Evaluation of the status of diabetic retinopathy after cataract surgery

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Abstract
Diabetes mellitus (DM) affects about 400 million adults globally, a number that is predicted to be doubled by 2035 according to the world health organization (WHO).When cataract surgery is done on diabetic patient the status of retina and retrieval of vision depends on severity of diabetic retinopathy and previous treatment received. In diabetic patients, macular oedema after cataract surgery can be a frequent and complex problem, especially in the patients with pre-existing diabetic retinopathy. The objective of present study is to evaluate the status of diabetic retinopathy after cataract surgery. The hospital based prospective, observational study was carried out. 50 diabetic patients underwent cataract surgery between October 2017 to September 2018. All were studied postoperatively at 1 month and 3 months.
This study used OCT to evaluate macular oedema in patients which in turn helped to find out the status of diabetic retinopathy. The present study does not show any progression in diabetic retinopathy in the operated eyes over the short term follow up of 3 months. None of the patients who were having no retinopathy pre-operatively developed retinopathy post operatively.

Keyword:Diabetic retinopathy, cataract, macular oedema

Introduction

Diabetes mellitus (DM) affects about 400 million adults globally, a number that is predicted to be doubled by 2035 according to the world health organization (WHO). Cataract and diabetic retinopathy are the prime source of acquired blindness throughout the world which is further saddened by the fact that patients with diabetes have an increased risk of developing cataracts [1].In an otherwise healthy eye, modern cataract surgery can restore excellent vision and correct myopia, hyperopia and astigmatism. But when there is a coexisting diabetic eye disease, cataract surgery may put additional stress on the eye and can lead to macular oedema, progression of retinopathy and limited vision [2].

Nowadays after accomplishment of cataract surgery, macular oedema (ME) is the most common cause of visual loss. Macular oedema is caused by increased vascular permeability in retinal capillaries as well as from microaneurysms [3]. Macular oedema can be observed with slit lamp biomicroscopy using +78D lens, while Optical Coherence Tomography (OCT) delineates the lesion much better. Cataract is more widespread and its development is rapid in diabetic patients. Due to altered blood retinal barrier and presence of diabetic retinopathy, incidence of macular oedema is also increasing [4]. Several studies made attempts to identify the risk factors of post-operative macular oedema in diabetic eyes, though the exact cause of

this phenomenon is still undetermined.

Optical Coherence Tomography is a new digital imaging technique first described in 1991. This provides high-resolution, cross-sectional imaging of the macula.[5]OCT compared to other tests is objective and takes only four seconds to perform. The third-generation machine, Stratus OCT (Carl Zeiss Meditec, Dublin, CA), is able to quantify the macular thickness at a resolution of approximately 10 µm axial resolution. Thus by using 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 [6-7].

The objective of present study is to evaluate the status of diabetic retinopathy after cataract surgery.

Materials and methods

The study was conducted at Department of Ophthalmology, Jawaharlal Nehru Hospital and Research Centre, Bhilai (C.G.), India. In present study, Patients enrolled were regularly visiting Department of Ophthalmology, J.L.N. Hospital and Research Centre, Bhilai who also fulfilled the inclusion and exclusion criteria.

Pre-operative assessment

In all patients a detailed history regarding age, sex, type of diabetes, duration of diabetes, any other systemic ailments and treatment taken. History of previous laser photocoagulation, prior intra-ocular surgery, treatment with intravitreal anti-VEGF or subtenon kenacort, medication taken for diabetes was also recorded. Any other systemic medication used like Angiotensin converting enzyme (ACE) inhibitor was recorded. All patients underwent complete ocular examination, clinical examination including general examination with vital parameters. Systemic examinations included examination of central nervous system, cardiovascular system, respiratory system and abdomen.

