

Macular edema after cataract surgery in diabetic patients evaluated by Spectral domain OCT at Thammasat eye center

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Objective: To estimate the incidence of postoperative development of macular edema among diabetic patients with and without diabetic retinopathy. A comparative study of central macular thickness was performed on this population before and after uncomplicated cataract surgery.

Methods: Forty-two diabetic patients with no diabetic retinopathy (no DR) and 23 diabetic patients with diabetic retinopathy (DR) that underwent phacoemulsification with intraocular lens implantation were enrolled in this study from March 2017 to May 2018. Central macular thickness (CMT) was measured with spectral domain optical coherence tomography (OCT). These parameters were recorded before and four-weeks after cataract surgery then analyzed using descriptive statistics.

Results: 65 patients consisted of 40 males (61.54%) and 25 females (38.46%). Mean age was 67.01 ± 8.12 years. All 65 patients had diabetes, of which 23 (35.38%) had diabetic retinopathy and 42 (64.62%) did not. Phacoemulsification with posterior chamber intraocular lens implantation were performed in all eyes. No serious intraoperative complications were found. Mean preoperative CMT were 230.10 ± 25.25 and 233.78 ± 28.13 μm in the no DR and DR group respectively ($P=0.705$). Mean postoperative CMT were 235.67 ± 27.59 and 239.04 ± 29.68 μm in the no DR and DR group respectively ($P=0.676$). Mean CMT increased over the preoperative study 5.57 ± 12.28 μm (2.40%) in the no DR group and 5.26 ± 7.67 μm (3.28 %) in the DR group. The incidence of all postoperative macular edema on spectral domain OCT (CMT > 300 μm) was 1.54%.

Conclusion: Central macular thickness in diabetic patients measured by spectral domain OCT increase after uncomplicated phacoemulsification at 4 weeks in both groups but there is no statistically significant difference between the no DR and DR group.

Conflicts of interest: The authors report no conflicts of interest.

Keywords: macular edema, spectral domain OCT, central macular thickness, phacoemulsification, diabetic retinopathy

Ethics: This study was approved for ethical research in human with the human research ethics committee of Thammasat University, Thailand (Research ID: MTU-EC-OP-6-016/60)

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Introduction

Cataract is a leading global cause of blindness and cataract surgery is also one of the most common surgical procedures performed worldwide.¹ Pseudophakic

macular edema occurs commonly after cataract surgery, even in the absence of risk factors and complications.² The incidence of pseudophakic macular edema in previous studies varies between 0.20% to 20%.³ In diabetic patients, postoperative macular edema is a complex and frequent encountered problem, especially in patients with preexisting diabetic retinopathy. Some investigators also found an increased progression of retinopathy and a higher incidence of macular edema after cataract surgery.⁴⁻⁶

Several studies made attempts to identify the risk factors of postoperative macular edema in diabetic eyes, though the exact cause of this phenomenon was still undetermined.⁷ Some studies found that diabetic eyes had a high incidence of increased center macular thickness on optical coherence tomography (OCT) after cataract surgery especially in eyes with a history or presence of diabetic macular edema (DME) before surgery.^{7,8} Spectral domain OCT is useful for retinal thickness monitoring quantitatively and qualitatively. It is proven to be a sensitive diagnostic test for the early detection of macular thickening in diabetic patients.⁹ Our study is designed to assess the quantitative change of macula in diabetic eyes after cataract surgery using spectral domain OCT to estimate the incidence of macular edema after surgery in diabetic eyes comparing between no DR and DR group. In eyes with diabetic retinopathy, the blood retinal barrier is often impaired to a variable degree, which may cause eyes to be more prone to developing postoperative macular edema depending on the disease severity, duration and presence of pre-existing macular edema.⁸

Materials and Methods

A prospective cohort study was conducted at Thammasat eye center from March 2017 to May 2018. Forty-two diabetic patients with no DR and 23 diabetic patients with

DR who underwent phacoemulsification with intraocular lens implantation were enrolled.

Inclusion criteria

1. Eyes diagnosed cataract in diabetic patient by a consultant level ophthalmologist.
2. Patients aged between 30 to 80 years old.
3. Patients informed and consented to participate in this study.
4. Patients able to attend follow-up at least 4 weeks postoperatively.

Exclusion criteria

1. Eyes with presence of macular edema within 3 months before surgery.
2. Eyes with previous macular scar, ocular trauma or other retinal diseases.
3. Eyes with history of previous intraocular surgery.
4. Patients with intraoperative or postoperative complications such as ruptured posterior capsule or endophthalmitis.
5. Patients unable to consent for follow up according to study protocol.

This study had been approved by the ethics committee of Thammasat University, Thailand. Informed consents were obtained from all patients. The authors verified that all applicable institutional and governmental regulations concerning the ethical use of human volunteers were followed during this research, adhering to the tenets of the declaration of Helsinki.

