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RESEARCH ARTICLE
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ASSESSMENT OF CHANGE IN MACULAR THICKNESS USING OPTICAL COHERENCE TOMOGRAPHY AFTER UNEVENTFUL PHACOEMULSIFICATION

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ABSTRACT

Background: Macular oedema, including cystoid macular oedema, is one of the primary causes of unfavourable visual outcomes after cataract surgery.

Objectives: To determine the frequency of macular oedema after uncomplicated phacoemulsification.

Methodology: It was a descriptive case series study. The study was conducted at the Department of Ophthalmology, Services Hospital, Lahore. A total of 111 patients, aged 40-60 years, of both genders undergoing uncomplicated phacoemulsification, were selected. Operative time was noted. After surgery, patients were shifted to post-surgical wards and were discharged from there. All patients were followed up in the OPD for 12 weeks. After 12 weeks, patients were examined again for central macular thickness on OCT, and if the thickness rose by>30% from baseline, then macular oedema was labelled.

Results: The age range in this study was from 40 to 60 years, with a mean age of 51.53 ± 4.34 years. The majority of the patients, i.e. 66 (49.46%), were between 51 to 60 years of age. Out of these 111 patients, 51 (45.95%) were male and 60 (54.05%) were female, with a male-to-female ratio of 1:1.2. Mean pre-therapy CMT was 211.40 ± 10.98 µm, and post-therapy was 237.48 ± 9.79 µm. Frequency of macular oedema after uncomplicated phacoemulsification was seen in 20 (18.02%) patients.

Conclusion: This study concluded that the frequency of macular oedema after uncomplicated phacoemulsification is quite high.

Keywords: Macular oedema, macular thickness, optical coherence tomography.

Introduction

Cataract is a leading cause of reversible blindness worldwide. Phacoemulsification combined with intraocular lens implantation, the most common treatment for cataract at present, has the benefit of less tissue injury, faster incision healing, and better postoperative vision. Numerous studies have shown that better visual acuity and good visual quality can be obtained after surgery. (1, 2)

Phacoemulsification is mostly used in cataract surgery techniques nowadays. Various factors involved in Phacoemulsification can influence the tissue structures of the eyeball. (3) Phacoemulsification without complication can widen the anterior chamber and lower the intraocular pressure, and can improve the visual acuity with a short period of follow-up. (4)

Macular oedema, including cystoid macular oedema, is one of the primary causes of unfavourable visual outcomes after cataract surgery. The incidence of clinically significant cases is 1-2% (5). Cystoid macular oedema occurs between the fourth and tenth postoperative week and can manifest as visual blurring, image distortion, photophobia, or some combination thereof (6). Optical coherence tomography (OCT) has become an integral part of the diagnosis and management of glaucoma and retinal disease (2).

One study reported that the mean CMT was 214±42 pm at baseline, which insignificantly grows at 3 months ($p>0.05$) (7). While another study reported that the mean macular thickness was 222.1±22.8 µm preoperatively versus 234.6±25.2 µm postoperatively ($P = 0.0003$) (8).

A significant increase in macular thickness after uncomplicated cataract surgery has been reported. The most important finding was the regional pattern of retinal thickening with an early involvement of the parafoveal area (9, 10). This indicated that macular oedema may develop in a few cases. The frequency of macular oedema was reported in 9.6% cases after phacoemulsification (11).

One study used OCT to examine 84 eyes with ME secondary to uveitis, which provided the added benefit of revealing or confirming the presence of epiretinal membranes and serous retinal detachment in 41 and 20 per cent of their cases, respectively (12). The study found a moderate correlation between retinal thickness and decreasing visual acuity, although the degree of correlation has varied across studies, with other investigators reporting weak,(13) moderate,(14) and strong correlations (15-17) using varying statistical methods in diverse patient populations, including patients with diabetic retinopathy, uveitis and CME.

This study aims to determine the macular thickness using optical coherence tomography after uncomplicated phacoemulsification.