Ocular examination: A detailed ocular examination was carried out under following headings:

- **Visual acuity:** Preoperative visual acuity both for distance and near was determined.
- **Preliminary examination:** of the eyes was done with torch light.
- **Anterior segment examination:** Done with slit lamp examination.
- **IOP measurement:** was recorded with Goldman's applanation tonometer based on imbert fick principle.
- **Fundus examination:** Was done after dilating the pupil with tropicamide 0.8% and phenylephrine 5% eye drop using direct and indirect ophthalmoscope. Slit lamp biomicroscopy was done with 90D lens.7 field fundus photographs were taken in all diabetics pre-operatively. Fundus fluorescein angiography was done. The level of diabetic retinopathy was recorded as none, mild, moderate and severe NPDR or proliferative diabetic retinopathy (PDR) as per ETDRS [8].
- **Lacrimal sac syringing:** To test the patency of lacrimal passages was done in all cases.
- **Optical coherence tomography:** Was done in all the patients pre-operatively.
- **Refraction:** Was done with streak retinoscope at 2/3rd meter distance.
- **Routinely systemic evaluation:** Of blood pressure and electrocardiography was done. Total blood count, differential count, haemoglobin, postprandial blood sugar, renal function tests and lipid profile.

Follow-up visit: All the patients were followed up for minimum 3 months. At 1 and 3 month visit they had undergone complete ocular examination including visual acuity, intra-ocular pressure, IOL position, anterior and posterior segment examination, status of diabetic retinopathy, 7 field fundus photo and OCT.

Ocular examinations at each visit

- **Visual acuity:** Was recorded using snellens chart and E chart for illiterate the visual acuity from snellen's chart was converted to log MAR unit.
- **Fundus examination:** Performed using direct ophthalmoscope, indirect ophthalmoscope, and slit lamp bio microscopy using 90D lens. Status of diabetic retinopathy was recorded.
- **7 field fundus photographs:** was taken in all the diabetic patients.
- **FFA:** Was done as and when required.
- **OCT:** Was repeated at 1 month and 3 months from same landmark post operatively. Grading of diabetic retinopathy was done by two observers as per ETDRS[8]report 26 from digital fundus photograph.

The level of diabetic retinopathy was recorded as none, mild, moderate and severe NPDR or proliferative diabetic retinopathy (PDR) as per ETDRS [8].

Results and observations

The hospital based, prospective, observational study was carried out in Department of Ophthalmology, Jawaharlal Nehru Hospital & Research Centre, Bhilai (C.G.), India from October 2017 to September 2018.

50 diabetic patients underwent cataract surgery between October 2017 to September 2018. All were studied postoperatively at 1 month and 3 months. From 50 patients 30 were males and 30 were females. 28 patients were below 60 years and 22 patients were 60 and above. 9(18%) patients were on insulin, 30(60%) patients were on oral hypoglycaemic and 11(22%) were treated by healthy diet. Among them 17(31%) were of type I diabetes i.e., insulin dependent diabetes and 33(66%) were of type II diabetes i.e. non-insulin dependent diabetes, as decided by patients diabetologists. Duration of diabetes at cataract surgery was 66% for below 10 years and 34% for 10 years and above. The stage of diabetic retinopathy was divided into no retinopathy (n=24, 48%), mild (n=11, 22%), moderate (n=7, 14%) and severe non proliferative diabetic retinopathy and proliferative diabetic retinopathy (n=8, 16%).

Table 1: Clinical characteristics of diabetic patients operated for cataract

Number (male/female)	50 (30/20)
Age at cataract surgery	
Below 60 years (%)	28(56%)
60 years and above (%)	22 (44%)
Duration of diabetes at cataract surgery (years)	
Below 10 years	33(66%)
10 Years and above	17(34%)
Treatment	
Insulin treatment (%)	9(18%)
Oral treatment (%)	30(60%)
Diet alone (%)	11(22%)
Type of diabetes	
Type 1 (%)	17(34%)
Type 2 (%)	33(66%)
Distribution of Retinopathy before surgery	
No DR	24(48.0%)
Mild DR	11(22.0%)
Moderate NDPR	7(14.0%)
Severe NDPR + PDR	8(16.0%)

