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Correlation Between Visual Acuity And Optical Coherence Tomography Macular Parameters In Controlled Type II Diabetic Patients

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ABSTRACT

Background: Diabetes Mellitus (DM) is a chronic metabolic disease with considerable morbidity and mortality. Diabetic retinopathy (DR) and diabetic macular edema (DME) are major complications of DM and are the principal cause of vision loss among the working age group in developed countries. Optical coherence tomography (OCT) uses low-coherence interferometry to provide noncontact and noninvasive optical biopsy of the tissue morphology of the retina, making it a useful tool for detecting and managing DME.

Aim of the Work: To study the effect of controlled type II DM on visual acuity (VA) and macular changes by OCT. In addition, to correlate VA to macular parameters detected on OCT retinal examination.

Patients and Methods: This is a retrospective case control study that included 30 eyes of 22 controlled type II diabetic patients (group1) and 30 eyes of 19, age and sex matched healthy subjects (group 2). All diabetic patients were diagnosed as DME using OCT parameters. Correlation between central foveal thickness (CFT) and VA was done.

Results: There were statistically significant differences in UCVA & BCVA between the 2 groups. The difference in the central foveal thickness (CFT) from ETDRS map of OCT between the 2 groups was statistically significant. There were statistically significant differences between CFT from ETDRS map and both UCVA & BCVA. Statistically significant differences were detected between CFT and both FBS and 2HPP levels. Furthermore, statistically significant differences were detected between BCVA and both FBS and RBS levels.

Conclusion: Based on the data in our study, results pose a recommendation of regular follow up of three blood sugar-assessing parameters (FBS, 2HPP and RBS) and referring patients to ophthalmologists if abnormal values were detected.

Recommendations: Using large sample size will give more valid results. In our study, we evaluated the structure of the fovea, further studies can evaluate structure using OCT and function by electrophysiology. OCT angiography also could be useful in scanning retinal vasculature.

Keywords: Diabetic macular edema (DME), visual acuity(VA), optical coherence tomography(OCT).

INTRODUCTION

DM is a chronic metabolic disease with considerable morbidity and mortality[(1)].

DR and cataract represent the leading cause of visual impairment and vision loss in adults younger than 75 years[(2)].

Visual impairment due to DR and DME has an impact on patients' quality of life[(3)].

The Diabetic Retinopathy Study (DRS) and the Early Treatment Diabetic Retinopathy Study (ETDRS) classified DR into: non-proliferative diabetic retinopathy (NPDR) {mild, moderate, severe and very severe} and proliferative diabetic retinopathy (PDR) {low risk, high risk and advanced PDR}. DME may be developed with both types of DR [(4)].

Clinically significant macular edema (CSME) was first used in the ETDRS and is defined as any of the following: a. Thickening of the retina within 500 μm of the fovea. b. Hard exudates within 500 μm of the fovea with adjacent retinal thickening. c. Thickening of the retina at least 1 disc area in size that extends to within 1 DD of the fovea[(4,5)].

Optical coherence tomography is used to diagnose DME, enabling better understanding of the mechanisms of disease and managing it[(6)].

AIM OF THE WORK

To study the effect of controlled type II DM on visual acuity (VA) and macular changes by OCT and to correlate VA to macular parameters detected on OCT retinal examination.

PATIENTS AND METHODS

This was a retrospective case control study that included 34 eyes of 22 controlled type II diabetic patients (group1) and 31 eyes of 19, age and sex matched healthy subjects (group 2),all diabetic patients were diagnosed as DME using OCT parameters. **The study was approved by the Ethics Board of Ain Shams University.**

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Inclusion criteria: Controlled type II DM patients. Patients with diffuse macular edema. Foveal thickness > 300 microns.

Exclusion criteria: Any ocular pathology detected on slit lamp examination of the fundus other than diabetic changes. Any systemic diseases other than type II DM. Uncontrolled DM. Patients with amblyopic eyes.

All participants underwent the following procedures:

1. History taking: Full ophthalmic history of ocular trauma or any previous ocular procedures. Systemic history was taken from the included patients.

2. Ophthalmological examination: Uncorrected visual acuity (UCVA) and best corrected visual acuity (BCVA): using Landolt Broken rings and converted to the logarithm of the minimum angle of resolution (Log MAR). Intraocular pressure (IOP) measurement using Goldmann applanation tonometer. Slit lamp examination to exclude any anterior segment pathology. Fundus examination with dilatation using cyclopentolate 1%, which was done by indirect ophthalmoscopy and the 3-mirror Goldman contact lens.

3. Ophthalmological and blood sugar investigations: Optical coherence tomography (OCT). Blood sugar investigations (Fasting blood sugar (FBS), Post prandial blood sugar (2HPP), Haemoglobin A1c (HbA1c), Random blood sugar (RBS)).

4. Statistical Methods: Statistical presentation and analysis of the present study was conducted using the mean, standard deviation, student t- test, Chi-square and linear correlation coefficient tests by SPSS software package version 17.

Student t-test [Unpaired]: Unpaired Student T-test was used to compare between two groups in quantitative data.

Chi-square: The hypothesis that the row and column variables are independent, without indicating strength or direction of the relationship. Pears on chi-square and likelihood-ratio chi-square.

Fisher's exact test and Yates': Corrected chi-square are computed for 2x2 tables.

Linear Correlation Coefficient [r]: Linear correlation coefficient was used for detection of correlation between two quantitative variables in one group: P-value > 0.05 Non-significant. P-value ≤ 0.05 Significant. P-value < 0.01 Highly Significant.

RESULTS

Thirty eyes of 22 controlled type II diabetic patients (group 1) and 30 eyes of 19 ages, and sex matched, healthy subjects (group 2) were included in the study.

