diabetes Federation, there are currently 537 million individuals (20–79 years old) with diabetes. According to the study, the number of people with diabetes is expected to rise from 643 million in 2030 to 783 million by 2045 [2]. According to the World Health Organization (WHO), diabetes mellitus leads to damage to the vasculature of heart, eyes, kidneys, and nerves [3].The burden of diabetes in India estimates in 2019 showed that 77million individuals had diabetes in India, which is expected to rise to over 134 million by 2045[21].Type 2 diabetes mellitus leads to ocular complications such as diabetic retinopathy and diabetic macular edema [4].

Diabetic macular edema (DME) is characterized by thickening of the retina brought on by intraretinal fluid accumulation, primarily affecting the inner and outer plexiform layers [5]. DME is caused by a disruption of the inner blood-retinal barrier, formed by the retinal vascular endothelium, due to hyperglycemia and increased levels of growth factors, inflammation, and cytokines [5]. Patients may complain of loss of color vision, poor night vision, and washing out of vision in bright sunlight with poor dark-light adaptation. DME prevalence ranges from 1.4% to 5.57% in type 2 diabetics [6]. There are different diagnostic methods that can be used for DME, such as optical coherence

tomography, stereoscopic fundus photography, or slit-lamp biomicroscopy [7].

OCT aids in understanding DME anatomy and intraretinal damage by performing micrometer-resolution, cross-sectional imaging of the retina and providing high-resolution, noninvasive tomograms of the human retina [8]. OCT is used in diagnosis, monitoring the response and progression of diabetic retinopathy. OCT has widely been applied in measurements of central macular thickness(CMT). OCT is used for classification of the morphological patterns of DME.OCT facilitated the identification of several OCT-based DME patterns that includes;spongiform edema, cystoid macular edema and the presence of subretinal fluid [9].

Materials and Methods

This study was conducted at a medical college hospital in South India, after the approval from the Institutional Ethics Committee. The study design was an observational study.

144 eyes of 72 patients who are diagnosed with Type 2 Diabetes Mellitus for more than a decade were enrolled in this study. The inclusion Criteria for the participants were as follows: 1) Patients of Type 2 Diabetes Mellitus. 2) Age more than 40. 3) Diabetic patients with any level of Diabetic retinopathy. The exclusion criteria for participants are as follows: 1) Presence of any anterior segment pathology. 2) Patients with previous history of any form of treatment taken for diabetic retinopathy. 3) Presence of any other posterior segment pathology affecting visual acuity. 4) Patients with advance cataractous changes. Written informed consent was taken before recruiting the patients for the study.

The demographic details, past history of diabetes mellitus and treatment history of diabetes were obtained from each participant. Best corrected visual acuity, indirect opthalmoscopy, slit lamp biomicroscopy, OCT were done in all participants. Snellen visual acuities were converted into the LogMAR scale. For each patient, the CMT was measured using a high definition spectral domain-Optical Coherence Tomography (SD-OCT). Prior to the examination, the pupils were dilated. To measure the thicknesses of the macula the examiner obtained retinal images by performing 512 × 128 scan pattern where a 6 × 6-mm area on the retina is scanned with 128 horizontal lines, each consisting of 512 A-scans per line within a scan time of 2.4 seconds. CMT in all four quadrants: superior, nasal, inferior and temporal, as well as mean were recorded. Internal fixation was used to ensure proper alignment of the eye. Only scans with signal strength of at least six were accepted.

Presence of CME was shown by the presence of oval and round parts of the image indicating low reflectivity. Subretinal fluid was identified by dome like fluid accumulation in the subretinal space. Spongiform edema is shown by diffused retinal thickening.