Patients planned for cataract surgery were examined preoperatively and at 4 weeks after surgery. Preoperative and postoperative examination included visual acuity using a Snellen chart, slit-lamp biomicroscopy, fundus examination (diabetic retinopathy graded by ETDRS). Central macular thickness were measured by spectral domain OCT using commercially available equipment (Cirrus HD-OCT, Carl Zeiss Meditec, Dublin, CA, USA). Only eyes with a confirmed absence of macular

edema before surgery were enrolled. Eyes with central subfield thickness by OCT more than 300 μm were excluded. Cataract surgeries in this study were performed by multiple surgeons with similar technique. Topical NSAIDS was prescribed preoperatively. Temporal clear cornea incision was made, and continuous anterior curvilinear capsulorhexis was performed. For cataract surgery, phacoemulsification equipment “Centurion” (Alcon Laboratories Inc., Fort Worth, TX, USA) was used in this study. Lens nuclei was divided by chopper, then phacoemulsification and cortical aspiration were performed. After that, acrylic foldable intraocular lens was inserted into the capsular bag. Steroid and antibiotic eye drops were prescribed postoperatively and adjusted by individual surgeons upon routine follow up depending on postoperative inflamed grading. The change of central macular thickness recorded before and four-week after the cataract surgery were analyzed using descriptive statistics.

Results

In this study, 65 diabetic patients joined to have cataract surgery. The average age of patient was 67.09 ± 8.12 years old. Of the 65 patients, 40 patients (61.54%) were male and 25 patients (38.46%) were female. Laterality was 31 (47.69%) on the right and 34 (52.31%) on the left eye. Overall the data on age, gender and laterality distribution did not show statistically difference. Forty-two diabetic patients had no DR while 23 diabetic patients had DR. The baseline patient characteristics of both groups are shown in table 1. Among the DR group, there were 4 subgroups: 18 (78.26%) mild non-proliferative diabetic retinopathy patients, 3 (13.04%) moderate non-proliferative diabetic retinopathy patients, 1 (4.34%) severe non-proliferative diabetic retinopathy patient and 1 (4.34%) very severe non-proliferative diabetic retinopathy patient were shown in table 2. All eyes had no macular edema before surgery. Before surgery, mean preoperative central macular thickness by spectral

Table 1: Baseline demographic characteristics in the no DR and DR group.

Patient Characteristics	no DR group (n=42)	DR group (n=23)	P
Age (years)	67.62 ± 7.93	66.13 ± 8.24	0.784
Gender	Male 25 (38.46%) Female 17 (26.15%)	Male 15 (23.07%) Female 8 (12.31%)	0.326
Laterality	Right 18 (27.69%) Left 24 (36.93%)	Right 13 (20.00%) Left 10 (15.38%)	0.854
DR staging	No DR 42 (64.62%)	DR 23 (35.38%)	1.000

Table 2: The proportion of diabetic retinopathy patients in different stages.

NPDR staging	mild NPDR	moderate NPDR	severe NPDR	very severe NPDR
Number (%)	18 (78.26%)	3 (13.04%)	1 (4.34%)	1 (4.34%)

* NPDR is non-proliferative diabetic retinopathy

Table 3: Baseline preoperative central macula thickness between the no DR and DR group.

Patient characteristics (preoperative)	no DR group (n=42)		DR group (n=23)		<i>P</i>
	Mean	SD	Mean	SD	
Preoperative CMT (μm)	230.10	25.25	233.78	28.13	0.705
Duration from surgery to postoperative OCT testing (days)	32.81	11.22	35.70	16.88	0.801

Table 4: Difference in postoperative central macula thickness between the no DR and DR group.

Patient characteristics (postoperative)	no DR group (n=42)		DR group (n=23)		<i>P</i>
	Mean	SD	Mean	SD	
Postoperative CMT (μm)	235.67	27.59	239.04	29.68	0.676
Change of CMT pre and post operation (μm)	5.57	12.28	5.26	7.67	0.456

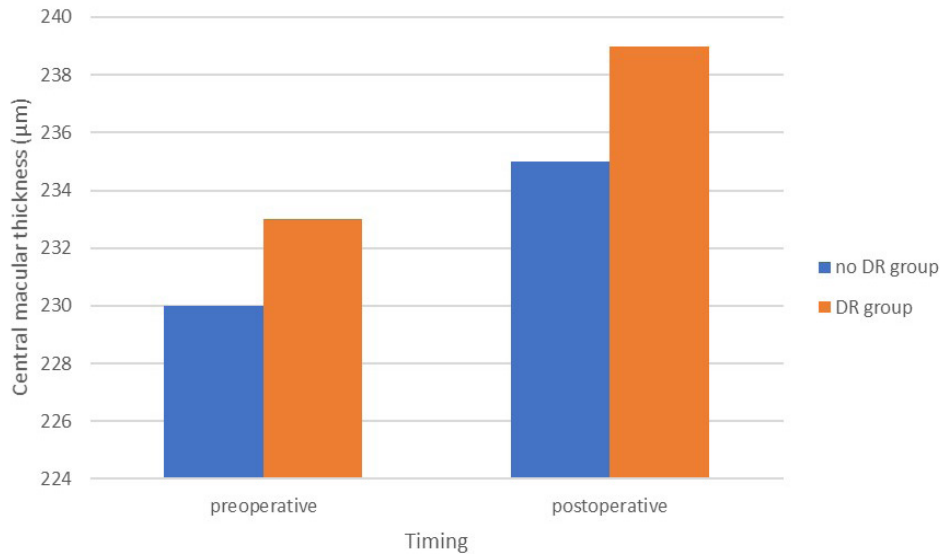


Figure 1: Comparison of preoperative and postoperative central macular thickness between no DR and DR group.

domain OCT was $230.10 \pm 25.25 \mu\text{m}$ in the no DR group and $233.78 \pm 28.13 \mu\text{m}$ in the DR group ($P = 0.705$) shown in table 3. There was no difference in preoperative CMT between the two groups.