Table 2: Corelation of line and fast macular scan in diabetic patients

Foveal thickness	Preoperative	1 month	3 month
Line scan	195.34±95.78	219.20±139.21	215.62±117.12
Fast macular scan	205.86±111.67	233.14±134.62	224.14±105.87
Mann-Whitney U test-difference between two scans	P=0.131	P=0.182	P=0.169

The mean foveal thickness by fast macular scan was pre-operatively 205.86±111.67µm which increased in the postoperative period to 233.14±134.62µm at 1 month and 224.14±105.87 µm at 3 months. While by line scan the pre-operative foveal thickness was 195.34±95.78µm and at 1 and 3 months postoperatively was 219.20±139.21µm and 215.62±117.12µm respectively. The readings by line scan were less than the readings obtained by fast macular scan (p value = 0.131, 0.182, 0.169).
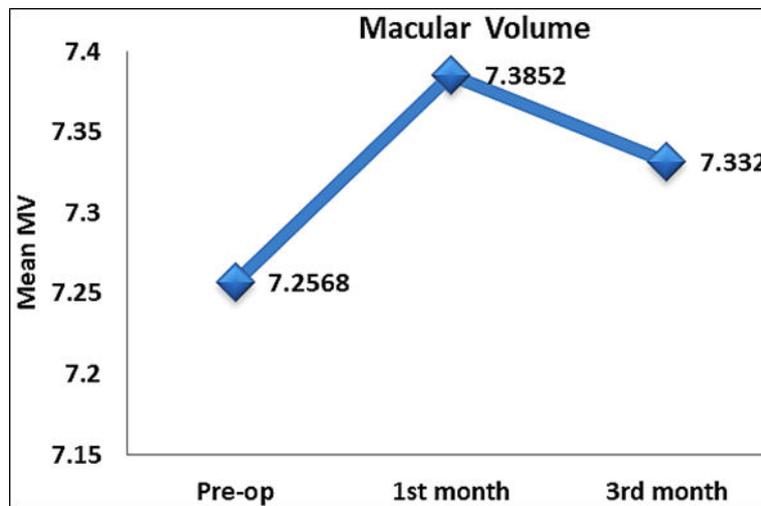

Fig 1: Mean macular volume preoperatively, 1 month and 3 months

The mean macular volume in patients was preoperatively $7.25\pm1.72mm^3$, increased to 7.38 ± 2.05 mm^3 (p=0.042) and 7.33 ± 1.74 mm^3 (p=0.285) at 1 month and 3 month respectively. The increase was higher by 1.8% and 1.1% from the baseline at one and three months respectively.
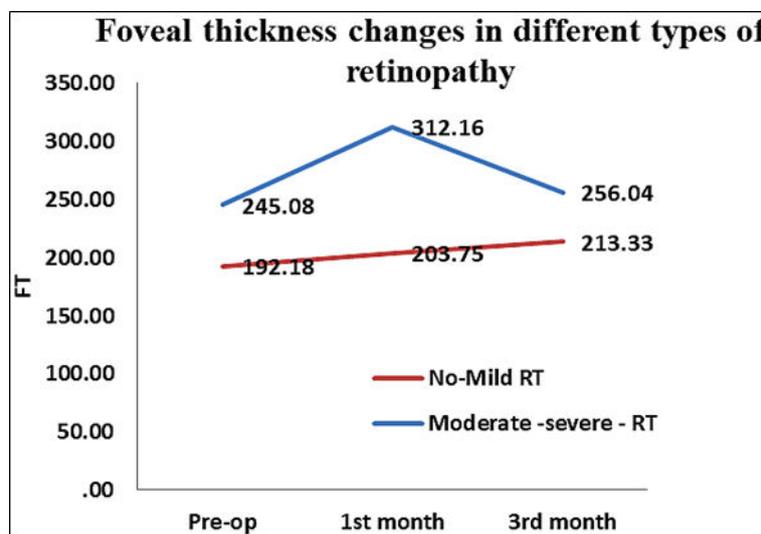

