ORIGINAL RESEARCH

To assess changes in macular thickness after uncomplicated cataract surgery in diabetic patients using optical coherence tomography

Dr. Amrita Chauhan

Associate Professor, Department of Ophthalmology, Dr S S Tantia Medical College Hospital & Research Centre, Sri Ganganagar, Rajasthan, India

Corresponding Author
Dr. Amrita Chauhan
Associate Professor, Department of Ophthalmology, Dr S S Tantia Medical College Hospital & Research Centre, Sri Ganganagar, Rajasthan, India

Received: 10 December, 2021 Accepted: 14 January, 2022

ABSTRACT

Aim: To assess changes in macular thickness after uncomplicated cataract surgery in diabeticpatients using optical coherence tomography. **Material and Method:** The present prospective observational study was conducted in the department of Ophthalmology. As this is a time bound study, we recruited minimum of 50 eyes in each group. Patients were further divided into two groups: **GROUP A:** Known case of Type 2 Diabetes Mellitus (DM) and Patients having fasting plasma glucose (FPG) of more thanor equal to 126 mg/dl or a 2-hour post prandial plasma glucose (PPBG) of more than or equal to 200mg/dl. **GROUP B:** Patients with no past history of type 2 DM and Patients withFPG less than 126mg/dl or PPBG of less than 200mg/dl. **Results:** Before the surgery, mean foveal thickness (optical coherence tomography) among thediabetic subjects was 252.35±11.21which increased to 311.45±14.31post cataract surgery. Before and after the cataract surgery, mean foveal thickness (optical coherence tomography) among the non- diabetic subjects was 229.42±7.53which increased to 265.46±5.73 post cataract surgery. Pre-operatively there was no significant difference among group A and B w.r.t. mean foveal thickness as $p>0.05$. Post-operatively (2 month) mean foveal thickness increased more in group A (study group) as compared to group B (control group) with statistically significant difference. Mean logarithm of minimal angle of resolution visual acuity (optical coherence tomography) among the diabetic subjects was 0.85±0.07 which decreased to 0.39±0.15 post cataract surgery with statistically significant difference. Before the surgery, mean logarithm ofminimal angle of resolution visual acuity (optical coherence tomography) among the non- diabetic subjects was 0.79±0.07 which decreased to 0.21±0.08 post cataract surgery with statistically significant difference. **Conclusion:** Diabetic individuals present a specific difficulty since they are prone to developing cataracts at an early stage and are more likely to have retinal edema and the advancement of retinopathy after undergoing cataract surgery. Uncomplicated phacoemulsification leads to an increase in central macular thickness in both diabetic and nondiabetic patients.

Keywords: Macular thickness, Cataract surgery, Diabetic patients, Optical coherence tomography

INTRODUCTION

Cataract is the primary cause of blindness globally and the most widespread eye condition. Cataract is responsible for around 47.8% of the global population of approximately 37 millionpeople who are blind. It is worth mentioning that almost 90% of the impact of cataracts on causing blindness is seen in poor countries[1]. The visual result of cataract surgery is influenced by several factors, including the state of the cornea, the type of cataract, the manipulation of the iris, the presence of pre-existing ocular conditions such as chronic uveitis,any associated systemic disease, the occurrence of complications during the surgery, and thesurgeon's level of experience[2]. Diabetes mellitus increases the probability of developing cataract and the risk of decreased visual outcomes after cataract surgery[3,4]. Diabetic patients pose a particular challenge because of the tendency for early formation of cataract in them and propensity to develop macular edema after cataract surgery[5,6]. The principles and type of cataract surgery have evolved over the past few decades. Manual small-incision cataract surgery (MSICS) is a cost-saving procedure and is suitable for developing countries. MSICS is significantly faster, less expensive, and less dependent on technology than phacoemulsification[7,8]. Although 16 to 30% of

patients who have undergone uncomplicated extracapsular cataract surgery will show signs of cystoid macular edema (CME) on fluorescein angiography, few will experience a significant effect on their vision, and less than 2.5% will suffer a permanent visual deficit as a result[9,10]. Still, CME is the most common cause of unexpected poor vision following cataract surgery.

The macular thickness can be measured using optical coherence tomography (OCT), and some studies have reported increased aqueous flare values in patients with CME after cataract surgery. CME in OCT appears as a collection of hypo-reflective spaces within the retina, with an overall increase in macular thickening and loss of the foveal depression. OCTis as effective as FFA at detecting macular edema, while it produces highly reproducible measurements so that serial examination may be used for follow up[11].