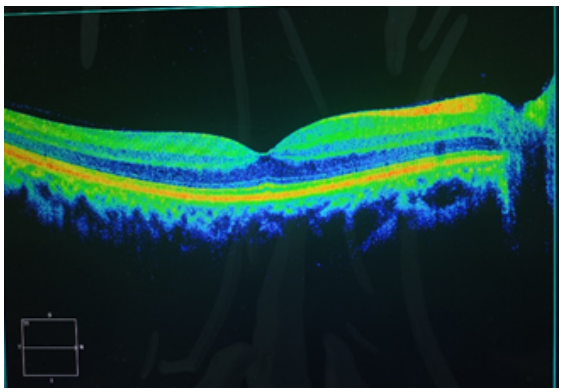


Figure 1: Normal

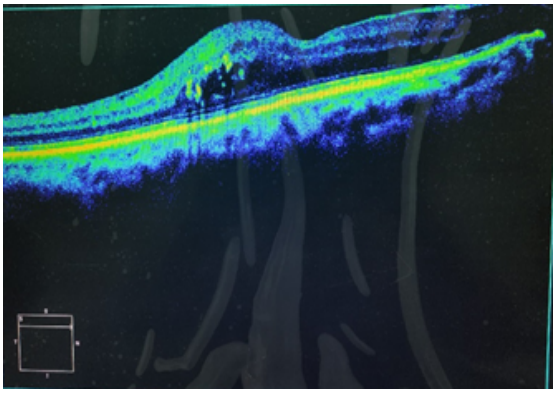


Figure 2: Spongiform edema

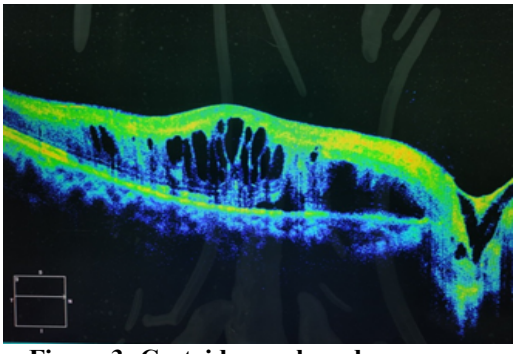


Figure 3: Cystoid macular edema

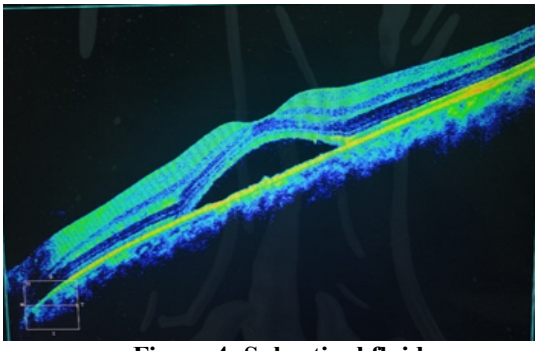


Figure 4: Subretinal fluid

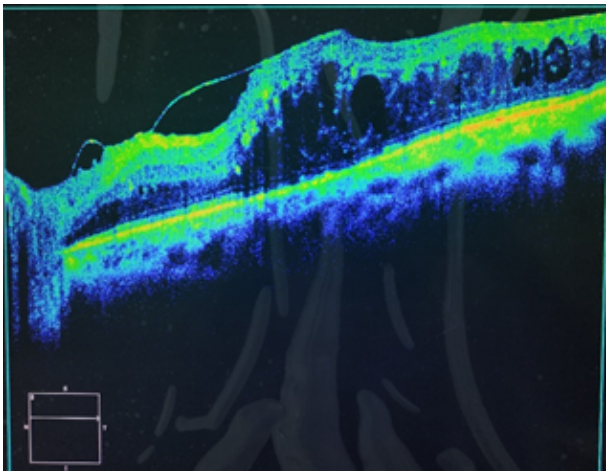


Figure 5: Vitreomacular traction

Statistical Analysis: The data were expressed as mean ±SD, and compared by one way ANOVA for multiple OCT patterns of DME. The data were expressed by n(%),and correlation were performed using pearson correlation method. p<0.05 was considered statistically significant.

Results

The study included 72 diabetic patients (144 eyes), 28 females and 44 males with average age 63.36+8.43(ranging from 44-80).

Table 1: Shows Gender distribution

Gender	n (%)	Mean (SD)	Median (IQR)	Min	Max
Female	28(38.9)	64.79(8.23)	67.5 (59-70)	48	78
Male	44(61.1)	62.45(8.52)	62.5 (55-70)	44	80
Total	72 (100)	63.36(8.43)	65 (57-70)	44	80

Table 2: OCT scan displayed 4 main morphological patterns namely; spongiform edema, cystoid macular edema, subretinal fluid, vitreomacular traction

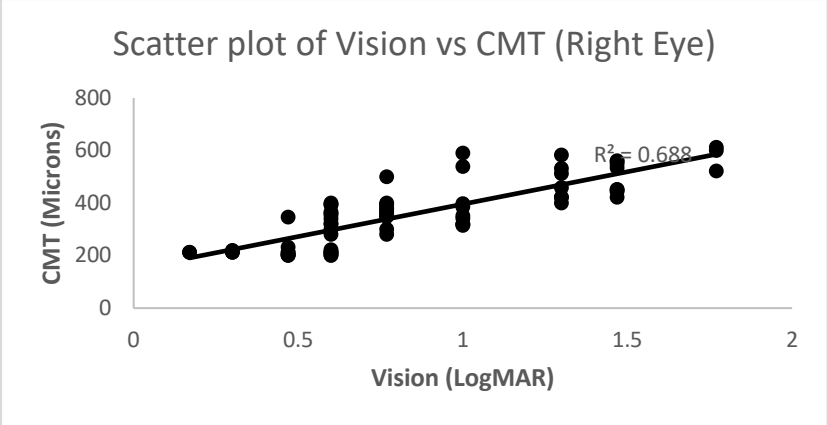
	Right eye(%)	Left Eye(%)
Normal	20 (27.8)	39 (54.2)
Cystoid macular edema	17 (23.6)	9 (12.5)
Spongiform edema	30 (41.7)	22 (30.6)
Subretinal fluid	3 (4.2)	2 (2.8)
Vitreomacular traction	2 (2.8)	0 (0)
Total	72 (100)	72 (100)

