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Evaluation of diabetic changes in the retina in type I diabetes mellitus after 15 to 20 years of its diagnosis

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Abstract

Background: Diabetic retinopathy is differentiated into two main types. They are non-proliferative and proliferative diabetic retinopathy. The presence or absence of aberrant new blood vessels is the differentiating characteristic between these two groups (retinal or optic disc neovascularization). The ischemic retina secretes vascular endothelial growth factor (VEGF). We conducted a study to evaluate the diabetic changes in the retina in type 1 diabetes mellitus (T1DM) after 15 to 20 years of its diagnosis using Fundus Fluorescein Angiography & Optical Coherence Tomography Angiography & Optical Coherence Tomography. Methods: The study was designed as a retrospective cohort clinical study conducted on T1DM patients. Results & Conclusion: The most frequent FFA finding was Microaneurysms (51.7%), followed by Cystoid macular edema (CME) (24.1%), while the least frequent findings were an artifact, neovascularization elsewhere (NVE), and branch retinal vein occlusion (BRVO) (3.4% for each). The most frequent OCTA finding was mean FAZ($0.32\pm0.09mm^2$) while mean SVD(46.2±4.6%) while mean DVD (46.1±5.6%).The most frequent OCT finding was epi-retinal membrane (16.7%), followed by exudate (13.3%) and intraretinal cyst (10.0%), while the least frequent finding was parafoveal macular edema (3.3%).

Key words: diabetic changes in the retina - type I diabetes mellitus

1. Introduction

Diabetic retinopathy refers to retinal changes that occur in DM patients. These changes affect the small blood vessels of the retina and can lead to vision loss through several different pathways. It is associated with increased risk for uncontrolled glucose or blood pressure level.[1]

Type 1 diabetes mellitus (T1DM), commonly known as autoimmune diabetes, is a chronic condition characterized by insulin insufficiency and hyperglycemia owing to the death of pancreatic beta cells. Despite the fact that symptoms often appear during childhood or adolescence, they can sometimes appear much later. The pathophysiology of T1DM is believed to entail T cell-mediated death of beta cells, despite the fact that its etiology is not fully known. [2]

Diabetic macular edema (DME) is caused by persistent hyperglycemia, which is the leading risk factor for DME. Twenty percent of individuals with younger onset diabetes get DME during a 10-year period, compared to around forty percent of those with older onset diabetes. Its risk factors are DM duration and Poor control with chronically elevated glycosylated hemoglobin (HbA1c), Hypertension, Hyperlipidemia and Kidney disease. [3]

Macular area refers to the central retinal region between the main branches (superior and inferior arcades) of the central retinal arteries (central retinal artery and central retinal vein) in the eye. The retina beyond this point is referred to as the "peripheral retina." Diabetic retinopathy can manifest abnormalities in the central retina. These characteristics are found in both the non-proliferative and proliferative types of illness. [4]

Fluorescein angiography is used to determine the degree of ischemia or the presence of retinal vascular abnormalities. The areas of microaneurysms appear as hyperfluorescent spots and may leak on the late frames resulting in areas of retinal edema clinically. The areas of NVD/ NVE show leakage on the FA. [5]

Ocular coherence tomography (OCT) is useful to determine the retinal thickness measurements. The OCT can be sequentially obtained to determine whether the macular thickening is responding to therapy or not. [6]

Optical coherence tomography angiography (OCT-A) is a new diagnostic non-invasive method by which the vascular structures of the retina and choroid can be visualized three-dimensionally without need for using fluorescence dyes or mydriasis. The technology of OCT-A is an advancement of the OCT. By means of more powerful software and hardware used for OCT-A not only morphological but also retinal and choroidal vascular perfusion analyses can be performed. [7]

The aim of this work was to study the diabetic changes in the retina in T1DM after 15 to 20 years of its diagnosis using OCT & OCT-A & Fundus Fluorescein Angiography.

2. Patients and Methods

Research Design:

The study is designed as a retrospective cohort clinical study.

Study group:

15 T1DM Patients collected and prepared from diabetic clinic.

Time of study:

From 1/2021 to 11/2021

Research subjects:

Inclusion Criteria

- T1DM
- Duration from 15 to 20 years of its diagnosis
- Controlled by medical treatment (Insulin)
- Clear optical media [no corneal opacities-no cataract]

Exclusion Criteria

- T2DM
- Duration less than 15 years
- Presence of other systemic diseases may affect the retina (renal, Hypertension…. etc.)