There are some controversies in the results of the studies reporting developed increase in central macular thickness (CMT) or macular edema after cataract surgery in patients with diabetes but no diabetic retinopathy (in diabetic patients without diabetic retinopathy). The risk for development of macular edema in diabetics without retinopathy (RR 1.80) was reported to be higher than in the population without diabetes (RR 1.17)[12]. On the contrary, a recently published meta-analysis showed no statistically significant increase in CMT values after cataract surgery in diabetic patients without diabetic retinopathy at 1, 3 and 6months after cataract extraction[13]. On the other hand, Katsimpris et al. found increased macular thickness after uncomplicated cataract surgery in diabetics without retinopathy compared to preoperative values or to a control group of patients at all follow-ups up to twelve months after cataract surgery[14].

MATERIAL AND METHOD

This prospective observational research was undertaken at the Ophthalmology department. Participants were recruited for the research after the acquisition of written informed permission and clearance from the Institutional Ethical Committee. The research covered all patients, regardless of gender, who were above 18 years of age and diagnosed with Cataract. Due to thetime constraints of the research, we ensured that a minimum of 50 eyeballs were recruited for each group. The patients were then categorized into two groups:

GROUP A

Known case of Type 2 Diabetes Mellitus (DM)

Patients having fasting plasma glucose (FPG) of more thanor equal to 126 mg/dl or a 2-hour post prandial plasma glucose (PPBG) of more than or equal to 200mg/dl.

GROUP B

Patients with no past history of type 2 DM.

Patients with FPG less than 126mg/dl or PPBG of less than 200mg/dl.

EXCLUSION CRITERIA

Patients with any complication during cataract surgery, Patients with any ocular or systemic condition that can cause macular edema, Patients with any ocular trauma, Patients with history of vitreo-retinal surgery or glaucoma surgery in the same eye and Patients with presence of any retinal or choroidal disease other than diabetes in the same eye were excluded from the study.

METHODOLOGY

Patients presenting in OPD with complaint of Diminution of vision, were asked a detailedocular and systemic history. Patients underwent an initial work-up such as: BCVA, Slit lamp examination, IOP measurement and Un-dilated fundus examination. Patients selected for cataract surgery were sub-divided into GROUP A (Study group) having diabetic patients with cataract and GROUP B (Control group) containing non-diabetic patients with cataract. Patients of both the group underwent routine pre-operative investigations such as OCT and dilated fundus examination (where possible). All Patientswere evaluated for Post prandial blood glucoselevels and HBA1C levels (where required). All the patients were evaluated for the macular thickness using OCT. Cataract surgeries were performed by the experienced surgeon.

SURGERY

One hour before surgery, pharmacologic mydriasis was induced in all patients by the instillation of phenylephrine 2.5% and tropicamide 1% eyedrops. Topical anesthesia was performed by administering eye drops of paracain. The surgery involved 2.2 mm corneal incision, capsulorhexis, hydrodissection, and ultimately intraocular lens implantation. The postoperative therapy prescribed for these patients provided eye drops of tobramycin and dexamethasone in decreasing doses for 4 weeks. On each follow-up visit at 1st week, 3rd week and 2nd month both the groups underwent post-operative investigations such as BCVA, Slit lamp examination, IOP measurement, Dilated fundus examination. All the patients were evaluated for macular thickness using OCT at 1st week, 3rd week and 2nd month.

EVALUATION OF MACULAR THICKNESS

It was done using OPTOVUE RTvue 100 OCT. After pupil dilation, the patient was seated at the machine, asked to fixate at the internal fixation point and scan is obtained. The macular thickness map was taken to measure the thickness of macula. CSME was diagnosed based on the modified ETDRS protocol." Retinal thickening at or within 500 um of centre of macula; hard exudates at or within 500 umof centre of the macula if associated with adjacentretinal thickening

; zone or zones of retinal thickening1disc area in size, at least part of whichwas within 1disc diameter of centre of macula.

EVALUATION

After the initial approach and group assignment, the objective assessment of macular thickness in diabetic patients pre-operatively and post operatively was compared. Any progression or worsening of macular edema in diabetic patients post-operatively was assessed. Also, the correlation of grade of DR with macular thickness was done.

STATISTICAL ANALYSIS

Data was analysed using SPSS software version 23. Anova, t and chi square tests were used to find the statistically significant difference between the groups.

RESULTS

Females were slightly more as compared to males in our study among both the groups. Mean age among group A and B was 55.04±5.36 and 57.62±4.15 years respectively with statistically insignificant difference as p>0.05 (table 1).

