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Original article:

Evaluation of total retinal thickness using optical coherence tomography in diabetic retinopathy

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ABSTRACT

Background: Diabetic retinopathy (DR), a microangiopathy affecting all of the small retinal vessels, & is characterized by increased vascular permeability, ocular haemorrhages, lipid exudate. The incidence of DR is related primarily to duration and control of diabetes and is related to hyperglycemia, hypertension, hyperlipidemia, pregnancy, nephropathy and anaemia.

Methodology: Study was conducted on patients coming to Ophthalmology OPD of tertiary eye care hospital, after taking institutional ethical clearance. A total of 150 eyes of 75 patients, coming to the Ophthalmology OPD of the tertiary eye care hospital, fulfilling the inclusion & exclusion criteria were included in the study & OCT imaging was performed .Total thickness at the level of fovea was measured.

Results: most common age group affected was between 61-70 years (46.67%) with the average age of the patients being 62.45 years out of 75 patients,53 patients (70.67%) were on treatment for diabetes mellitus, 22 patients (29.33%) patients were not on any treatment o had discontinued treatment for more than a year.

Key words- Diabetic retinopathy, retinal thickness, OCT macula

INTRODUCTION

The term Diabetes Mellitus describes a metabolic disorder of multiple etiology characterised by chronic hyperglycemia with disturbances of carbohydrate, fat and protein metabolism resulting from defects in insulin secretion, insulin action or both. 1 DM can leads to several ocular complications such as diabetic retinopathy, diabetic papillopathy, glaucoma cataract, and ocular surface diseases 2

Diabetic retinopathy (DR), a microangiopathy affecting all of the small retinal vessels, such as arterioles, capillaries and venules, is characterized by increased vascular permeability, ocular haemorrhages, lipid exudate, by vascular closure mediated by the development of new vessels on the retina and the posterior vitreous surface. The incidence of DR is related primarily to duration and control of diabetes and is related to hyperglycemia, hypertension, hyperlipidemia, pregnancy, nephropathy and anaemia.3 DR is an important complication of diabetes mellitus affecting the eye and in industrialized countries it is the leading cause of legal blindness among working age population.4 Broadly, DR can be divided into non-proliferative and proliferative DR, of which the latter is a more severe form of the disease.

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The patient with DR presents with symptoms of gradual, painless diminution of vision. In the initial stages of DR, the patient presents with floaters and painless diminution of vision. As the disease progresses and the retinopathy increases, severity of the symptoms increase and the patient may have sudden loss of vision due to the extreme complications of the disease. 4

Optical Coherence Tomography (OCT) is one such non invasive imaging technique which highlights the retinal sections with almost histological precision and has made it possible to deepend the DR study 4 It performs high resolution, cross sectional tomographic imaging of internal microstructure by measuring backscattered or back reflected light 5

OCT makes it possible to:

-Determine the cause of decrease in vision

-Provide a snapshot of the retinal situation at the moment and help in evaluation

-Assess the presence of retinal oedema and quantify it

-Measure the thickness of retina

-Compare the thickness of the retina and vision

-Decide the need for intervention

-Assess the efficacy of treatment -Postoperative follow up 4

AIM: To study the findings of total retinal thickness on Optical Coherence Tomography (OCT) in patients with Diabetic Retinopathy.

Primary objective:

To study the findings of total retinal thickness on Optical Coherence

Tomography in patients with Diabetic Retinopathy

Secondary Objective:

To study the relationship of stage of the disease with total retinal thickness and

visual acuity

MATERIALS & METHODS

METHODS: Study was conducted on patients coming to Ophthalmology OPD of the tertiary eye care hospital, after taking institutional ethical clearance.It is a hospital based Cross-Sectional Observational study.

A total of 150 eyes of 75 patients, coming to the Ophthalmology OPD of the tertiary eye care hospital, fulfilling the inclusion & exclusion criteria, OCT imaging was performed .Total thickness at the level of fovea was measured.

The study duration was from Nov 2015 to Nov 2017.

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Inclusion Criteria:

1. Diabetic patients above 18 years of age
2. Diabetic patients with Diabetic Retinopathy findings on Indirect ophthalmoscopy
3. Patients able to cooperate for OCT scans
4. Patients willing to participate in the study

Exclusion Criteria:

1. Significantly poor media clarity affecting vision of the patients
2. Patients with other coexisting retinal pathologies
3. Patients with Advanced Diabetic Retinopathy
4. Patients with prior retinal photocoagulation treatment
5. Patients with prior intravitreal injections treatment
6. Other pathologies affecting vision like pituitary lesions, demyelinating diseases, other debilitating diseases
7. Patients refusal to participate in the study

Ophthalmological Examination:

- Visual acuity by Snellen's chart ,vision with pin hole, BCVA.
- Slit lamp examination.
- Fundoscopic examination under mydriasis
- Fundus Photography
- OCT
- SD-OCT imaging was performed with pharmacological pupil dilatation with 1% tropicamide and 2.5% phenylephrine to obtain minimum pupillary diameter of 5mm.
  OCT macula scan of all patients was done. Total thickness at the level of fovea was measured.