Fig 2: Foveal thickness (microns) changes in different types of retinopathy

For the purpose of further statistical analysis, patients were clubbed into no-mild retinopathy and moderate-severe retinopathy. The foveal thickness and macular volume at 1 month were statistically significant as compared to pre-operative values (p=0.001, 0.017) in patients of moderate-severe NPDR. But in patients with no retinopathy and mild NPDR mean foveal thickness and macular volume increase at 1 month was not significant (p value=0.14, 0.78). The comparison of change in foveal thickness between no-mild retinopathy patients and moderate-severe retinopathy patients were not statistically significant at 1 and 3 months (p= 0.109, 0.782). This could be attributed by wider range of data for foveal thickness and higher standard deviation in moderate-severe retinopathy group.
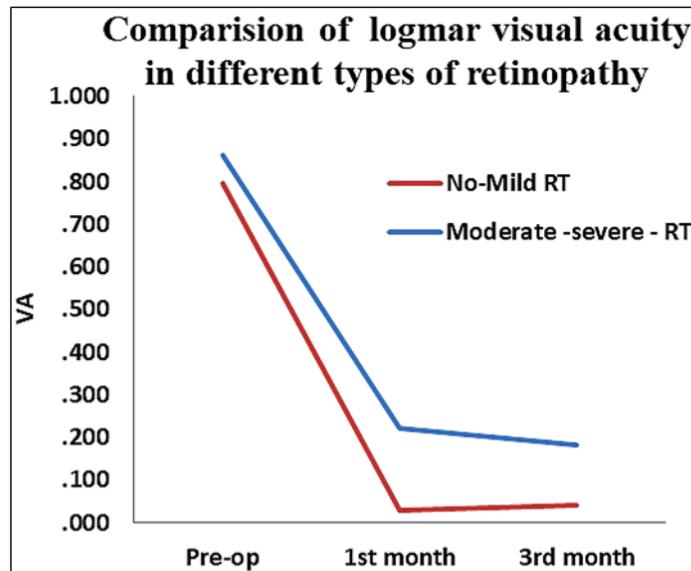

Fig 3: Comparison of visual acuity (log MAR) in different types of retinopathy

The log MAR visual acuity is improving significantly in all patients at 1 and 3 months, although improvement in moderate- severe group (log MAR 0.18, 0.15) is 1 line less than no-mild (log MAR 0.08, 0.06) retinopathy patients at 1 and 3months respectively (p value= >0.05). The final visual acuity between these patients was not statistically different (p=>0.05).

None of the patients of no diabetic retinopathy had post-operative CME and 30.3% had CME from mild, moderate and severe NPDR group (p value=0.01). There was no significant association between hypertension, type of diabetes, type of treatment and cystoid macular oedema.
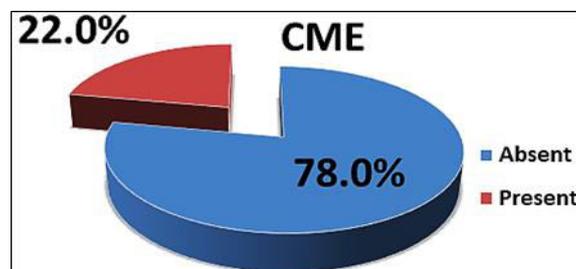

Fig 4: Cytoid macular edema

The incidence of post-operative cystoid macular oedema is present in 22% (n=11) patients.

Discussion
When cataract surgery is done on diabetic patient the status of retina and retrieval of vision depends on severity of diabetic retinopathy and previous treatment received. In diabetic

patients' macular oedema after cataract surgery can be a frequent and complex problem, especially in the patients with pre-existing diabetic retinopathy [9].Flesner P et al. [10] reported increased risk of macular oedema after cataract surgery in a relatively low risk group of diabetic patients as well.

Our study included 50 diabetic eyes, completing 3 months of follow up. The mean age in our study was 57.82, which was younger age group as compared to other studies [11, 12] where the mean age was ranging between 68 to 76 years. Male to female ratio was 1.6:1 in our study which is comparable to other study [11]. All the diabetic patients in the present study were metabolically stable pre-operatively consistent with a study and thus ruled out any confounding effect of systemic variables. Our study had predominance of Type 2 DM patients over Type 1 DM (1.9:1), comparable to study by Kim SJ et al., [11] (2:1).

