IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 22, Issue 3 Ser.18 (March. 2023), PP 18-23
www.iosrjournals.org

"Optical Coherence Tomography analysis of macula - Preoperative & postoperative diabetic patients undergoing cataract surgery".

Dr.Nand mohan[1], Dr.Ashok Kr.Meena[2], Dr.Jaishree Singh[3]
[1]*Resident (ophthalmology) govt. medical college Kota, India*
[2]*Sr.Professor HOD (Ophthalmology) Govt. medical college Kota, India*
[3]*Sr. Professor (Ophthalmology) Govt. medical college Kota Rajasthan, India.*

Abstract
Aim*: To assess the macular thickness changes after cataract surgery in diabetic patients using optical coherence tomography (OCT).*
Materials and methods*: In this Prospective study each diabetic patient Optical coherence tomography testing was performed within 1 week before surgery and at 4th and 12th week postoperative visits. Best-corrected visual acuity (BCVA) was recorded at each visit. Macular edema was defined as an increase of foveal thickness on OCT > 30% from preoperative baseline.*
Results: *The incidence of ME on OCT was 17.64% and progression of ME was 14.70%. Increase in foveal thickness was more Duration of diabetes ≥ 10 years, insulin dependence, risk factors like hypertension, HbA1c & level of diabetic retinopathy were associated with reduced visual improvement.*
Conclusion: *Post-operative change in macular thickness and visual outcomes depends significantly on the diabetic status, duration and retinopathy levels, and hypertension. A positive correlation was also found between change in macular thickness and HbA1C levels in diabetic patients.*
Keywords*: macular edema, OCT*

Date of Submission: 15-03-2023 Date of Acceptance: 31-03-2023

I. Introduction

Macular edema (ME) is one of the most common causes of visual loss after uncomplicated cataract surgery nowadays. A higher incidence of ME after cataract surgery is reported to occur in eyes with diabetic retinopathy (DR), and worsening of ME often occur after surgery in eyes with pre-operative diabetic macular edema (DME). Several studies made attempts to identify the risk factors of post-operative ME in diabetic eyes, though the exact cause of this phenomenon is still undetermined. Despite these efforts, the accurate prediction of post-operative macular status before surgery is still no easy task. However, with the availability of the optical coherence tomography (OCT), we can obtain qualitative and quantitative parameters of macula better than ever and explore the relationship of macular status before and after cataract surgery in diabetic patients we assessed the changes of macular thickness in diabetic patients after cataract surgery using OCT. We analyzed the incidence of both central-involved ME and non-central- involved ME following cataract surgery regarding preoperative status of macula. We aimed to assess the quantitative changes of macula in diabetic eyes after cataract surgery and help to estimate the incidence of ME after surgery in diabetic eyes. Optical coherence tomography may provide a more effective, safer, less time- intensive means of detecting ME in diabetic patients undergoing cataract surgery than fluorescein angiography. Incidence and progression of ME determined from OCT testing may allow for more precise risk stratification. This may translate ultimately into more timely treatment and targeted prophylaxis for patients with high-risk characteristics[1].

II. Material & Method

A Prospective interventional study was conducted on 34 diabetic patients undergoing cataract surgery to assess the incidence and progression of macular edema (ME) after cataract surgery in diabetic patients using optical coherence tomography (OCT).
This study has conducted on 34 eyes of 34 patients in the department of ophthalmology, MBS Hospital Kota. This study duration was 24 months from May 2019 to May 2021.
This study was approved by the ethics committee of the Govt. medical college Kota and associated groups of hospitals and this study has conducted as per the good clinical practice guidelines.

Case records of all patients visiting retina service at our M.B.S. hospital Govt, medical college Kota between May 2019 to May 2021 with diagnosis of ME were taken from follow-up OCT reports of patients.
Inclusion Criteria Diabetic patients with senile immature cataract with varying levels of retinopathy including absence of retinopathy and uncomplicated small incision cataract surgery done by an experienced surgeon.

Exclusion Criteria
1. Diabetic patients with severe non proliferative diabetic retinopathy
2. Proliferative diabetic retinopathy
3. History of any type prior intraocular surgery.
4. History of uveitis
5. Presence of any retinal or choroidal disease,
6. Presence of preoperatively macular edema

III. Method

Study participants consisted of a consecutive cohort of diabetic patients with varying levels of retinopathy- mild and moderate NPDR including the absence of retinopathy, who were scheduled for routine cataract surgery. Study participants were examined at the MBS Hospital Kota.

