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Assessment of macular thickness following cataract surgery in diabetic patients

Apurva H Suthar

Associate Professor, Department of Ophthalmology, GMERS Medical College, Vadnagar, Gujarat, India

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ABSTRACT

Background: Cataracts and diabetes very commonly coexist. While the results of cataract extraction (CE) procedure are astounding, patients with diabetes may have more unfortunate visual outcomes in comparison to their counterparts. **Aims and Objectives:** This study is planned to see the frequency of development of macular oedema (ME) in diabetic patients as compared to non-diabetics and also to see the progression of ME after cataract surgery. **Materials and Methods:** This prospective comparative study enrolled 100 diabetics and 100 non-diabetics undergoing cataract surgery fulfilling inclusion criteria. Complete ocular examination was done for both the groups preoperatively and postoperatively at 1 week, 1 month, and 3 months including central macular thickness evaluation using optical coherence tomography (OCT). **Results:** Improvement in visual acuity was observed in both the group but, non-diabetics achieved better visual acuity in comparison to diabetics. A significant increase in mean central foveal thickness (CFT) in diabetics and in non-diabetics post 1 month of surgery was observed; however, at 3 month, the difference was not significant. All the patients with mild, moderate, and severe non-proliferative diabetic retinopathy (NPDR) showed increment in the CFT from the baseline value but none of the patient of mild NPDR grade presented with new development of clinically significant macular edema on OCT. **Conclusion:** Cataract surgery causes a significant increase in macular thickness post 1 month of surgery in both diabetic and non-diabetics. Cataract surgery did not lead to the progression of stages of DR, although patients with all the three grades of DR showed increment in CFT from the baseline reference value.

Key words: Cataract extraction; Cataract surgery; Central foveal thickness; Diabetes mellitus

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INTRODUCTION

Diabetes mellitus (DM) is the most frequent metabolic disorder in humans. It is one of the greatest public health problems worldwide, involving a large amount of financial and human resources. Diabetes causes many ocular complications, such as cataracts and diabetic retinopathy (DR), which are the main causes of decreased vision in diabetic patients and often coexist.[1] Cataracts occur more frequently and earlier in diabetic patients than in non-diabetic patients. Phacoemulsification surgery can not only improve visual acuity but also help doctors detect DR in the early stage.[2] However, some studies have shown that cataract surgery can accelerate the progression of DR, and the incidence of macular edema is significantly higher in diabetic patients.[3,4]

In India, cataract is the leading cause of blindness and various researches has shown that liquefaction of lens fibers precipitates more rapidly in diabetic individuals and at an early age.[5,6] While the results of cataract extraction (CE) procedure are astounding, patients with diabetes may have more unfortunate visual outcomes in comparison to their counterparts. It can precipitate retinopathy more rapidly, induce rubeosis, or lead to macular changes like macular edema (ME).[7] Optical coherence tomography (OCT) is a very sensitive modality for visualization of ME.[8] It has shown to be able to detect subtle irregularities and has become essential for monitoring the pre- and post-operative course. Both

Address for Correspondence:
Dr. Apurva H Suthar, Department of Ophthalmology, GMERS Medical College, Vadnagar, Gujarat, India. **Mobile:** +91-9601885753.
E-mail: apurva.suthar@ymail.com

qualitative and quantitative data can be provided by OCT to investigate the interrelationship of edematous macula and CE in subjects with DR.[9] The advantage of OCT for the assessment of ME is its accuracy and reproducibility.[10] Hence, this study is planned to see the frequency of development of ME in diabetic patients as compared to non-diabetics and also to see the progression of ME after cataract surgery.

Aims and objectives

The purpose of this study is to compare the frequency of ME development in diabetes patients to that in non-diabetics and to track the development of ME following cataract surgery.

MATERIALS AND METHODS

This prospective comparative study was conducted after clearance from College Research Committee and Ethical Committee of the institute. After obtaining informed consent, total 300 subjects, 150 diabetics and 150 non-diabetics, were enrolled during the study period of 1 year.

Inclusion criteria

All patients with cataract of either gender above 18 years of age were included and sub-divided into study group having diabetic patients with cataract and control group containing non-diabetic patients and patients with any complication during cataract surgery, any ocular or systemic condition that can cause ME, patients with a history of ocular trauma, vitreoretinal surgery, or glaucoma surgery in the same eye, and patients with presence of any retinal or choroidal disease.

Exclusion criteria

Other than diabetes in the same eye, patients with a history of treatment for diabetic macular edema or proliferative DR within 6 months prior surgery, and patients with any other ocular/systemic comorbidity which will hinder fundus examination and OCT were excluded from the study.