Methodology

It was a descriptive case series study. The study was conducted at the Department of Ophthalmology, Services Hospital, Lahore. The study duration was from 30th March 2023 to 29th September 2023. By using the WHO calculator, a sample size of 111 cases is calculated with a 95% confidence level, 5.5% margin of error and macular oedema, i.e. 9.6% on coherence tomography after uncomplicated phacoemulsification.[11] Non-probability, consecutive sampling technique was used. Patients aged 40-60 years, both genders, undergoing uncomplicated phacoemulsification (as per operational definition) were included in the study. Patients with preoperative macular edema, retinal detachment or uveitis (on clinical examination), undergoing repeat surgery, patients with corneal opacity, diabetic retinopathy, epiretinal membrane, age- related macular degeneration, invisible fundus or media opacity which can interfere with optimal imaging in OCT; h/o using prostaglandin analogues and intraoperative complications like posterior capsular rupture, damage of iris, iris protrusion through corneal incision site, vitreous loss, remaining lens cortex after surgery, posterior capsulotomy shortly after surgery, anterior chamber lens insertion, and IOL scleral fixationwere excluded from the study.

111 patients meeting the inclusion criteria were recruited for this study. Informed consent was obtained. Demographics like name, age, gender, lateral side, h/o smoking (>5 pack years),

hypertension (BP>140/90 mmHg), duration of symptom, were noted. Before surgery, OCT was performed to assess the macular thickness. Then, patients underwent phacoemulsification by a single surgical team with the assistance of a researcher. Operative time was noted. After surgery, patients were shifted to post-surgical wards and were discharged from there. All patients were followed up in the OPD for 12 weeks. After 12 weeks, patients were examined again for central macular thickness on OCT, and if the thickness rose by>30% from baseline, then macular oedema was labelled (as per operational definition). All this information was recorded in a proforma (attached). SPSS version 26 was used to analyse the data. Quantitative variables like age, duration of symptom, operative time, pre- & post-operative central macular thickness were represented in the form of mean and standard deviation. Qualitative variables like gender, lateral side, smoking, hypertension and macular oedema were represented in the form of frequency and percentage.

Effect modifiers like age, gender, lateral side, smoking, hypertension, duration of symptom, and operative time were controlled through stratification. Post stratification, the chi-square test was applied to compare stratified groups for macular oedema. P-value <0.05 was considered significant.

Results

The age range in this study was from 40 to 60 years, with a mean age of 51.53± 4.34 years. The majority of patients, i.e., 66 (49.46%), were between 51 and 60 years of age, as shown in Table I.

Table I: Distribution of patients according to age (n=111).

Age (in years)	Frequency (n) (%)
40-50	45 (40.54%)
51-60	66 (59.46%)
Total	**111 (100%)**

Mean ± SD = 51.53 ± 4.34 years

Out of these 111 patients, 51 (45.95%) were male and 60 (54.05%) were female, with a male-to-female ratio of 1:1.2. (Figure 1)

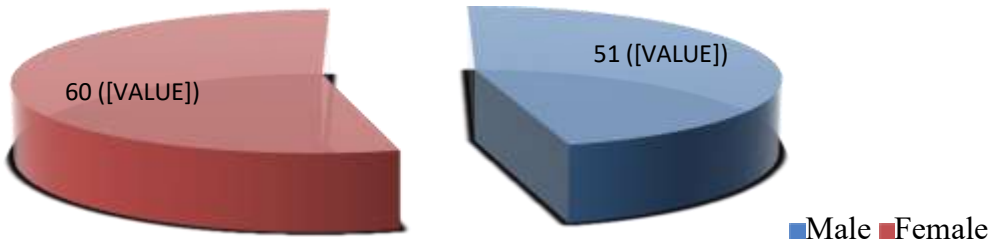

Figure 1: Distribution of patients according to Gender (n=111).

Table II represents the distribution of 111 patients based on the duration of the symptoms. Most of them (58.56%) experienced symptoms for 8 weeks or less, while 41.44% had symptoms for more than 8 weeks. The mean duration of symptoms was 9.28 weeks with a standard deviation (SD) of 3.72.