Each study eye underwent fundus examination and OCT testing no more than 1 week before surgery. Optical coherence tomography testing was repeated at the 4th and 12th week postoperative visits. Best-corrected visual acuity (BCVA) was recorded at each visit.

Subject characteristics including age, gender, duration of diabetes, hemoglobin A1c and type of diabetes. History of previous laser photocoagulation, prior intraocular surgery, and treatment with an intravitreal or sub– Tenon's capsule injection of triamcinolone acetonide was documented from review of the patient's chart. Age and gender was recorded at the time of the preoperative visit. Duration of diabetes was estimated and subdivided into 2 groups: < 10 years or > 10 years. Hemoglobin A1c was recorded from the patient's investigations. Type of diabetes was defined as insulin dependent or non–insulin dependent. All cataract surgeries were small incision cataract surgery with posterior chamber intraocular lens implantation done under local anesthesia by an experienced surgeon. Optical coherence tomography results were not revealed until all follow-up testing was completed. Fundus examination of the retina were done in a manner described in the Early Treatment Diabetic Retinopathy Study.[2] Optical coherence tomography testing was performed by a trained doctors with close monitoring of patient fixation under direct observation. Optical coherence tomography images were generated with the use of six, 6-mm radial scans in a spoke-like pattern according to the manufacturer protocol as described in the user's manual.[3] The macular map program analyzes six, 6mm scans radiated through the fovea equally spaced angular (30°) orientation and provides an average retinal thickness map in nine regions of the macula. The OCT macular map is divided into nine zones that correspond to the Early Treatment Diabetic Retinopathy Study Research - ETDRS regions: fovea within 1000μm centered on the fixation point; internal peripheral ring, the circular band from the central 1000μm to 3000μm, divided into upper, lower, temporal, and nasal and; external peripheral ring from 3000μm up to 6000μm and the same subdivisions therefore, central foveal thickness relates to the mean of the six spoke meridians inside 1000μm centered on the foveola For the purposes of this study, maximal retinal thickness was calculated in the Central sub field (Foveal thickness), defined by the area formed within 1000μm of the map. Foveal thickness was defined as the average thickness in the central 1000-μm diameter of the Early Treatment Diabetic Retinopathy Study layout. Central foveal thickness was defined as the mean thickness at the point of intersection of the 6 radial scans.We used the term macular edema an increase in foveal thickness >30% on OCT after cataract surgery in our diabetic cohort. Descriptive statistics, including mean and standard deviation (SD), were calculated for case characteristics. Visual acuity in Snellen equivalents was converted to logarithm of the minimum angle of resolution (logMAR) units for analysis purposes. For conversion of Snellen to LogMAR in step first Snellen to MAR=Snellen denominator/Snellen numerator. In step second take log of this MAR. for example Snellen VA 6/60 in step1 convert to MAR=60/6=10. In step2 log (10) =1. We also use quotient rule $\log_a(x/y)= \log_a x- \log_a y$.

STATISTICAL ANALYSIS

Data were entered in Microsoft Excel and reported as mean ± standard deviation (SD). Data analysis was done using one way Analysis of variance (ANOVA) and p-value <0.05 was considered significant. Snellen's BCVA is converted into logarithm of minimum angle of resolution (LOGMAR) for analysis.

IV. Results

A total of 34 eyes of 34 diabetic patients on preoperative OCT were enrolled and underwent uncomplicated small incision cataract surgery with posterior chamber intraocular lens implantation. Consequently, 34 study eyes of 34 study subjects completed 4week follow-up (100% completion), and 34 study eyes completed 12week follow-up (100% completion).

Table 1: Showing Baseline Characteristics of 34 Study Eyes IMSC with diabetes, Described as Categorical Variables.