Table 1: Gender and age distribution of the participants

Gender	Group A (Study group)		Group B (Control group)		Chi Square	p value
	N	%	N	%		
Male	23	46	21	42		
Female	27	54	29	58	0.45	0.22
Total	50	100	50	100		
Age					t test	p value
Mean	55.04		57.62		1.22	0.32
SD	5.36		4.15			

Before the surgery, mean foveal thickness (optical coherence tomography) among the diabetic subjects was 252.35±11.21which increased to 311.45±14.31post cataract surgery. Before and after the cataract surgery, mean foveal thickness (optical coherence tomography) among the non- diabetic subjects was 229.42±7.53which increased to 265.46±5.73 post cataract surgery. Pre-operatively there was no significant difference among group A and B w.r.t. mean foveal thickness as p>0.05. Post-operatively (2 month) mean foveal thickness increased more in group A (study group) as compared to group B (control group) with statistically significant difference (table 2).

Table 2: foveal thickness among the group A and B

Mean Foveal Thickness	Group A (Studygroup)		Group B (Controlgroup)		Unpaired ttest	p value
	Mean	SD	Mean	SD		
Pre	252.35	11.21	229.42	7.53	3.08	0.23
3rd Week	271.11	12.42	239.53	5.63	5.61	0.01*
2nd Month	311.45	14.31	265.46	5.73	4.17	0.007*
Anova test	6.85		5.41			
p value	<0.01*		<0.01*			

*: statistically significant

Table 3 shows the comparison of mean logarithm of minimal angle of resolution visual acuity (pre-postoperative optical coherence tomography) among the study groups. Pre- operatively there was no significant difference among group A and B w.r.t. mean logarithmof minimal angle of resolution visual acuity as p>0.05. Post-operatively mean logarithm of minimal angle of resolution visual acuity decreased more in group B (control group) as compared to group A (study group) with statistically significant difference.

Mean logarithm of minimal angle of resolution visual acuity (optical coherence tomography) among the diabetic subjects was 0.85±0.07 which decreased to 0.39±0.15 post cataract surgery with statistically significant difference. Before the surgery, mean logarithm of minimal angle of resolution visual acuity (optical coherence tomography) among the non-diabetic subjects was 0.79±0.07 which decreased to 0.21±0.08 post cataract surgery with statistically significant difference

Table 3: Mean logarithm of minimal angle of resolution visual acuity among the study groups

Mean Foveal Thickness	Group A (Study group)		Group B (Control group)		t test	p value
	Mean	SD	Mean	SD		
Pre	0.85	0.07	0.79	0.07	0.13	0.44
Post	0.39	0.15	0.21	0.08	4.62	0.006*

As the staging of DR become severe, MFT also increases with statistically significant difference. Mean MFT thickness was 305.16±11.73, 336.26±13.26 and 432.15±11.86 amongsubjects having mild, moderate and severe DR respectively (table 4).

Table 4: Staging of diabetic retinopathy and mean foveal thickness postoperatively in the diabetic group

Staging of DR	MFT (Postoperative OCT)		Anova Test	p value
	Mean	SD		
None	267.62	12.36	8.62	<0.01*
Mild	305.16	11.73		
Moderate	336.26	13.26		
Severe	432.15	11.86		

