Original Research Article

Macular edema after uncomplicated phacoemulsification in type 2 diabetics with NPDR

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Abstract

Introduction: After uncomplicated cataract surgery, macular oedema has been suggested as the most common cause of visual deterioration and there is increased incidence of Macular Oedema (ME) in patients with diabetic retinopathy (DR). Further, ME has been seen to worsen after eye surgery in patients with pre-operative DME. **Objective:** To evaluate and compare the macular thickness changes after uncomplicated phacoemulsification in type 2 diabetes mellitus patients with Non Proliferative DR using Optical Coherence Tomography (OCT).**Methods:** The study was a hospital based prospective observational study conducted on 75 eyes of type 2 diabetes mellitus with NPDR who were diagnosed with cataract and underwent uncomplicated phacoemulsification. In all study subjects macular thickness using Cirrus High Definition (HD) OCT and Best Corrected Visual Acuity (BCVA) in Logarithm of Minimum Angle of Resolution (Log MAR) was recorded preoperatively and postoperatively at Day One, two weeks, four weeks, Six weeks and eight weeks to see changes in the macular thickness.**Results:** Out of 75 eyes macular edema was developed in 3 (4.0%) eye postoperatively. All central as well as parafoveal thickness increased significantly during our follow up time.**Conclusion:** Increase in central as well as parafoveal macular thickness was observed in subjects with NPDR after phacoemulsification. In few patients macular edema was also observed during our follow up period. OCT is a noninvasive, rapid, and useful tool in detecting and monitoring CME in post cataract surgery patients but longer follow up is needed to assess the risk of Cystoid macular edema (CSME) progression after cataract surgery and to see whether increase in central and parafoveal thickness after phacoemulsification is temporary or permanent.

Keywords: Non Proliferative Diabetic Retinopathy,Optical Coherence Tomography,Macular Oedema

Introduction

Diabetic retinopathy may be the most common microvascular complication of diabetes. Retinopathy develops in one every four diabetics which is major cause of visual impairment. Prevalence of retinopathy in diabetics is 25%.[1]

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It has been estimated that 28.85% of all diabetics will have some form of retinopathy irrespective of severity and duration of diabetes. Diabetic Retinopathy is one of the major tragedies of ophthalmology in our present generation, effecting the young as well as the aged, and relatively untreatable, chronic and progressive in its course and leading to blindness in a distressing percentage of cases.[2]After uncomplicated cataract surgery, macular oedema has been suggested as the most common cause of visual deterioration.[3,4] and there is increased incidence of ME in patients with diabetic retinopathy (DR). Further, ME has been seen to worsen after eye surgery in patients with pre-

operative DME.[5,6] However, qualitative as well as quantitative parameters of macula can now be attained better with the availability OCT and the relationship between macular status pre and post cataract surgery can be explored in patients with diabetes.[7-9]Previous studies on patients with diabetes undergoing cataract removal using intracapsular and extracapsular cataract extraction techniques suggested that for incidence of macular edema (ME) or worsening of diabetic retinopathy, cataract surgery was a risk factor.[10-12] Some reports suggested that in people with diabetes macular edema after cataract surgery may occur predominantly in people with concurrent pre-existing diabetic macular edema (DME) involving the centre of the macula. However other reports indicate that pre-existing DME is not needed for ME to occur post-operatively.[3] However, these studies were completed prior to the availability of optical coherence tomography (OCT) technology. In this study, we tried to assess the changes of macular thickness in patients with diabetes having non-proliferative retinopathy after phacoemulsification using OCT which helped us to estimate the ME incidence post-surgery in diabetic eyes in our institution.

Subjects and Methods

Study design, settings and participants: It was a hospital based prospective observational study conducted over a period of 18 months from March 2018 to August 2019 in ophthalmology department of a tertiary care teaching hospital in Southern Rajasthan, India. 75 eyes of type 2 diabetes mellitus patients age >40 years with NPDR, BP≤ 150/90mmHg and with >5 years of diabetes duration who were diagnosed with cataract and underwent uncomplicated phaco-emulsification and posterior chamber intraocular lens implantation at our departmentconstituted the study population. Eyes with high myopia, neuro-ophthalmic anomalies, advanced cataract or hazy media, history of ocular diseases like glaucoma, uveitis, any ocular surgeries, patient with complications of diabetes like severe diabetic nephropathy, uncontrolled hypertension or CVS disease, previous medical treatment of retinal disorder or any therapy that affect retinal edema, patients with refractive errors of more than +5 Diopters spherical, or -8 Diopters spherical, IOP >21 mmHg as determined by Goldmannapplanation tonometry or patients with pre-existing Macular edema were excluded from the study.