All patients underwent:

1. History taking including:

- Age, Sex, diabetes duration and type, Past ocular history (disease, surgery, laser photocoagulation), Detailed visual complaints and other associated systemic disease

2. Ocular examination:

- Best corrected visual acuity (BCVA) by Snellen chart
- Anterior segment examination
- Measurement of intraocular pressure (IOP) by air puff (Topcon)
- Fundus examination with slit lamp bio microscopy with +90 lens and indirect ophthalmoscopy

3. Ocular investigation:

Were done in Benha University hospital – ophthalmology Department – Investigation Unit by FFA and OCT and OCTA.

A. FFA (Zies device)

- Eyes were dilated for FFA examination in all cases with 1% cyclopentolate (swixolate)
- Both eyes were imaged by FFA device after ingection of flurecien stain in the canula.

B. OCT (Topcon device)

- Eyes were dilated for OCT examination in all cases with 1% cyclopentolate (swixolate)
- Both eyes were imaged by OCT device

C. OCT angiography (OCTA) (Optovue device)

- Eyes were dilated for OCTA examination in all cases with 1% cyclopentolate (swixolate)
- Both eyes were imaged by OCTA device

Statistical methods

Using version 25 of SPSS, data management and statistical analysis were performed. (International Business Machines Corporation, Armonk, New York, United States) Means and standard deviations were used to summarize numerical data. As a summary of categorical data, figures and percentages were used. Using a one-sample t-test, the OCTA parameters of the examined patients were compared to the normal values. A two-tailed P-value below 0.05 was deemed statistically significant.

3. Results

The most frequent FFA finding was Microaneurysms (51.7%), followed by Cystoid macular edema (CME) (24.1%), while the least frequent findings were an artifact, neovascularization elsewhere (NVE), and branch retinal vein occlusion (BRVO) (3.4% for each) The OCTA mean FAZ was 0.32 ±0.09 mm2, while the mean SVD and DVD were 46.2 ±4.6% and 46.1 ±5.6%, respectively.

The most frequent OCT finding was epi-retinal membrane (16.7%), followed by exudate (13.3%) and intraretinal cyst (10.0%), while the least frequent finding was parafoveal macular edema (3.3%).

Table (1) FFA findings in the studied eyes

	n (%) *
Microaneurysms	15 (51.7)
CME	7 (24.1)
Exudate	3 (10.3)
FME	3 (10.3)
PRP	3 (10.3)
Dot hemorrhage	3 (10.3)
NVD	2 (6.9)
NVE	1 (3.4)
Artifact	1 (3.4)
BRVO	1 (3.4)

The patients mean FAZ was 0.32 ±0.09 mm2, while the mean SVD and DVD were 46.2 ±4.6% and 46.1 ±5.6%, respectively.

Table (2) OCTA findings in the studied eyes

FAZ (mm^2)	0.32 ±0.09
SVD (%)	46.2 ±4.6
DVD (%)	46.1 ±5.6

The patients had significantly higher FAZ (0.32 ±0.09 vs. 0.28 ±0.113, P = 0.017) and DVD (46.1 ±5.6 vs. 31.6 ±4.4, P < 0.001).

Table (3) OCTA parameters in the studied patients compared to normal values

	Patients	**Normal values**	**P-value**
FAZ (mm^2)	0.32 ±0.09	0.28 ±0.113	0.017*
DVD (%)	46.1 ±5.6	31.6 ±4.4	<0.001*
SVD (%)	46.2 ±4.6	47.8 ±2.8	0.075*

Data are presented as mean ±SD; * significant

The most frequent OCT finding was epi-retinal membrane (16.7%), followed by exudate (13.3%) and intraretinal cyst (10.0%), while the least frequent finding was parafoveal macular edema (3.3%).

Table (4) OCT findings in the studied eyes

	n (%)
Epiretinal membrane	5 (16.7)
Exudate	4 (13.3)
Intraretinal cyst	3 (10.0)
Abnormal foveal thickness	2 (6.7)
Sub-foveal neurosensory detachment	2 (6.7)
CME	2 (6.7)
Disorganization of retinal layer	2 (6.7)
Parafoveal macular edeme	1 (3.3)

CME: Cystoid macular edema

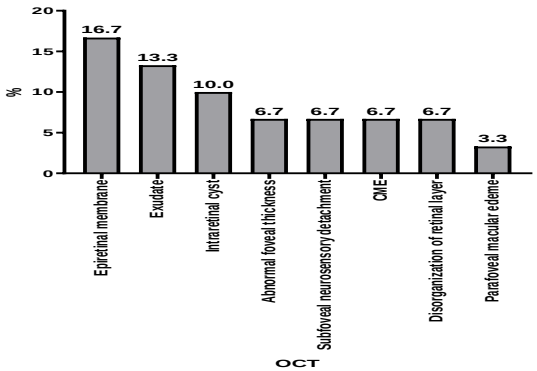

Fig. (1) OCT findings in the studied eyes

4. Discussion

In our study group we studied changes occurring in the retina in type 1 diabetes after 15 to 20 years of it's diagnosis & the first investigation done was FFA & the most common complication was Microaneurysms which was 51.7% of the studied cases While Cystoid macular edema was 24.1%. The most threatening complications were NVD & NVE by 6.9% & 3.4% respectively of the studied cases. Also Hard Exudate, Focal Macular Edema & Dot hemorrhage were 10.3%.while the least common complications was Branch Retinal Vein Occlusion which was 3.4%.