DISCUSSION

CSME is a major risk factor for reduced vision after cataract surgery. Therefore, after cataract surgery, diabetic patients may have angiographic macular edema (ME) caused by either pseudophakic CME or diabetic macular edema (DME). However, the presence of angiographic ME alone may not be a reliable indicator of visual acuity (VA) in these individuals. Nevertheless, macular thickening might have clinical significance. In addition, Kim et al. presented findings indicating that the severity of diabetic retinopathy (DR) is a risk factor for the thickening of the retina after cataract surgery[15]. Hence this prospective study was planned to evaluate changes in macular thickness after uncomplicated cataract surgery using OCT in diabetic patients. Females were slightly more as compared to males in our study among both the groups. El-Saadani et al[5] in their study revealed similar findings too. Açar et al[16] too revealed no statistical difference between the gender distributions of the diabetic and nondiabetic groups. Hammam MHA et al[17] too revealed slightly more females as compared to males in their study. Mean age among group A and B was 55.04±5.36 and 57.62±4.15 years respectively with statistically insignificant difference as p>0.05 in our study. Açar et al[16], Hammam MHA et al[17]and El-Saadani et al[5] revealed similar results too. In the present study, pre-operatively there was no significant difference among group Aand B w.r.t. mean foveal thickness as p>0.05. Post-operatively mean foveal thickness increased more in group A (study group) as compared to group B (control group) with statistically significant difference. Oh et al[18] showed that diabetic patients may be susceptible to developing postoperative subclinical retinal swelling or clinical ME after cataract surgery. Similarly El- Saadani et al[5] reported that in the diabetic group, the MFT increased significantly from 252.35±11.21which increased to 311.45±14.31at 1 month postoperatively (P = 0.001). In the control group, the MFT increased significantly from 229.42±7.53which increased to 265.46±5.73 at 1 month postoperatively. Post-operatively mean foveal thicknessincreased more in diabetic group as compared to non-diabetic group with statistically significant difference. Dowler et al[19] showed that DME progressed in∼20–40% of eyes that underwent cataractsurgery, but in a considerable percentage of these eyes the ME resolved spontaneously. Accordingly, these studies suggested that progression of DME may be classified as follows: a transient pseudophakic ME (Irvine–Gass syndrome) or a substantialprogression of diabetic maculopathy. Moreover, the study hasdemonstrated that MFT in nondiabetic patients after uncomplicated phacoemulsification increases significantly at 1 monthpostoperatively, and MFT increases more significantly in diabetic patients than in the control group at 1 month postoperatively. Biro and Balla[11] compared the CMT of 18 eyes of diabetic patients with 36 eyes of nondiabetic patients using SD-OCT preoperatively and at 1, 7, 30, and 60 days post-op, with the contralateral eye acting as the control. Patients with any other ophthalmic pathologies wereexcluded, as well as those with severe NPDR or with proliferativeDR. A significant increase was noted in the CMT in both the groupswith DM and without DM as compared with their respective controls. In this study, before the surgery, mean logarithm of minimal angle of resolution visual acuity (optical coherence tomography) among the diabetic subjects was 0.85±0.07 which decreased to 0.39±0.15 post cataract surgery with statistically significant difference. Before the surgery, mean logarithm of minimal angle of resolution visual acuity(optical coherence tomography) among the non-diabetic subjects was 0.79±0.07 which decreased to 0.21±0.08 post cataract surgery withstatistically significant difference. Pre-operatively there was no significant difference among group A and B w.r.t. mean logarithm ofminimal angle of resolution visual acuity as p>0.05. Post-operatively mean logarithm of minimal angle of resolution visual acuitydecreased more in group B (control group) as compared to group A (study group) with statistically significant difference. Eriksson et al[20] showed that the visual outcome in diabetic eyes with mild to moderate retinopathy is as good as in the control group 6 months after cataract surgery. However, at 6 weeks there was a significant difference, with lower VA in eyes with DR combined with a higher frequency of macular changes both on fluorescein angiography and on OCT, when compared with the control group. Kim et al[15] found a good correlation between BCVA and retinal thickening. However, other reports show only a moderate correlation between central retinal thickness and VA in patients with DME, implying that VA may depend mainly on the disruption of the retinal architecture or on direct

photoreceptor damage. In our study, as the staging of DR become severe, MFT also increases with statistically significant difference. Mean MFT thickness was 305.16±11.73, 336.26±13.26 and 432.15±11.86 among subjects having mild, moderate and severe DR respectively. El-Sobkya et al[21] showed that uncomplicated phacoemulsification does not cause acceleration of DR postoperatively. Moreover, ME, which is common after cataract surgery, may follow a benign course and any progression that is observed postoperatively probably represents natural progression rather than being a direct effect of surgery. Kim et al[15] suggested that there was an association between the level of DR and central retinal thickening. The increase in the central retinal thickness in subjects with moderate or severe NPDR or PDR was much higher than in the patients without DR[2]. Similarly El-Saadani et al[5] found that there was a statistically significant correlation between postoperative MFT and staging of DR in the diabetic group.

CONCLUSION

Diabetic individuals present a specific difficulty since they are prone to developing cataracts atan early stage and are more likely to have retinal edema and the advancement of retinopathy after undergoing cataract surgery. Uncomplicated phacoemulsification leads to an increase in central macular thickness in both diabetic and nondiabetic patients. However, the increase is greater in diabetic patients, particularly those who already have higher central macular thickness or a higher grade of diabetic retinopathy at the beginning. Although there was a rise in MFT, BCVA improved after the surgery in both groups.