Table 3: Shows the visual acuity of both eye in OCT patterns of DME

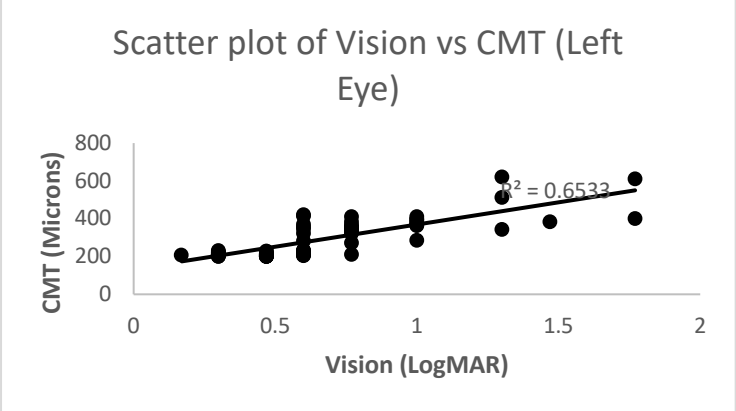
OCT patterns of DME	RE LogMAR vision Mean (SD)	LE LogMAR vision Mean (SD)	One way ANOVA
Normal	0.47 (0.15)	0.42 (0.12)	P<0.05
Cystoid macular edema	1.44 (0.2)	1.18 (0.46)	
Spongiform edema	0.76 (0.16)	0.79 (0.15)	
Subretinal fluid	0.79 (0.2)	1.15 (0.21)	
Vitreomacular traction	1.39 (0.12)	-	

Table 4: Shows CMT(Central macular thickness) of both eye in OCT patterns of DME

OCT patterns of DME	RE CMT Microns Mean (SD)	LE CMT Microns Mean (SD)	One way ANOVA
Normal	218 (33.2)	211.87 (9.83)	P<0.05
Cystoid macular edema	508.47 (71.82)	465.33 (93.21)	
Spongiform edema	352.97 (36.51)	340.05 (44.16)	
Subretinal fluid	467.33 (93.39)	361.5 (27.58)	
Vitreomacular traction	491.5 (55.86)	-	



Graph 1: Shows the scatter plot of vision and central macular thickness in Right eye



Graph 2: Shows the scatter plot of vision and central macular thickness in left eye

Discussion

Diabetic macular edema is the most frequent cause of vision loss among the diabetic population and it is more prevalent among insulin dependent type 2 diabetes mellitus. Macular edema is clinically detected by slit lamp biomicroscopy. The ETDRS (Early treatment diabetic retinopathy study) classified macular edema by its severity. It was defined as clinically significant macular edema (CSME) if any of the following features were present:1)thickening of the retina at or within 500 micron of the center of macula. 2) Hard exudates at or within 500 micron of the center of macula if associated with thickening of the adjacent retina. 3) A zone of retinal thickening one disc area or larger any part of which is within one disc diameter of the center of the macula [10].

The identification of the morphological pattern of DME is essential in predicting the evolution of the disease and its response to treatment. OCT is a noninvasive, rapid and repeatable tool for obtaining high resolution cross-sectional images of the retina

In our study we have found that 27.8% in right eye and 54.2% in left eye had normal OCT findings. we have found four patterns of diabetic macular edema. In our study spongiform edema was most common type found (41.7% in right eye) and (30.6%in left eye) followed by cystoid macular edema (23.6% in right eye) and (12.5% in left eye),while the subretinal fluid was present in (4.2% in right eye and 2.8% in left eye) and vitreomacular traction (2.8% in right eye)

In the Alkuraya H et al study(1995),the spongy edema was the most common (45.4%),followed by the cystoid edema (29.0%),serous retinal detachment (21.8%) and vitreofoveal traction (3.6%) patterns [11]. In a study done by otani T et al (1999), spongy edema was the most common pattern found in 88% of the patient [12]. Kim et al have reported spongy retinal thickening in 97%,cystoid macular edema in 55%, serous retinal detachment in 7%, VMT in 13% of eyes with diabetic macular edema [13].

This study also found that visual acuity varied with different DME patterns. All DME OCT patterns showed significant positive correlations with visual acuity in LogMAR with P-value <0.005. Patients with cystoid macular edema had less vision. Visual acuity is correlated linearly with central macular thickness. It is also found that the central macular thickness increases with the different types of OCT presentations, being least for spongy thickening and highest for cystoid macular edema and visual loss correlate with these changes. Increased retinal thickness is correlated with reduced visual acuity.

[14-18] Vascular changes associated with diabetes can be detected by OCTA even before the appearance of clinically visible diabetic retinopathy. OCTA can also identify foveal avascular zone parameters which have been correlated with severity of diabetic retinopathy. However in our study we could not asses by OCTA and FFA for localizing the focal leaks which would help in further management. [19-21]

Conclusion

OCT is a non-invasive tool to measure retinal thickness and other aspects associated with diabetic macular edema. OCT may assist in patient selection with diabetic maculopathy who can benefit from treatment, identify what treatment is indicated in different morphological patterns of DME and allow precise monitoring of treatment response. In patients with DME, OCT can be successfully utilized as an objective monitoring technique of the macular thickening before and after treatment.

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