Table II: Distribution of patients according to duration of symptoms (n=111).

Duration of symptoms (weeks)	No. of Patients	%age
≤8	65	58.56
>8	46	41.44

Mean ± SD = 8.28 ± 3.72 weeks

Table II demonstrates that among 111 patients, 50.45% patients had right-sided involvement and 49.55% patients had left-sided involvement. This shows an almost equal distribution of laterality among patients.

Table III: Distribution of patients according to laterality (n=111).

Laterality	No. of Patients	%age
Right	56	50.45
Left	55	49.55

Table IV reveals that out of 111 patients, 30.63% of patients had hypertension, while 69.37% of patients did not. This shows a higher proportion of patients without hypertension in the study participants.

Table IV: Distribution of patients according to HTN (n=111).

HTN	No. of Patients	%age
Yes	34	30.63
No	77	69.37

Table V reveals that out of 111 patients, only 23.42% were smokers, while 76.58 % were non-smokers. This shows a higher prevalence of non-smokers smoking among the patients.

Table V: Distribution of patients according to smoking (n=111).

Smoking	No. of Patients	%age
Yes	26	23.42
No	85	76.58

Table IV reveals that 52.25% of study participants had an exposure time of 15 minutes or less, while 47.75% of patients exceeded 15 minutes. The mean operative time was 16.94±4.41 minutes.

Table-VI: Distribution of patients according to operative time (n=111).

Operative time (min)	No. of Patients	%age
≤15	58	52.25
>15	53	47.75

Mean ± SD = 16.94 ± 4.41 minutes

Table VII reveals a significant increase in central macular thickness (CMT) from 211.40±10.98 µm pre-therapy to 237±9.79 µm post-therapy following uncomplicated phacoemulsification. The p-value of 0.001 shows this change is statistically significant.

Table VII: Mean pre- and post-therapy central macular thickness after uncomplicated phacoemulsification.

	Pre-therapy	**Post-therapy**	**p-value**
Central macular thickness (µm)	211.40 ± 10.98	237.48 ± 9.79	**0.0001**

Frequency of macular oedema after uncomplicated phacoemulsification was seen in 20 (18.02%) patients, as shown in Figure II