Data collection

After taking written informed consent patients with inclusion criteria were subjected to detailed history regarding duration of diabetes and treatment taken, history of hypertension and any other systemic and ocular.All patients underwent preoperative ophthalmological examination which included:

- UCVA (uncorrected visual acuity) & BCVA using Snellen's chart and converted to logarithm of the minimal angle of resolution (LogMAR) scale for analysis. Slit Lamp assisted Biomicroscopy of anterior segment
- Slit Lamp assisted Biomicroscopy of posterior segment with+90D/+78D
- Intraocular pressure measurement (IOP) with Applanation Tonometry
- Intraocular Lens (IOL) Power was calculated using Keratometer& A-scan
- Macular thickness was recorded using Cirrus HD-OCT(Carl Zeiss/Meditec)

In those patients in whom preoperative thickness value was not possible because of the presence of significant media opacity interfering with good quality OCT scan, macular thickness on the first postoperative day was taken as baseline value in our study as no significant change in the foveal and perifoveal thickness values occurs on the first postoperative day[13,14].Pre-operative mydriasis was done byEye drops Tropicamide 1% + Phenylephrine 2.5% while 8-10 ml Peribulbaraneasthesia (eye drops xylocaine 2% + adrenaline1:200000 + eye drops bupivacaine 0.5%) was given to the patients before the surgery.

Phacoemulsification

A 2.8 mm superior clear corneal incision was made using a 2.8 mm keratome. A paracentesis incision of 1 mm was made 90° apart with a 15° knife. After the capsulorrhexis, hydrodissection and hydrodelineation followed by nucleus rotation was done. A phacoemulsification tip was used to emulsify the cataract using direct chopping or divide and conquer technique. After emulsification of nuclear fragments, irrigation aspiration of residual cortical matter was done. A posterior chamber intraocular lens was put inside the capsular bag. After this the removal of the ophthalmic viscoelastic material was done and finally the incision was hydrated using a 30-gauge cannula. Hydration of the cornea was maintained throughout the surgery. In the end subconjuctival injection of Gentamycin (40mg/ml) with Dexamethasone (4mg/ml) was given in the operated eye. All subjects were followed up on postoperative Day 1, 2 Weeks, 4 Weeks, 6 Weeks and 8 weeks.

Baseline DME category	Definition
No central DME and no non-central DME	CSMT <310 μm, all ISF thickness <356 μm, and all OSF thickness <303 μm
No central DME and non-central DME	CSMT <310 μm, and ⩾1 ISF thickness ⩾356 μm or OSF thickness ⩾303 μm
Central DME and no non-central DME	CSMT⩾310 μm, all ISF thickness <356 μm, and all OSF thickness <303μm
Central DME and non-central DME	CSMT⩾310 μm, and ⩾1 ISF thickness ⩾356 μm or OSF thickness⩾303 μm
DME at follow-up	
New development or progression central-involved ME	1) CSMT ⩾310 μm and CSMT increased ⩾1 logOCT unit from baseline; 2) CSMT increased ⩾2 logOCT units from baseline.
New development or progression non-central-involved ME	1) ⩾1 ISF thickness ⩾356μm and the corresponding ISF thickness increased ⩾1 logOCT unit from baseline, or ⩾1 OSF thickness ⩾303 μm and the corresponding OSF thickness increased ⩾1 logOCT unit from baseline; 2) ⩾1 ISF thickness increased ⩾2 logOCT units from baseline or ⩾1 OSF thickness increased ⩾2 logOCT units from baseline.

DME: Diabetic macular edema; ME: Macular edema; CSMT: Central subfield macular thickness; ISF: Inner subfields; OSF: Outer subfields; OCT: Optical coherence tomography.

Fig 1:Baseline and outcome diabetic and cystoid macula oedema definitions[3]

Statistical analysis

The collected data were transformed into variables, coded and entered in Microsoft Excel. Data were analyzed and statistically evaluated using SPSS-PC-20 version.Quantitative data was expressed in mean, standard deviation while qualitative data were expressed in percentage. Comparison between values measured preoperativelyand postoperatively in the same group was carriedout using the paired t-test or Wilcoxon sign rank test. 'P' value less than 0.05 was considered statistically significant

Ethical issues

All participants were explained about the purpose of the study. Confidentiality was assured to them along with informed written consent. The study was approved by the Institutional Ethical Committee.