Each patient underwent best corrected visual acuity examination with logMar equivalent of snellen's chart, slit lamp examination of the anterior segment, slit lamp biomicroscopy of the fundus using + 90D lens, and intraocular pressure measurement using non-contact tonometer. On dilated fundus examination, DR and clinically significant macular edema (CSME) were graded as per early treatment DR scale criteria. Central macular thickness evaluation was done using macular cube scan 512*128 protocol of OCT cirrus HD machine. Pre-operative macular thickness was referred as baseline reference value. Study group patients were evaluated for fasting plasma glucose, postprandial blood glucose, and hemoglobin A1C levels. Cataract surgery was performed by the experienced surgeon. Follow-up of the patients was done at 1 week, 1 month, and 3 month. Complete ocular examination and OCT for macular thickness evaluation were done at 1st month and 3rd month.

Statistical analysis

The recorded data were compiled and entered in a spreadsheet computer program (Microsoft Excel 2007) and then exported to data editor page of Statistical Package for the Social Sciences version 15 (SPSS Inc., Chicago, Illinois, and USA). For all tests, confidence level and level of significance were set at 95% and 5%, respectively.

RESULTS

In the present study, age of patients enrolled ranged between 40 and 90 years, mean age of patients was 62.58±10.12 years. Both the groups had equal representation of male and female (Table 1). Diabetics were found to be associated with hyper dense and more of with Grade 4 cataract ($P<0.05$). Improvement in visual acuity was observed in both the group but, non-diabetics achieved better visual acuity in comparison to diabetics. A significant increase in mean central foveal thickness (CFT) in diabetics and in non-diabetics post 1 month of surgery was observed; however, at 3 month, the difference was not significant [Table 2]. Incidence of development of CSME on OCT was 14% diabetic eyes and 5% non-diabetic eyes post 1 month of surgery. No progression of DR postoperatively at any follow-up visit was observed. Out of the 75 patients presented with DR, 30 had pre-existing CSME and worsening was observed in patients with moderate and severe non-proliferative DR (NPDR). All the patients with

Table 1: Demographics distribution of study participants

Demographics	Data
Patients (diabetics:non-diabetics)	300 (150:150)
Gender (M:F)	160:140
Age (years)	62.58±10.12
Pre-operative best corrected visual acuity in diabetics (logMAR)	1.26±0.24
Pre-operative best corrected visual acuity in non-diabetics (logMAR)	0.70±0.59
Baseline CFT in diabetics (μm)	262.94±83.45
Baseline CFT in non-diabetics (μm)	219.05±36.40
DR stages	
No DR	74/150
Mild NPDR	15/150
Moderate NPDR	18/150
Severe NPDR	12/150
Pre-existing ME	30/150

CFT: Central foveal thickness, DR: Diabetic retinopathy, NPDR: Non-proliferative diabetic retinopathy, ME: Macular edema

Table 2: Comparison of CFT between diabetics and non-diabetics

Groups	Mean	Standard deviation	P value
Pre-op			
Diabetics	262.90	82.40	0.001*
Non-diabetics	221.45	36.15	
1st month			
Diabetics	286.15	105.22	0.03*
Non-diabetics	242.10	38.47	
3rd month			
Diabetics	240.14	66.23	0.20
Non-diabetics	227.45	56.55	

*Indicates statically significance at P≤0.05

mild, moderate, and severe NPDR showed increment in the CFT from the baseline value but none of the patient of mild NPDR grade presented with new development of CSME on OCT.

DISCUSSION

At present, cataracts and diabetes very commonly coexist. The conclusions of studies on the development of DR and DME after cataract surgery are controversial. Some studies have shown that phacoemulsification can accelerate DR.[11,12] Other studies suggest that the development of DR and DME after cataract surgery is part of the natural history of the disease and that cataract surgery does not cause the progression of DR.[13,14] The mean age of study population in present investigation was found to be 62.58±10.12 years in both the groups. This was lower compared to that seen in the study by Mentes et al., and by Chen et al.[15,16] Out of total diabetic patients, 34 patients had Type 2 DM for more than 10 years and 77 patients had h/o DM for <10 years. Similarly, Singhi and Bora reported that 37 subjects had T2DM for more than 10 years and 63 subjects had T2DM for <10 years.[17]

Diabetics were found to be associated with hyper dense and more of with Grade 4 cataract. The difference was highly significant in distribution between diabetics and non-diabetics. In support of our study Schafer et al., in their study compared grades of cataract in diabetics and non-diabetics and found diabetics to be associated with higher grades of opacities in comparison to nodiabetics.[18]

In this clinical study, visual acuity improved in both the groups postoperatively at 3 months. However, non-diabetic group achieved better visual acuity postoperatively in comparison to diabetics this difference is due to the "diabetic retinal changes present" in diabetic group. In a study by Chen et al., mean pre-operative BCVA of diabetics in log MAR units was 0.57±0.47 and mean BCVA (log MAR) improved from 0.57 to 0.35 at 1mo and 0.26 at 3 months which is nearly comparable to our study.[16]