CHARACTERISTICS	TOTAL DIABETIC PATIENTS PRE-OP (%)	POST-OP MACULAR EDEMA IN PATIENTS (%)	
		4week	12 weeks
Gender			
Male	19(55.88)	3(15.78)	3 (15.78)
Female	15(44.12)	3(20)	2 (13.33)
Association with HTN			
with HTN	18(52.94)	3(16.66)	3 (16.66)
without HTN	16(47.06)	3(18.75)	2 (12.50)
Duration of diabetes			
>10yrs	10(29.41)	5(50)	4 (40)
<10yrs	24(70.59)	1(4.16)	1 (4.16)
Type of Diabetes			
Insulin dependent	6(17.64)	2(33.33)	2 (33.33)
Non-insulin dependent	28(82.35)	4(14.28)	3 (10.71)
Level of retinopathy			
None	25 (73.52)	0	0
mild NPDR	7 (20.58)	5(71.42)	4 (57.14)
moderate NPDR	2 (5.88)	1(50)	1 (50)
Macular edema at 4th and 12th week			
Present		6(17.64)	5 (14.70)
Absent		28(82.35)	29(85.29)

Table 2: Showing Features of 34 Study Eyes IMSC with DM, Described as Continuous Variables

Characteristics	Mean
Age(years)	55.97
Hemoglobin A1c (mean of all pts)	7.02
Hemoglobin A1c (ME eyes)	7.23
1-week Preoperative BCVA in (LogMAR)	1.12
4th week postoperative BCVA in (LogMAR)	0.62
12th week postoperative BCVA in (LogMAR)	0.41

LogMAR - logarithm of the minimum angle of resolution; ME - macular edema, BCVA-best corrected visual acuity

This table showing Overall, mean visual acuity (VA)improved from 1.12 logMAR unit preoperatively to 0.62 and 0.41 logMAR units at 4th and 12th weeks after surgery, respectively. The mean hemoglobin A1c level of the study cohort was 7.02, and the mean hemoglobin A1c of study eyes with ME on OCT at baseline was 7.23.

Table 3. Correlation between Mean change in foveal thickness (µm) from preoperative baseline to at 4th and 12th week after cataract surgery among different study group.

Time of examination	IDDM	NIDDM	Duration > 10years	Duration < 10years	With HTN	Without HTN
4week	42±19.93	28.71±22.80	50.4±30.89	23±11.44	31.16±23.59	30±20.93
12week	59.66±16.70	41.32±20.85	67.3±27.14	37.20±11.56	46.33±22.06	37.68±21.10

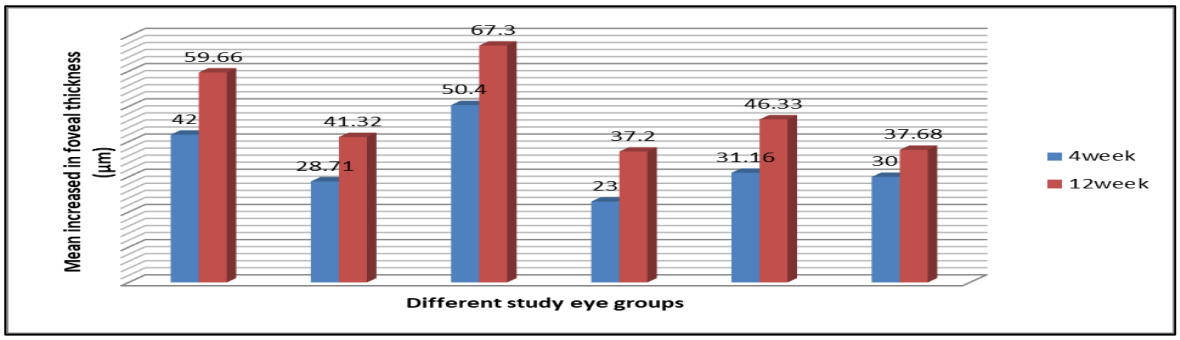

Figure: 1 Correlation between Mean increased in foveal thickness and different study eye group

Table 4. Correlation between Mean change in visual acuity (LogMAR) from preoperative baseline to at 4th and 12th week after cataract surgery among different study group.