In our study both fast macular and line scans were used to compare foveal thickness while in other studies only fast macular scan was used. The foveal thickness readings by line scan were less than that obtained from fast macular scan at all the follow ups (p value >0.05). In view of fast macular scan being used in most of the studies to measure the foveal thickness and macular volume, further analysis was carried out considering fast macular thickness scan readings.

In our study foveal thickness and macular volume was maximum at 1 month and decreased at 3 months but did not return to baseline which was consistent with the result by Kim SJ et al., [11] in a study by Jurecka T et al., [13] they did 6 month follow up and found normalisation of retinal thickness at 6 months. Mean increase in foveal thickness was 28 µm (13%) at 1 month in diabetics in the present study as compared to 50 µm increase (30%) in the study by Kim SJ et al. [11] At three months the foveal thickness was 38µm above the preoperative value in our study, which was comparable with 37 µm as reported by Kim SJ et al. [11]

Comparison depending on type of retinopathy: The present study did not find any significant difference as found by Hayashi K et al. [14] of increased foveal thickness and macular volume in diabetic retinopathy eyes compared to eyes without retinopathy. Our study did not find any significant increase in foveal thickness postoperatively between (no, mild) and (moderate, severe) retinopathy eyes. In a study by Kim SJ et al. [11] they showed a significant increase in foveal thickness of moderate and severe NPDR and PDR at one and three months. However, the final visual acuity in our study in eyes with retinopathy is one line less than no retinopathy eyes consistent with results by Kim SJ et al. [11].

Effect on macular thickness after phacoemulsification: Several studies were conducted to evaluate effect on macular thickness after uncomplicated phacoemulsification months, which was consistent with results by Perente I et al. [15] and Biro Z et al. (Our study on diabetic. please omit this.

Ching H-Y et al. [17] found significantly less foveal thickness post operatively as compared to pre-operative value, which they had attributed to status of lens affecting quality of OCT image.

Incidence of CME

The incidence of CME in diabetic was 22% in present study which was similar when compared to study by Kim SJ et al. [11] on diabetics (22%). However, Kim SJ et al. [11] defined CME as increase of foveal thickness by greater than 30% from the baseline and did not consider cystoid spaces. The incidence of CME in diabetics in a report by Pedro Romero-Aroca et al. [18] was very less as compared to our study (1.52%).The increased incidence of CME is attributed to defective blood retinal barrier and higher levels of VEGF in diabetics.

Final vision gains in diabetic patients: Diabetic CME patients had less vision at 3 months. Four diabetic CME patients were given sub tenon kenacort for CME after which it was resolving, others resolved on their own.

Progression of Diabetic Retinopathy: The present study did not report any progression of diabetic retinopathy in the operated eyes over the short term follow up of 3 months, which was consistent with the results by Squirrell D *et al*. [19] who concluded that uncomplicated phacoemulsification does not cause acceleration of diabetic retinopathy and any progression reported by other studies could be because of natural history of the disease.

None of the patients who were having no retinopathy pre-operatively developed retinopathy post operatively consistent with findings by Kim SJ *et al*. [11]. This may be because of strict metabolic control during the study period.

No positive correlation was found between hypertension, type of diabetes, type of treatment and macular thickness in contradiction to report by Kim SJ *et al*. [11] who found that insulin dependence is associated with more postoperative macular oedema and reduced visual improvement. Our study included a smaller number of IDDM patients as compared to previous study.

Relation between duration of diabetes and development of CME

The duration of diabetes (>10 years) had borderline significance in development of post-operative CME (p=0.056) and this finding is strongly positive and consistent with study by Kim SJ *et al*. [11] The results in our study suggest that OCT is effective tool in estimating the post-operative macular oedema and should be done if available to get baseline macular status and diagnosis. The preoperative evaluation of macular status in diabetics by OCT is important in determining post-operative visual gain.

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