Of all the eyes in this study, cataract surgery was performed using phacoemulsification with posterior chamber intraocular lens implantation. No serious intraoperative complications were found obviously. After cataract surgery, mean duration from surgery date to postoperative OCT testing were 32.81 ± 11.22 and 35.70 ± 16.88 days in the no DR and DR group respectively. Table 4 showed the comparison of postoperative CMT between the no DR and DR group. There was no significant difference in mean postoperative CMT ($P = 0.676$). Between the preoperative and postoperative group, mean change of CMT was also no significant difference ($P = 0.456$).

Central macular thickness increased over the preoperative study approximately 2.40% in the no DR group and 3.28% in the DR group as shown in Figure 1. Finally, the incidence of all central macular edema on postoperative OCT (CMT > 300 μm) was 1.54%.

Discussion

This study investigates the change of CMT evaluated by spectral domain OCT before and after cataract surgery in both diabetic patient groups (no DR and DR group). The results reveal an increase in CMT found at 4 weeks postoperatively in both groups ($P = 0.456$). The increasing of CMT following cataract surgery in diabetic patients depends on both the presence with and without diabetic retinopathy preoperatively. These factors possibly aggravate macular thickness after cataract surgery. Furthermore, many studies revealed increasing of CMT postoperatively. Pollack et al. found that mean central macular thickness increased approximately 21.00 μm after surgery.¹⁰ The significant increase

of CMT was detected by spectral domain OCT in their study.¹¹

Past studies have defined the incidence of macular edema after cataract surgery by fundus fluorescein angiography, but in this study today define the incidence of macular edema by spectral domain OCT. The cutoff to define macular edema varied in many studies. Some concluded that an increase of central macular thickness of 30% was a useful criteria because it was the point of experienced significant loss of vision.⁶ Following this cutoff point, the incidence of macular edema in this study is null. Typically, macular edema in diabetic patients after cataract surgery cannot be clearly attributed to a cause, whether it is as a result of diabetic retinopathy, or cases that developed cystoid macular edema (CME). In our study, every case receives non-steroidal anti-inflammatory drugs (NSAIDS) eye drops to prevent CME before the operation, which may reduce the incidence of macular edema. This finding is similar to many studies, suggesting that the macular status in diabetic patient is still good in the first 4 weeks after phacoemulsification.^{8,12} The small sample size in our study may cause our result to be insignificant. In contrast to the study of Stephen et al. which demonstrated that 22% of diabetic patients developed a 30% increase in central macular thickness at 4 weeks after uncomplicated phacoemulsification.⁶ So all of the results of these studies were not quite the same.

Upon comparing the change in CMT between the no DR and DR group after cataract surgery, we found that there were no statistically significant differences in CMT between both groups. Our result is similar to the study by Wang et al.⁸ and Flesner et al.¹³ who concluded that the level of severity of DR did not contribute to the risk for developing macular edema after cataract surgery in diabetic patients. In our study, the severity of diabetic retinopathy group

is mostly mild non-proliferative diabetic retinopathy (mild NPDR), so this may be a contributing factor towards our statistically insignificant result. Other studies comparing between 3 groups consisting of no DR, NPDR and proliferative diabetic retinopathy (PDR) group should be brought to study more. A study by Kim et al. found that different levels of preoperative diabetic retinopathy were correlated with increased postoperative central macular thickness.⁶ The eyes in their study with moderate NPDR, severe NPDR, very severe NPDR and PDR developed thickening of macula much more frequent than eyes with no DR.⁶ Back to our study, this duration of the collected data is limited to approximately 4 weeks after surgery, so we could not detect late progression of macular edema. Finally, the author also has the opinion that preoperative cataract severity factors such as lens graded opacity and the difficulty of phacoemulsification can affect central macular thickening postoperatively.

Conclusion

Mean change of CMT measured by OCT in diabetic patients of this study increased by 2.40% in the no DR group and 3.28% in the DR group after uncomplicated cataract phacoemulsification at 4 weeks, but there are no statistically significant difference of macular thickness between the preoperative and postoperative group. Also there are no statistically significant difference in change of CMT after cataract surgery between the no DR and DR group. The incidence of macular edema after cataract surgery measured by spectral domain OCT (CMT > 300µm) is 1.54%, which was found only in the DR group. Uncomplicated phacoemulsification is safe for postoperative macular edema development in patients with mild degree of diabetic retinopathy.

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