MATERIALS REQUIRED

1. Fundus Examination by Indirect ophthalmoscope
2. Slit Lamp microscope
3. OCT
4. Fundus camera

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RESULTS

An observational cross sectional study carried out in a tertiary centre which included 150 eyes of 75 patients was carried out and the observations were as follows:

Table 1. Distribution of subjects based on Age.

Age group	Number of patients	Percentage
</= 50 years	**6**	**8**
51-60 years	**25**	**33.33**
61-70 years	**35**	**46.67**
>71 years	**9**	**12**
Total	**75**	**100**

In our study the most common age group affected was between **61-70 years (46.67%)** with the average age of the patients being **62.45 years**

Table 2. Distribution of subjects based on Gender

Gender	Number of patients	Percentage
Male	**45**	**60**
Female	**30**	**40**
Total	**75**	**100**

In our present study, out of **75 patients** with diabetic retinopathy fulfilling our criteria , 4**5** patients **(60%)** were males and 30 patients **(40%)** were females.

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Table 3. Distribution of subjects based on treatment for Diabetes Mellitus

On Treatment for diabetes mellitus	Number of patients	Percentage
Yes	53	70.67
No	22	29.33
Total	75	100

In the present study, 53 patients (**70.67%)** were on treatment for diabetes mellitus, 22 patients (**29.33%)** patients were not on any treatment or had discontinued treatment for more than a year.

Table 4. Distribution of subjects based on number of years of Diabetes Mellitus.

Number of years of Diabetes Mellitus	Number of patients	Percentage
</= 1 year	4	5.33
>1-5 years	14	18.67
>5-10 years	25	33.33

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>10 years	**32**	**42.67**
Total	**75**	**100**

Maximum patients with diabetic retinopathy had history of diabetes mellitus **>10 years (42.67%)** and least percentage **(5.33%)** with **< 1 year** duration.

Table 5. Distribution of subjects based on Best Corrected Visual Acuity (BCVA)
(150 eyes of 75 cases)

BCVA	Number of eyes	Percentage
6/6-6/24	**70**	**46.67**
<6/24-6/60	**36**	**24**
<6/60-4/60	**20**	**13.33**
<4/60	**24**	**16**
Total	**150**	**100**

Maximum number of eyes affected with Diabetic Retinopathy had BCVA in the range of **6/6-6/24 (n=70, 46.67%)**

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Table 6. Distribution of subjects based on stage of Diabetic Retinopathy (150 eyes of 75 cases)

Stage of Diabetic Retinopathy	Number of eyes	Percentage
Mild	40	26.67
Moderate	36	24
Severe	30	20
Very severe	20	13.33
Proliferative	6	4
Macular edema	18	12
Total	150	100

Maximum patients were in the category of **mild NPDR (n=40, 26.67%),** followed by **moderate NPDR (n=36, 24%) Proliferative DR** was least encountered among the categories (**n=6, 4%)**

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Table 7. Distribution of subjects based on retinal thickness

Retinal thickness (microns)	**Number of eyes**	**Percentage**
200-300	**76**	**50.67**
>300-400	**50**	**33.33**
>400	**24**	**16**
Total	**150**	**100**

Maximum number of eyes were in the category of 200-300 microns (50.67%)

Table 8. Distribution of subjects based on stage of the disease and retinal thickness

Stage of disease	Total number of eyes	Retinal thickness	Total number of eyes
Mild NPDR	40	200-300 microns	32
		300-400 microns	8
Moderate NPDR	36	200-300 microns	26
		300-400 microns	10
Severe NPDR	30	200-300 microns	18
		300-400 microns	12

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Very severe NPDR	20	300-400 microns	12
		>400 microns	8
PDR	6	300-400 microns	4
		>400 microns	2
Macular edema	18	300-400 microns	4
		>400 microns	14

Out of the 40 eyes presenting with mild DR, 32 had retinal thickness in the range of 200-300 microns and 8 eyes were in the range of 300-400 microns. Similarly, in moderate DR, 26 out of 36 eyes and in severe DR, 18 out of 30 were in the range of 200-300 microns. And 10 in moderate & 12 in severe D.R.were in the range of 300-400 microns respectively. In very severe DR, 12 out of 20, in proliferative DR, 4 out of 6 and in macular edema, 4 out of 18 presented in the range of 300-400 microns and 8 from very severe NPDR ,2 from PDR, & 14 from Macular edema were >400 microns respectively.