Time of examination	IDDM	NIDDM	Duration > 10years	Duration < 10years	With HTN	Without HTN
4 week	0.8±0.34	0.59±0.26	0.87±0.28	0.52±0.22	0.63±0.30	0.62±0.27
12 week	0.55±0.38	0.38±0.30	0.72±0.37	0.28±0.17	0.41±0.33	0.41±0.30

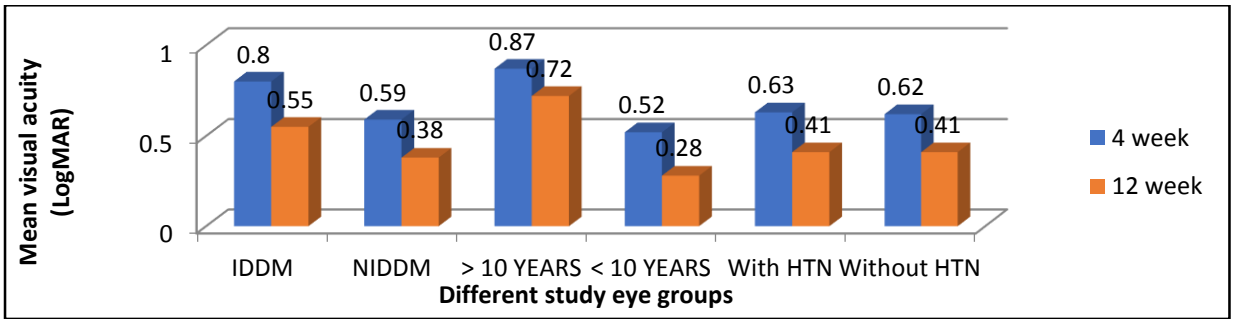

Figure: 2 Correlation between Mean visual acuity(LogMAR) and different study eye group

Table 5. showing relationship between Mean change in foveal thickness (µm) from preoperative to at 4th and 12th week after surgery among study participants with varying levels of diabetic retinopathy.

Time of examination	NO DR	Mild NPDR	Mod. NPDR	All DM	p value
4week	20.96±6	62±29.35	49±31.13	31.05±22.62	0.0001
12week	36.2±8.38	70.85±30.46	57±25.45	44. 55±34	0.0007

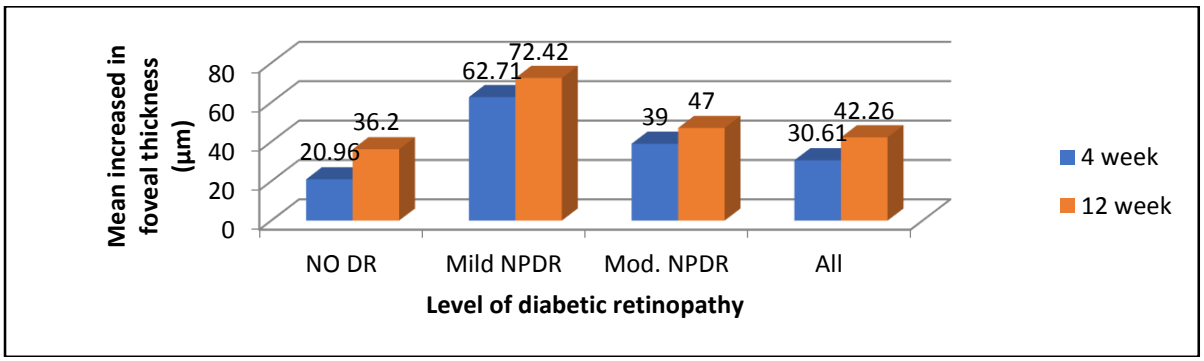

Figure: 3 Correlation between Mean increased in foveal thickness and Level of diabetic retinopathy

V. Discussion

A total of 34 diabetic patients were included in study and reports the incidence of foveal thickness changes on OCT in diabetic patients undergoing cataract surgery. As cataract formation is common in people with diabetes, obtaining 1week preoperative and postoperative OCT scans at 4th and 12th week allowed us to quantify changes in foveal thickness and to follow the progression. study participants were grouped for comparison by whether they were insulin dependent or non-insulin dependent, duration of diabetes >10years or

<10 years, with HTN or without HTN, different level of diabetic retinopathy. Several published reports have confirmed the reproducibility of OCT measurements among diabetic patients, even in the setting of pronounced thickening of the retina on OCT.[4] OCT has been able to demonstrate a moderate correlation between retinal thickness and best-corrected visual acuity.