Regarding age, gender and laterality between the 2 groups, no statistically significant differences were detected.

Laboratory investigations:-

Regarding the laboratory findings of HbA1c, FBS, 2HPP and RBS; the differences between the 2 groups were statistically insignificant, denoting that the patients' blood sugar level was controlled as mentioned in the study protocol.

Ocular examination:-

UCVA & BCVA:-

There were statistically significant differences in UCVA & BCVA between the 2 groups; as shown in tables (1) & (2).

Table (1): P-value of UCVA.

UCVA+ Log Mar	Groups		T-Test	
	Group 1	Group 2	t	P-value
Range	1-2	0-0.78	13.741	<0.001*
Mean ± SD	1.283 ± 0.301	0.280 ± 0.263		

+= Uncorrected visual acuity.

Table (2): P-value of BCVA.

BCVA+ Log Mar	Groups		T-Test	
	Group 1	Group 2	t	P-value
Range	0.6-2	0-0	18.426	<0.001*
Mean ± SD	1.254 ± 0.373	0 ± 0		

+ = Best corrected visual acuity.

IOP and slit lamp examination:-

There were no pathological findings detected in all the recruited cohorts.

Fundus examination:-

There were 6 diabetic patients with NPDR (20%) and 24 with PDR (80%). Also all healthy persons had a normal healthy fundus.

OCT findings:-

The difference in the central foveal thickness (CFT) from ETDRS OCT map of OCT between the 2 groups was statistically significant as shown in table (3).

Table (3): CFT from ETDRS map of OCT.

CFT+ from ETDRS++ map of OCT+++	Groups		T-Test	
	Group 1	Group 2	t	P-value
Range	331-671	208-257	12.449	<0.001*
Mean ± SD	440.100 ± 92.908	226.600 ± 13.868		

+ = central foveal thickness, ++ = Early treatment diabetic retinopathy study, +++ = Optical coherence tomography.

There were statistically significant differences between CFT from ETDRS map and both UCVA & BCVA as shown in table (4).

Table (4): Correlation between CFT and UCVA & BCVA.

Correlations				
	CFT from ETDRS map of OCT		UCVA Log Mar	
	r	P-value	r	P-value
UCVA Log Mar	0.783	<0.001*		
BCVA+ Log Mar	0.707	<0.001*	0.866	<0.001*

+ = Best corrected visual acuity.

Statistically significant differences were detected between CFT and both FBS and 2HPP levels. However, no statistically significant differences were detected with other blood sugar parameters, as shown in table (5).

Statistically significant differences were detected between BCVA and both FBS and RBS levels. however, no statistically significant differences were detected with other blood sugar parameters as shown in table (5).

Table (5): Correlation between CFT, BCVA and duration of DM& all blood sugar parameters.

	CFT from ETDRS map of OCT		BCVA Log Mar	
	r	P-value	r	P-value
HBA1C	0.121	0.525	-0.045	0.814
FBS	0.589	0.001*	0.454	0.012*
2HPP	0.413	0.023*	0.319	0.085
RBS	0.294	0.115	0.396	0.030*

DISCUSSION

DR is the most frequently occurring microvascular complication of diabetes and, in many diabetic patients it is a leading cause of blindness[7,8].

When diabetic changes affect the CFT of the macula causing DME, this leads to affection of VA, which may affect patient`s quality of life[9,10].

The most sensitive parameter related to DME is accurate measurement of macular thickness using OCT[11,12].

Previous studies indicated several degrees of correlation between OCT-measured retinal thickness and VA[12,13,14].

Our retrospective case control study aimed to detect the correlation between the VA and CFT of ETDRS map as well as assessment of the correlation between both CFT and BCVA with blood sugar parameters.

Laboratory findings showed no statistically significant differences between the 2 groups, denoting that the patients' blood sugar level was controlled as mentioned in the study protocol.

Statistically significant differences were found in UCVA and BCVA between the 2 groups (p=<0.001 for both of them) denoting affection of VA of group 1. This is in accordance with the study of ***Nathan et al.*** [15], **Elner *et al.*** [16] and **Quillen *et al.*** [17].

Moreover, statistically significant differences were found in CFT values between the 2 groups indicating affection of the central part of the macula between the 2 groups with decrease in VA. This is in agreement with **Ahmadpour-Baghdadabad et al.** [18], **Alasil et al.** [19], Shrestha **et al.** [20], Zaidi [21] and **Hannouche et al.** [22].

On the other hand, studies were contradictory to our results as Otani et al. (2010)[23] study reported a weak negative correlation between BCVA and CFT (Spearman's r =-0.23; P< 0.01) and this was attributed to their exclusion of cases with marked ME in their study.

There is a partial agreement of our results with ***Yang et al.*** study[24].

The correlation between CFT and blood sugar parameters showed statistically insignificant differences of HbA1c and RBS. Contrarily, there were statistically significant differences between CFT and both FBS and 2HPP. Furthermore, positive correlation was detected between BCVA and both FBS and RBS.

We detected no correlation of HbA1c with both CFT and BCVA, this is in contradiction with **Chou et al.** study[25].

Our results pose a recommendation of regular follow up of the three blood sugar-assessing parameters (FBS, 2HPP and RBS) and referring patients to ophthalmologists if abnormal values are detected. To our knowledge, this is the first study to detect a correlation between CFT and parameters other than HbA1c.

CONCLUSION

Based on the data in our study, results posed a recommendation of regular follow up of three blood sugar-assessing parameters (FBS, 2HPP, RBS) and referring patients to ophthalmologists if abnormal values are detected.

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