The correlation between the stage of the disease and retinal thickness shows an extremely significant correlation with p=0.0001

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Table 9. Distribution of subjects based on stage of the disease and BCVA

Stage of disease	Total number of eyes	BCVA	Total number of eyes
Mild NPDR	40	6/6-6/24	36
		<6/24-6/60	4
Moderate NPDR	36	6/6-6/24	20
		<6/24-6/60	16
Severe NPDR	30	6/6-6/24	14
		<6/24-6/60	16
Very severe NPDR	20	<6/60-4/60	16
		<4/60	4
PDR	6	<6/60-4/60	2
		<4/60	4
Macular edema	18	<6/60-4/60	2
		<4/60	16

In the 40 eyes presenting with mild NPDR, 36 eyes (90%) had BCVA in the range of 6/6-6/24. 4 eyes (10%) had BCVA in the range of <6/24 to 6/60. 36 eyes had moderate NPDR, out of which 20 eyes (55.6%) had BCVA in the range of 6/6-6/24. 16 eyes (44.4%) had BCVA in the range of <6/24 to 6/60. Of the 30 eyes with severe NPDR, 14 eyes (46.7%) had BCVA in the range of 6/6-6/24. 16 eyes (53.3%) had BCVA in the range of <6/24 to 6/60. Out of 20 eyes with very severe NPDR, 16 eyes (80%) had BCVA in the range of <6/60-4/60. 4 eyes (20%) had BCVA <4/60 6 eyes presented with PDR, of which 2 eyes had BCVA in the range of <6/60-4/60 and 4 eyes had BCVA <4/60 ; 18 eyes had Macular edema, of which, 2 eyes had BCVA in the range of <6/60-4/60. 16 eyes (88.89%) had BCVA <4/60.

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DISCUSSION

It is important to accurately identify eyes with early structural damage and administer preventive therapy before the development of vision loss. Recent studies with optical imaging systems have indicated that macular thickness may be valuable for early diagnosis and timely treatment of DR.8

In present study, we analyzed correlation of macular thickness in 150 eyes of 75 patients with Diabetic Retinopathy. The range of age distribution was between 32 to 78 years with the age group between 61 to 70 years being maximally affected (n=35, 46.67%) The average age of the affected patients was 62.45 years.

In our study, both groups were comparable with respect to gender distribution with slight predominance of male population (Males – 60% and 40%). In a study by Yilma Chisha et al 51.1% of the study subjects were male, which is similar to results in our study (60% male). In an Indian study by Salil Gadkari et al, the prevalence of male population presenting with diabetic retinopathy in India was found to be 61.2%.10

Our study presented with maximum patients with duration of diabetes mellitus >10 years (42.67%) followed by 33.33% with 5-10 years of duration of DM with an average duration of 8 years in patients presenting with Diabetic Retinopathy.

In a study by Jenchitr E et al, in NPDR, the retinopathy varied from 13.11 to 22.91% in personhaving diabetes for less than 10 years and up to 42.86% in those with diabetes for up to 20 years. In the PDR group, the prevalence was 2.15 to 2.42% in persons with diabetes for less than 10 years and up to 10.20% for those with diabetes for up to 20 years.11 Salil Gadkari et al concluded that the prevalence of DR was maximum in patients with more than 5 years duration of DM (35.12%) 10

In our study, mild NPDR was seen in 26.67% eyes, moderate NPDR in 24%, severe NPDR in 20%, very severe NPDR in 13.33%, Proliferative DR in 4% and macular edema in 6% eyes.

In a study by Sanchez-Tocino et al, out of the total 148 eyes examined, 45 eyes with no diabeti retinopathy, 54 with nonproliferative diabetic retinopathy without CSME (NPDR without CSME) and 21 eyes with proliferative diabetic retinopathy without CSME (PDR without CSME). Diabetic retinopathy with CSME (DR with CSME) was diagnosed in 28 eyes.8 In a study by Xie et al, prevalence of macular edema was 5.2% which is comparable to our study which shows 6%. 12

In our study, the retinal thickness at the level of macula was divided into 3 groups, with 50.67% eyes falling in the range of 200-300 microns, 33.33% within 300-400 microns and 16% showed more than 400 microns thickness at the level of macula.

In the investigation by Sanchez-Tocino et al, eyes with NPDR or PDR with CSME had greater macular thickness in all regions than that in normal eyes. There were no significant differences in average thickness in any area between NPDR and PDR without CSME. 8

A Study by Hee MR et al has found 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.13

Diabetic macular edema is responsible for most of the visual loss experienced by patients with diabetes as it remains the major cause of vision loss in the highly prevalent type 2 diabetes and is invariably present in patients with type 2 diabetes with PDR . 14

In a study by Salil Gadkari et al, 35.6% eyes with Diabetic Retinopathy had visual acuity less than 6/60.87 This is comparable to our study where around 30% eyes with DR had BCVA less than 6/60. 10 Also, in our study, around 46% eyes with DR had visual acuity better than 6/24. In the same study by Salil Gadkari et al, 23% eyes with DR had BCVA of or better than 6/18. Thus, the important message to be taken from these values is that vision may not be always hampered in clinically evident DR.10

Our study showed that there is an increase in the retinal thickness in eyes with diabetic retinopathy as compared to the normal values generally encountered.

Similarly, factors like duration of diabetes mellitus and stage of diabetic retinopathy were also found to be important in the visual loss associated with diabetic retinopathy.Our study also shows the co-relation of various factors playing role in diabetic retinopathy, study of which can be beneficial for early diagnosis and better management of the patients.

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