REFERENCES

1. Peterson S.R., Silva P.A. Cataract Surgery in Patients with Diabetes: Management Strategies. Semin. Ophthalmol. 2018;33:75–82.
2. Minassian DC, Mehra V. 3.8 million blinded by cataract each year: projections from the first epidemiological study of incidence of cataract blindness in India. Br J Ophthalmol 1990; 74:341-343.
3. Guliani BP, Agarwal I, Naik MP. Effect of Uncomplicated Cataract Surgery on Central Macular Thickness in Diabetic and Non-diabetic Subjects. J Ophthal Vis Res. 2019;14(4):442.
4. Denniston A.K., Lee A.Y. United Kingdom Diabetic Retinopathy Electronic Medical Record (UK DR EMR) Users Group: Report 4, Real-World Data on the Impact of Deprivation on the Presentation of Diabetic Eye Disease at Hospital Services. Br. J. Ophthalmol. 2019;103:837–843.
5. El-Saadani AE, Mandour SS, Laymouna MF. Evaluation of macular changes after uncomplicated phacoemulsification surgery in diabetic patients using optical coherence tomography. Menoufia Med J. 2018;31(1):289.
6. Ikegami Y., Takahashi M. Evaluation of choroidal thickness, macular thickness, and aqueous flare after cataract surgery in patients with and without diabetes: A prospective randomized study. BMC Ophthalmol. 2020;20:102.
7. Nicholas S, Riley A, Patel H, Neveldson B, Purdie G, Wells AP. Correlations between optical coherence tomography measurement of macular thickness and visual acuity after cataract extraction. Clin Experiment Ophthalmol. 2006; 34:124–129.
8. Onal S, Gozum N, Gucukoglu A. Visual results and complications of posterior chamber intraocular lens implantation after capsular tear during phacoemulsification. Ophthalmic Surg Lasers Imaging. 2004; 35:219–224.
9. Blomquist PH, Rugwani RM. Visual outcomes after vitreous loss during cataract surgery performed by residents. J Cataract Refract Surg. 2002; 28:847–852.
10. Ersoy L, Caramoy A, Ristau T, Kirchhof B, Fauser S. Aqueous flare is increased in patients with clinically significant cystoid macular oedema after cataract surgery. Br J Ophthalmol. 2013;97:862–5.
11. Biro Z, Balla Z, Kovacs B. Change of foveal and perifoveal thickness measured by OCT after phacoemulsification and IOL implantation. Eye (Lond) 2008; 22:8–12.
12. Chu CJ, Johnston RL, Buscombe C, Sallam AB, Mohamed Q, Yang YC, United Kingdom Pseudophakic Macular Edema Study Group. Risk factors and incidence of macular edema after cataract surgery: a database study of 81984 eyes. Ophthalmol. 2016;123(2):316-23.
13. Liu J, Jones RE, Zhao J, Zhang J, Zhang F. Influence of uncomplicated phacoemulsification on central macular thickness in diabetic patients: a meta- analysis. PLoS One. 2015; 10(5):e0126343.
14. Katsimpris JM, Petropoulos IK, Zoukas G, Patokos T, Brinkmann CK, Theoulakis PE. Central foveal thickness before and after cataract surgery in normal and in diabetic patients without retinopathy. Klinische Monatsblätter für Augenheil kunde. 2012;229(04):331-7.
15. Kim SJ, Equi R, Bressler NM. Analysis of macular edema after cataract surgery in patients with diabetes using optical coherence tomography. Ophthalmol. 2007;114(5):881-9.
16. Akarsu Açar ÖP, Olgun A, Ergen E, Demir AG, Güven D. Evaluation of Changes in Macular Thickness Using Optical Coherence Tomography After Cataract Surgery in Diabetic and Nondiabetic Patients. JAREM 2019; 9(1): 32-7.
17. Hammam MHA, Zaky MA, Marey HM. Evaluation of macular thickness after uncomplicated cataract surgery using optical coherence tomography. Nat Sci 2019;17(10):219- 224.
18. Oh JH, Chuck RS, Do JR, Park CY. Vitreous hyper reflective dots in optical coherence tomography and cystoid macular oedema after uneventful phacoemulsification surgery. PLoS One 2014; 9:e95066.
19. Dowler JGF, Sehmi KS, Hykin PG, Hamilton AMP. The natural history of macularedema cataract surgery in diabetes. Ophthalmology 1999;106:663–668.
20. Eriksson U, Alm A, Bjärnhall G, Granstam E, Matsson AW. Macular edema and visual outcome following cataract surgery in patients with diabetic retinopathy andcontrols. Graefes Arch Clin Exp Ophthalmol 2011; 249:349–359.
21. Sobkya HM,Hagaab AA, Gaber NK. Evaluation of the progression of diabetic retinopathy after phacoemulsification. Menouf Med J 2014; 27:643–649