Observations & Results

Two-third of the study subjects were between the age group of 51-70 years. The mean ± SD age was 58.41± 8.92 years in diabetes subjects.Out of 75 subjects, there were 36 female patients and 39 male patients showing almost equal distribution.sixty-three cases (84%) had mild and 12 cases (16%) had moderate NPDR. None of the subject was having severe NPDR. Out of 75 study subjects 52 (69.3%) patients had diabetes form 6-10 years while 22 (29.3%) patients had diabetes history between 11-15 years. One patients informed regarding history of diabetes since >15 years. 3 (4.0%) study subjects developed macular oedema after phacoemulsification till 8 weeks follow up. All central as well parafoveal thickness showed significant increase at 2,4,6 and 8 weeks follow-up compared with baseline measurements (<0.001). (Table 2).

Table 1: Central Macular thickness before surgery and till 8 weeks follow-up in study subjects

	CMT	SMT	NMT	IMT	TMT
Baseline	239.49±15.24	309.15±13.81	308.01±37.53	307.71±13.59	301.31±11.86
At 2 weeks	249.20±18.25	316.03±14.21	318.65±15.15	316.56±15.01	313.39±12.07
P value with baseline	<0.001	<0.001	<0.001	<0.001`	<0.001
At 4 weeks	244.67±15.71	315.21±14.09	316.49±15.16	314.68±14.91	310.73±11.98
P value with baseline	<0.001	<0.001	<0.001	<0.001	<0.001
At 6 weeks	251.47±30.16	319.08±14.02	319.37±17.69	316.60±14.19	312.39±15.59
P value with baseline	<0.001	<0.001	<0.001	<0.001	<0.001
At 8 weeks	259.0±29.56	328.92±11.87	325.28±16.05	324.85±13.61	320.52±15.61
P value with baseline	<0.001	<0.001	<0.001	<0.001	<0.001

Discussion

The present study was a Hospital based prospective observational study conducted on 75 eyes of patients with type 2 diabetes mellitus with NPDR who were diagnosed with cataract and underwent uncomplicated phacoemulsification and posterior chamber intraocular lens implantation at ddepartment of ophthalmology of tertiary care teaching hospital of Southern Rajasthan. In our study, meancentral macular thickness (CMT) increased from 239.49±15.24 µm to 249.20±18.25 µm at 2 weeks follow up, 244.67±15.71 µm at 4 weeks follow-up, 251.47±30.16 µm at 6 weeks follow-up and 259.01±29.56 µm at 8 weeks follow-up.In contrast to our study, Abdl-El-Khalik et al[15] reported very high increase of foveal thickness after cataract surgery (from 254.88 ± 32.53 initially to 310.52 ± 64.74 at1 month) postoperatively in diabetic patients. This difference could be due to inclusion of severe diabetic retinopathy subjects which might shows higher increase in macular thickness. Another study by El-Sobkya HM et al[16] also reported increase in central macular thickness. In diabetic group, the preoperative CMT was 245 ± 57.89 µm. At the first follow-up, the CMT mean foveal thickness was 300.35 ± 76.28 µm, whereas at last follow-up it was 250.54 ± 82.41 µm. Similarly, Degenring RF et al[13]and Chen XY et al[17]also reported significant increase in central macular thickness.In our study parafoveal thickness also showed significant increase after phacoemulsification compared to baseline at 2,4,6 and 8 weeks follow-up (<0.001). Similar to our study Chen XY et al[17] also observed increase in average inner ring thickness from314.0 µm preoperatively to 328.2 µm (post-op 1month) to332.2 µm (post-op 3month). And the average outer ringthickness increased from276.5 µm preoperatively to 286.0 µm (post-op 1month) to 289.4 µm (post-op 3month). However, theabsolute changes in thickness were mild in all measurements.Similar results have also been reported by Biro and Balla[18], though the extentof increase was pretty much the same extent as the accuracyof OCT measurement, the definite trend of increase inthickness in all quadrants makes the probability ofmeasurement variation unlikely. However, the clinicalmeaning of this increase in macular thickness remains to beexplored, as most patients with this subclinical increasemaintain good vision after surgery.[19]In present study, 3 (4.0%) study subjects developed macular oedema after phacoemulsification till 8 weeks follow up. In our study, similar to more recent studies, OCT was used to evaluate progression of Macular oedema following cataract surgery. Earlier studies, however, reported rates of Macular oedema progression from other methods; for example, one study reported the proportion of eyes manifesting angiographic CME was 9% after cataract surgery using fluorescein angiography in people without diabetes.[4] Another study by Romero-Aroca reported development of diabetic macular oedema in 6.06% of 132 eyes on evaluation by fluorescein angiography and OCT following uneventful phacoemulsification.[8]In a single-centre study of 50 eyes, Kim SJ et al[3] reported an incidence rate of 22% of macular oedema one month after cataractsurgery which was very high compare to our study.DowlerJG et al78 also reported that DME progressed in ∼20–40% of eyes that underwent cataract surgery, 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 substantial progression of diabetic maculopathy.[20]The variability inreported progression rates of ME following cataract surgery in diabetic persons may beexplained by the lack of a unified definition of clinically-important progression of oedemaand/or different population settings or pathological parameters between studies.[21]Eriksson U et al[22]found development of clinical CME in 12% of diabetic eyes defined as a loss of >5letters between day 7 and week 6. Incidence of FA leakage was 76% in diabetic eyes. At 6 weeks, 44% of the diabetic eyes had qualitative changeson OCT. A statistically significant increase in thickness was observed for all three macular areasin both groups, part of it remaining at 6 months. Retinal thickening had poor correlation with VA.FunatsuH et al[23] also showed that diabetic macularoedema progressed in ∼20–40% of eyes that underwentcataract surgery, but in a considerable percentage ofthese eyes the macular oedema resolved spontaneously. In study by Chen XY et al[17] at 1-month follow-up postoperatively, 15 of 92 eyes met the criteria of newdevelopment or worsening of central-involved DME,including 4 eyes with pre-existing central-involved ME but in their study, they adaptedand modified the concepts provided by DRCR.net anddefined ME based on macular thickness.Liu J et al[24] from a meta-analysis also supported our study's findings. Overall,there was a statistically significant increase in CMT values in diabetic patients with mild tomoderate NPDR compared with diabetic patients without DR at postoperative 1month. Suchan increase was still higher in diabetic patients with mild to moderate NPDR at postoperative 3and 6 months. After cataract surgery,