[8] found that Microaneurysms was 62.13% among their study group in type1 diabetes. Hard Exudate was 32.13% .As regard Focal Macular Edema it was 14.18% among their studied group. NVE was 4.9%. NVD was 0.15% among study group. Dot hemorrhage was 41.52%.

[9] found that Microaneurysms was 67.7% (p value<0.001) . Dot hemorrhage was 69.7% and this was significant (p value<0.001). Hard Exudate was 69.7% and this was significant (p value<0.001). Another study found that Hard Exudate was 84.62%. Dot hemorrhage was 61.54%. NVD was 0.00% among study group and 23.0% with Hypertention. NVE was 7.69%. Another study found that CME was 24.2% in mild or moderate in NPDR and was 13.9% in severe NPDR and was 17.1% in PDR and this was significant (p value= 0.016) and this result agree with our study.

[10] found that CME was 40%. As regard Focal Macular Edema they found that it was 50%.

[11] found that BRVO was 52% (13 eyes were affected from 25 eyes) among study group.

[12] found that capillary occlusion occur in 25% among study group by FFA in type1 diabetes{duration of diabetes was 1month-19 years}and this result disagree with our study. Hard Exudate was 18%. Dot hemorrhage was 25%.

OCTA in this study revealed that FAZ was 0.32±0.09 mm² & this was significant (p value=0.017). While SVD was 46.2±4.6% & this was significant (p value=0.075). while DVD was 46.1±5.6% & this was significant (p value<0.001).

[13] found that DVD was 57.0±3.3 % among study group and this was significant (P value<0.001). SVD was 49.8±4.2% among study group was insignificant (P value =0.143). FAZ was 0.040±0.15 mm² in DCP (P value=0.510) and in SCP was 0.26±0.12 mm² and this was insignificant (P value =0.821).

[14] found that FAZ was 0.29±0.09 mm² (p value =0.0234).

[15] found that SVD was 42.3% among study group (p value <0.001). DVD was 28.9% (p value <0.001).

In this study OCT revealed that the most serious complication distorting the central vision was Epiretinalmembrane.it was 16.7% followed by exudate which was 13.3%. while CME, Abnormal foveal thickness & subfoveal neurosensory detachment were 6.7%. Also intraretinal cyst was 10 %.While the least complication to occur was Para foveal macular edema by 3.3%.

[16] found that CME was 10.4% (P value= 0.5). Epiretinal membrane was 19.8% and this was insignificant (P value= 0.4). Hard Exudate was 46.8% (P value= 0.001).

[17] found that Hard Exudate was 29% (23 eyes of 78 eyes) among study group and this result disagree with our study. Abnormal foveal thickness was 100% (in all cases) of their study group (mean foveal thickness was 531±138 Mm) and this result was in disagreement with our study.

[18] found that Hard Exudate was 20.6% and this result disagree with our study. Abnormal foveal thickness they found that it was 12.3% among study group and this result disagree with our study.

[19] found that Intraretinal cyst among study group by OCT was 31.6% P value in study was significant (P value= 0.01) and this result was in contrast with our study .

[20] found that CME by OCT was 11.8% and this study was significant (p value<0.01) and this result disagree with our study.

[21] found that Parafoveal macular edema in OCT was 54.5% among study group & this was significant (P value< 0.001) and this result disagree with our study. Sub-foveal neurosensory detachment was 72% among study group (which

was done on 86 eyes and our study was on 29 eyes) and this was significant (P value< 0.01) and this result disagrees with our study.
[22] found that Subfoveal neurosensory detachment by OCT was 32.14% among study group and this result was in disagreement with our study.

5.Conclusion

The most frequent OCT & OCTA finding were epi-retinal membrane (16.7%), followed by exudate (13.3%) and intraretinal cyst (10.0%), while the least frequent finding was parafoveal macular edema (3.3%). The most frequent FFA finding was Microaneurysms (55.6%), followed by Cystoid macular edema (CME) (18.5%), while the least frequent findings were an artifact, neovascularization elsewhere (NVE), and branch retinal vein occlusion (BRVO) (3.7% for each).

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