The rate of development of macular edema following cataract surgery at different time intervals in people with diabetes varies from 31% to 81%.[18] Certain minimal changes in the retina like subclinical CME and retinal leakage can occur even after uneventful cataract surgery. These subclinical changes in macular thickness after cataract surgery can be easily diagnosed on OCT and fluorescein angiography (FA).[11] It has been reported by some studies that macular edema after cataract surgery, in people with diabetes, may occur predominantly in patients with concurrent pre-existing DME involving the center of the macula. On the other hand, some researchers have reported that for post-operative macular edema to develop pre-existing DME is not required.[5] However, these studies were completed before the availability of OCT technology. For detecting CME, the sensitivity and specificity of OCT are 96% and 100%, respectively, compared with FA.[19]

On comparing CFT between diabetics and non-diabetics, highly significant increase in mean CFT was found in diabetics as compared to non-diabetics at 1-month post-operative. In diabetics, pre-operative mean CFT was 262.90±82.40, which increased to 286.15±105.22 post 1 month of surgery. In non-diabetics, mean pre-operative CFT was 221.45±36.15, which increased post 1 month to 242.10±38.47. Post 3 months of surgery a decline in the mean CFT was observed in both diabetics from 286.15±105.22 to 242.10±38.47 and in non-diabetics from 242.10±38.47 to 227.45±56.55. Chen et al., found a substantial amount of expansion in mean central subfield foveal thickness from baseline value (246.6 μm), at 1-month (267.6 μm) and at 3-month (272.1 μm) of follow-up postoperatively, respectively, (P<0.05) which is nearly comparable to our study.[16] Baker et al., assessed severity of DR in 229 (82%) eye post 16 weeks of surgery did not found any change in the severity of DR from baseline.[11]

In the present study, incidence of new development of CSME on OCT was 14% in diabetic patients and 5% in non-diabetic patients. The average increase in CFT post 1 month in diabetics and non-diabetics was 286.15±105.22 and 242.10±38.47, respectively. Although patients presented with all the grades of retinopathy show "increase in macular thickness" most of the patients with moderate-and-severe NPDR have developed CSME post 1 month of surgery. Furthermore, patients with "pre-existing CSME" presented with the "worsening of the ME" post 1 month of surgery and at 3 months of surgery a declining trend was seen in the incidence of CSME. Similarly, in a study by Chen et al.,[16] they discovered that post 1 month following surgery, 11 eyes with central macular involvement and nine eyes with non-central involvement developed DME, four eyes with central involved, and six eyes with non-central involvement "met the criteria of worsening of DME." Kurt and Kilic[20] showed a decrease

in MT on the first post-operative day, increases at week 1 and months 1 and 3, and a relative decrease at month 6, although MT did not return to pre-operative levels. Zhao et al.,[21] also reported that at 1 month and 3 months after surgery, the full retina of the fovea, parafovea, and perifovea increased significantly, and this change was more obvious in the inner layer. There is some disagreement in the observations of various studies reporting an increase in CMT or development of macular edema after cataract surgery in patients with diabetes without DR. In a case–control study conducted on around 4500 diabetics without pre-operative macular edema, the incidence of post-operative macular edema was 4%, which was higher than that in the population without diabetes (P<0.001).[22] These authors also reported a higher risk for the development of macular edema (RR=1.80) in diabetic subjects without DR compared to patients without diabetes (RR=1.17). On the other hand, Katsimpris et al., found increased macular thickness after uncomplicated cataract surgery in diabetics without DR compared to pre-operative values or to a control group of patients at all follow-ups up to 12 months after cataract surgery.[23] Many studies have postulated an association between progression of DR and cataract surgery,[24] whereas other studies did not observe any significant association and consider any diabetic retinal changes as part of the natural course of the disease.[25]

Limitations of the study

Limitation of our study was may be small sample size so studies with large sample size may be required to access the risk of progression of macular thickness.

CONCLUSION

Cataract surgery causes a significant increase in macular thickness post 1 month of surgery in both diabetic and non-diabetics. Cataract surgery did not lead to the progression of stages of DR, although patients with all the three grades of DR showed increment in CFT from the baseline reference value. Furthermore, a positive correlation was found in patients with presence of ME preoperatively for worsening of ME postoperatively with a peak at 1 month and shows a declining trend at 3 months.

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AS- Concept and design of the study, prepared draft of manuscript, interpreted the results, reviewed the literature and manuscript preparation, concept, coordination, preparation of manuscript, statistical analysis, and interpretation.

Work attributed to:
Department of Ophthalmology, GMERS Medical College, Vadnagar, Gujarat, India.

Orcid ID:
Dr. Apurva H Suthar - https://orcid.org/0009-0004-2543-710X

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