one of the difficulties of assessing and managing ME arises from thefact that two clinical forms of oedema can be present, either alone or in combination, in this setting: DME and "post-surgical" or Irvine-Gass CME. Depending on the type of edema present, the course of treatment may be different. For example, CME maybe treated with anti-inflammatory treatments (both corticosteroid and non-steroidal). On the other hand, anti-VEGF and steroid products have increased the treatment options for CME. None of these treatments, however, have been proven definitively to have a role in the management of post-surgical ME.[25] The distinction between diabetic maculopathy and pseudophakic "Irvine Gass" cystoid macular oedema in postoperative cataract patients remains controversial. Pollack A et al[26]reported natural history of macular oedema in diabetics after cataract surgery by first prospective controlled trial. They found that although 22 of the 44 patients in their study developed postoperative macular oedema, this settled without recourse to laser treatment in 11. Only five patients required laser treatment for clinically significant oedema which met the ETDRS criteria, findings which suggested that the early laser treatment of all diabetics with postoperative macular oedema was unnecessary. [26]Benson later proposed that laser photocoagulation of postoperative macular oedema in diabetic patients should therefore be delayed for up to 6 months to allow the Irvine Gass component to resolve before applying treatment.[27]

Limitations

- As previous studies revealed, DME and Irvine-Gass cystoid macular edema(CME) both types of ME can occur in diabetic eyes undergoing cataract surgery. However, in our study, we did not differentiate these two types.
- Follow-up time of only 8 weeks is another limitation of study. Though studies suggested that more than 60% ME occur at 1-month follow-up, there are reports that ME occur at 6months or even 1year after surgery. Study with longer follow-up in the future is needed to derive a more accurate incidence of ME in diabetic eyes after cataract surgery.
- In our study, since measurements of blood sugar, HbA1c, and blood pressure were not obtained during follow-up in this observational study, we cannot determine from this study whether sudden worsening of these features accounted for the results.
- We used only OCT to detect macular oedema which is not a gold standard for detection. It is difficult to tell these two forms apart just assessing OCT measurements, obtaining parallel results of fundus fluorescence angiography may help to differentiate as petaloid accumulation of fluorescein around the fovea with staining of the optic disc characteristic of Irvine-Gass CME.

Conclusion

From the observations made during the course of the study and considering the results & discussion of the present study, it was found that central and perifovealthickness increases in diabetic eyes after phacoemulsification regardless ofstages of DR. Clinicians should continue to maintain vigilance in diabetic patients after cataract extraction, and OCT should be used before surgery to establish baseline measurements which will help to assess the risk of ME development.Studies with large sample size and longer follow up are needed to assess the risk of Cystoid macular oedema (CSME) progression after cataract surgery and to see whether increase in central and perifoveal thickness after phacoemulsification is temporary or permanent because macular oedema may follow a benign course and any progression that is observed postoperatively can also represents natural progression rather than being a direct effect of surgery.

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