Table 1-In present study among 34 diabetic patients incidence of macular edema is more in diabetic patients associated with insulin dependent DM, duration of DM >10years, level of diabetic retinopathy (mild and moderate) and with HTN as compare to insulin non- dependent DM, duration DM<10 years, no diabetic retinopathy and without HTN at 4th week and 12th week post cataract surgery. The increase in foveal thickening observed with these risk characteristics directly translated into poorer VA outcomes.

The findings of our study confirm with published reports of **Pollack A, Leiba H, Bukelman A, Oliver M et al[5] Br J Ophthalmol study**. that level of diabetic retinopathy is a risk factor for thickening of the retina after cataract surgery.

Table 2- In present study post operative macular edema is associated with level of HbA1c at the time of cataract surgery. In present study found that HbA1c level in patients with ME is more (7.24) as compare to patients without ME (7.02).

K Hayashi, C Igarashi, A Hirata and H Hayashi et al[6]. 2009 their quantitative study suggests that the percentage of haemoglobin A1C present at the time of surgery may be a significant predictor for progression of macular edema.

Table 3- In present study in diabetic patients mean increased in foveal thickness (µm) in group of IDDM, duration of DM > 10years, HTN is more as compared to group of NIDDM, duration of DM<10years, without HTN. Mean change in foveal thickness ± SD from preoperative baseline to at 4th and 12th week after surgery among study patients grouped according to above risk characteristics: At 4thweek insulin dependence (IDDM) 42±19.93µm versus insulin dependence (NIDDM) 28.71±22.80 µm (p value=0.1963 not significant). duration of diabetes >10years 50.4±30.89µm or < 10 years 23±11.44µm (p value=0.0006 significant). and with HTN31.16±23.59µm versus without HTN 30±20.93µm (p value=0.8804 not significant). At 12thweek IDDM 59.66±16.70µm, NIDDM 41.32±20.85µm (p value=0.0526 not significant). duration of diabetes >10years 67.3±27.14µm, duration of diabetes <10years 37.20±11.56µm (p value=0.0008 significant). with HTN 46.33±22.06µm, without HTN 37.68±21.10µm (p value=0.2531not significant).

Table 4- In present study in diabetic patients mean visual acuity improvement (LogMAR) is less in group of IDDM, duration of DM > 10years, HTN as compared to group of NIDDM, duration of DM<10years, without HTN. Mean visual acuity [logMAR] ±SD from preoperative baseline to at 4th and 12th week after surgery among study patients grouped according to above risk characteristics: At 4thweek insulin dependence (IDDM) 0.8±0.34logMAR versus insulin dependence (NIDDM) 0.59±0.26logMAR (p value=0.1121not significant), duration of diabetes >10years 0.87±0.28logMAR versus < 10 years 0.52±0.22logMAR (p value=0.0005 significant) and with HTN 0.63±0.30log MAR versus without HTN 0.62±0.27logMAR (p value=0.9254 not significant). At 12thweek IDDM 0.55±0.38 logMAR versus NIDDM 0.38±0.30 logMAR (p value=0.2337 not significant), duration of diabetes >10years 0.72±0.37 logMAR, versus duration of diabetes <10years 0.28±0.17 logMAR (p value=0.0001 significant), with HTN 0.41±0.33 logMAR versus without HTN 0.41±0.30 logMAR (p value=0.9593 not significant).

In our study **table 4** results is similar to **K Hayashi et al[6] study** the degree of macular edema was related to types of diabetes, duration of diabetes, and the presence of hypertension.

Neumaier-Ammerer B et al (2008)[7] studied included patients with diabetes ± hypertension. They found that percentage of eyes with foveal thickening was higher in group diabetes ± hypertension.

Table 5- In present study in diabetic patients increased in mean foveal thickness (µm) is more and improvement in visual acuity (LogMAR) is less in patients of mild and moderate DR as compare to non DR patients.

Pollack A, Leiba H, Bukelman A, Oliver M.[5]study.The findings of our study confirm published reports that level of diabetic retinopathy is a risk factor for foveal thickening after cataract surgery.

Zaczek A, Zetterstrom C et al[8], Funatsu H et al[9], Moriarty AP et al[10] studies suggest similar correlation between level of diabetic retinopathy and increased in foveal thickness and visual outcome after cataract surgery.

