EN FACE IMAGE BASED CLASSIFICATION OF DIABETIC MACULAR EDEMA USING SPECTRAL DOMAIN OPTICAL COHERENCE TOMOGRAPHY

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Introduction

Diabetic macular edema (DME) is the most common cause of visual loss in patients with diabetic retinopathy (DR). It is characterized by fluid accumulation and retinal thickening and can occur at any stage of DR To date, various classifications have been used to assess disease progression in patients with DME. In recent years, classifications based on the pattern of retinal thickening on B-scan images have been used, and these include diffuse retinal thickening, cystoid macular edema, and subretinal fluid (SF) The spectral domain OCT (SD-OCT), which contains algorithm called split spectrum technology, has enabled the acquisition of high-resolution, three dimensional (3D) images of the retinal structure. By using en face images constructed from the 3D images, the changes in the retinal structure can be visualized at an arbitrary retinal depth from a bird's-eye view. For example, investigated epiretinal membrane (ERM) using en face imaging and revealed significant associations of the distribution of ERM and the depth of retinal folds due to retinal traction by ERM with visual functions.

Aim of the work

The aim of the study was to utilize en face imaging to simultaneously evaluate the pattern of the fluid in DME patients and to propose a classification based on these findings.

Patients

This cross sectional study was conducted at Alexandria Main University Hospital between June 2023 and December 2023. Forty eyes of diabetic patients were enrolled from those attending the Ophthalmology Outpatient Clinic, Faculty of Medicine, Alexandria University.

Inclusion Criteria:

Eyes with clinically significant macular edema on clinical examination

Exclusion Criteria

History of intravitreal anti-VEGF or steroid injection.

History of macular laser treatment or pan-retinal laser photocoagulation.

History of vitrectomy.

Recent history of cataract surgery within the last 6 months

History of other diseases that may cause macular edema, such as retinal vein occlusion.

Media opacity that prevents reliable OCT imaging scans.

High myopia (<− 6 D of spherical correction), and glaucoma.

Bad OCT signal quality < 6/10

Methods

cross sectional study Patients enrolled in this study were subjected to

1) Full history taking including: • Age • Gender • Past ophthalmic history • Medical history • Surgical history • Presenting symptoms

Full ophthalmologic examination including:

Visual acuity (corrected and uncorrected).

Slit lamp bio-microscopy and fundus examination, to assess the anterior and posterior segment abnormalities.

OCTA examination utilizing en face scans for the macular area performed using Optovue Avanti® unit (Optovue, Inc., Fremont, CA, USA) :

Results

In total, 40 eyes of 40 patients with with clinically significant macular edema on clinical examination .

Best-corrected visual acuity (BCVA) was significantly different among the different types of DME (P = 0.001, Table (1), When we classified the eyes according to the presence or absence of fluid in Segment 1which mainly comprised the inner nuclear layer and the outer plexiform layer, including Henle's fiber layer and Segment 2 which icluded the outer nuclear layer. The BCVA of eyes with diffuse fluid in Segment 2 was significantly worse than that of eyes without fluid in Segment 2 (segment 1 only 0.33 ± 0.14 and segment 1 + segment 2 1.02 ± 0.24)

Table (1): Relation between classification of DME with VA (Log MAR)

	Total (n = 40)	Classification of DME		U	P
		Segment 1 (n = 25)	Segment 1 + Segment 2 (n = 15)		
VA (Log MAR)					
Min. – Max.	0.10 – 1.30	0.10 – 0.50	0.70 – 1.30	0.000*	<0.001*
Mean ± SD.	0.59 ± 0.38	0.33 ± 0.14	1.02 ± 0.24		
Median (IQR)	0.50 (0.25 – 1.0)	0.30 (0.20 – 0 .50)	1.0 (0.85 – 1.30)		

In accordance with the BCVA findings, the ellipsoid zone (EZ) disruption rate was significantly higher for eyes with fluid in Segment 2 (parafoveal cystoid space/ diffuse fluid, Diffuse fluid segment1/ Diffuse fluid segment2, and Diffuse fluid segment1/ Diffuse fluid segment2 + Subretinal fluid types) than for eyes without fluid in Segment 2 (Foveal cystoid space / No fluid and Parafoveal cystoid space / No fluid types; 93.3% and 0.00% respectively P < 0.001; Table 2, while the central subfield thickness (CST) was significantly greater in the former type (Parafoveal cystoid space / diffuse fluid, Diffuse fluid segment1/ Diffuse fluid segment2, and Diffuse fluid segment1/ Diffuse fluid segment2 + Subretinal fluid types) than in the latter type (foveal cystoid space / No fluid and Parafoveal cystoid space / No fluid types; 485.53 ± 145.73and 332.44 ± 74.61µm, respectively; P < 0.001

Table (2):Relation between classification of DME with Disruption of ellipsoid zone %

	Total (n = 40)		Classification of DME				χ^2	p
			Segment 1 (n = 25)		Segment 1 + Segment 2 (n = 15)			
	No.	%	No.	%	No.	%		
Disruption of ellipsoid zone %								
No	26	65.0	25	100.0	1	6.7	35.897*	<0.001*
Yes	14	35.0	0	0.0	14	93.3		

Conclusion

Based on the findings of this study, the following conclusions can be derived:

1-En-face images using spectral domain OCT (SD-OCT) is a useful tool for analyzing and quantifying pathological changes in DME.

2-Fluid accumulation in the ONL and the subretinal space is an important pathological change associated with reduced vision in DME.

3-Ischemia is a major factor that threatened vision in DME, and is correlated with decreased BCVA.