Alkuraya H et al[11] reported a significant correlation between OCT patterns of clinically significant diabetic macular edema and severity of retinopathy, CMT, and visual acuity. Our study showed similar significant correlation between level of retinopathy, foveal thickness and visual acuity.

Finally, our study suggested that insulin dependence, duration of diabetes of > 10 years, risk factors like hypertension, HbA1c and level of diabetic retinopathy predict increase in foveal thickness which correlates with poorer visual outcomes at 4th week with gradual recovery at 12 week.

OCT-3 provided objective documentation of foveal structural changes in eyes with diabetic retinopathy. Best-corrected visual acuity provided a significant correlation with the retinal thickness at the

fovea. These results indicate that OCT can facilitate deciding on the treatment protocol (surgical or medical) and follow-up of diabetic patients, which is especially important in the early stages of diabetic maculopathy when the structural changes are not yet evident with slit-lamp biomicroscopy or angiographically.[12]

We acknowledge some limitations to our study:

- First, the number of eyes with active DR was small.
- Secondly, the grade of macular edema and the stage of DR evaluated in our study were relatively simple.
- Thirdly, due to covid-19 pandemic most of time elective surgery banned so sample size is small.

VI. Summary & Conclusion

Diabetic patients have a high incidence of increasing foveal thickness on OCT after cataract surgery, associated with decreasing vision at 4 weeks, with gradual visual improvement at 12 weeks.

Reference

[1]. S.C. Chow and J.P. Liu, Design and Analysis of Clinical Trials: Concepts and Methodologies, Wiley, New York (1998), pp. 277–280286–90.

[2]. Photocoagulation for diabetic macular edema. Early Treatment Diabetic Retinopathy Study report number Early Treatment Diabetic Retinopathy Study research group. Arch Ophthalmol. 1985;103(12):1796-806.

[3]. OCT IIIC.A. Dublin, Zeiss-Humphrey Systems(2004).

[4]. Antonio Polito, MD; Michele Del Borrello, MD; Miriam Isola, MHS; Nicola Zemella, MD; Francesco Bandello, MD Repeatability and Reproducibility of Fast Macular Thickness Mapping With Stratus Optical Coherence Tomography Arch Ophthalmol. 2005;123:1330-1337.

[5]. Pollack A, Leiba H, Bukelman A, Oliver M. Cystoid macular edema following cataract extraction in patients with diabetes. Br J Ophthalmol 1992; 76:221–4.

[6]. Changes in Diabetic Macular Edema after Phacoemulsification Surgery: K Hayashi, C Igarashi, A Hirata and H Hayashi Eye. 2009;23(2):389-396.

[7]. Neumaier-Ammerer B, Schmid KE, Binder S. Foveal thickness after cataract surgery–Measurement by optical coherence tomography. Spektrum der Augenheilkunde. 2008 Nov 1;22(5):301-4

[8]. Zaczek A, Zetterstrom C. Aqueous flare intensity after phacoemulsification in patients with diabetes mellitus. J Cataract Refract Surg 1998; 24:1099–1104.

[9]. Oshika T, Kato S, Funatsu H. Quantitative assessment of aqueous flare intensity in diabetes. Graefes Arch Clin Exp Ophthalmol 1989; 227:518–520.

[10]. Moriarty AP, Spalton DJ, Moriarty BJ, Shilling JS, Ffytche TJ, Bulsara M. Studies of the blood-aqueous barrier in diabetes mellitus. Am J Ophthalmol 1994; 117: 768–771.

[11]. Alkuraya H, Kangave D, Abu El-Asrar AM. The correlation between optical coherence tomographic features and severity of retinopathy, macular thickness and visual acuity in diabetic macular edema. Int Ophthalmol. 2005 Jun; 26(3):93-9.

[12]. Engül C. Özdek, M. AlperErdinç, GökhanGürelik, BahriAydn, UmutBahçeci, Berati Hasanreisolu Optical Coherence Tomographic Assessment of Diabetic Macular Edema: Comparison with Fluorescein Angiographic and Clinical Findings Ophthalmologica 2005;219:86-9.

Dr.Nand mohan, et. al. "Optical Coherence Tomography analysis of macula -Preoperative & postoperative diabetic patients undergoing cataract surgery." *IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)*, 22(3), 2023, pp. 18-23.