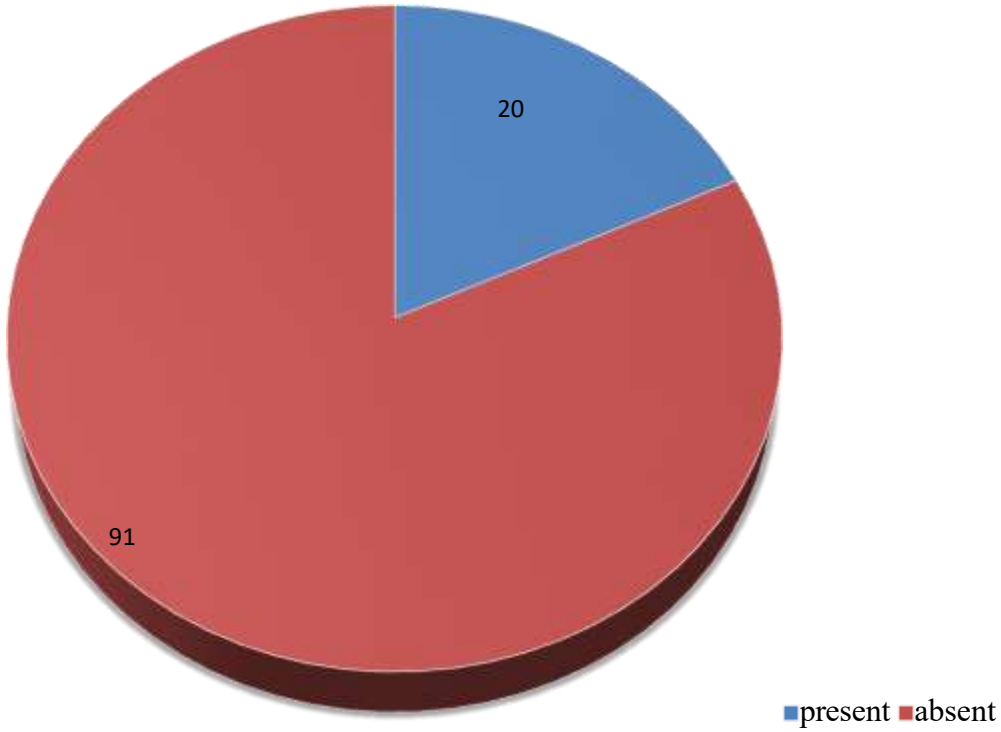

Figure II. Frequency of macular oedema after uncomplicated phacoemulsification (n=111).

Table VIII reveals the stratification of macular oedema according to several parameters. A statistically significant association was found between the duration of symptoms (>8 weeks, p-value=0.018) and hypertension (HTN) (p-value=0.006), showing that these groups had a higher incidence of macular oedema. Smoking reached significance with a p-value of 0.053, showing a significant association. There was no association seen with age, gender, laterality, or operating time (min).

Table VIII: Stratification of macular oedema concerning age, gender, lateral side, smoking, hypertension, duration of symptom, and operative time.

		Present (n=20)	Absent (n=91)	P-value
Age (years)	40-50	07 (15.56%)	38 (84.44%)	**0.577**
	51-60	13 (19.70%)	53 (80.30%)	
Gender	Male	12 (23.53%)	39 (76.47%)	**0.164**
	Female	08 (13.33%)	52 (86.67%)	
Duration (weeks)	≤8	07 (10.77%)	58 (89.23%)	**0.018**
	>8	13 (28.26%)	33 (71.74%)	
Laterality	Right	10 (17.86%)	46 (82.14%)	**0.965**
	Left	10 (18.18%)	45 (81.82%)	
HTN	Yes	01 (2.94%)	33 (97.06%)	**0.006**
	No	19 (24.68%)	58 (75.32%)	
Smoking	Yes	08 (30.77%)	18 (69.23%)	**0.053**
	No	12 (14.12%)	73 (85.88%)	
Operative time (min)	≤15	10 (17.24%)	48 (82.76%)	**0.824**
	>15	10 (18.87%)	43 (81.13%)	

Discussion

Phacoemulsification is the most widely utilised surgical technique that uses ultrasonic energy to remove the lens darkened by cloudy imperfections, and the clouded lens is then replaced

with an intraocular lens. (18) Diabetic patients pose a particular challenge because of the tendency for early formation of cataract in them and propensity to develop macular oedema after cataract surgery. Macular oedema (ME) is a major cause of vision loss after cataract surgery in patients with diabetes (19, 20). Optical coherence tomography (OCT) has been established as a practical method for examining retinal architecture. OCT, with its noninvasive nature, has been proven to be an indispensable tool for diagnosing retinal pathologies, including cystoid macular oedema (CME). Many studies have reported incidences of CME and changes in macular thickness, as determined by OCT, following uneventful cataract surgeries. (21)

ME may be related to impairment of the blood–retinal barrier and an increased susceptibility to surgical trauma in diabetic patients. Other factors that may contribute to the progression of diabetic retinopathy (DR) and possibly to an increased incidence of CME after phacoemulsification in diabetics may include chronic inflammatory mechanisms. (22) Clinically significant macular oedema (CSME) is an important risk factor for decreased vision after cataract surgery. Thus, after cataract surgery, angiographic ME in diabetic patients may be from pseudophakic CME or diabetic macular oedema (DME), and by itself may not be clinically useful in predicting visual acuity (VA); however, macular thickening may be clinically important (23). Moreover, Kim et al. published (24) reports indicating that the level of DR is a risk factor for retinal thickening after cataract surgery.

I have conducted this study to determine the frequency of macular oedema after uncomplicated phacoemulsification. The age range in this study was from 40 to 60 years, with a mean age of 51.53 ± 4.34 years. The majority of the patients, i.e. 66 (49.46%), were between 51 to 60 years of age. Out of these 111 patients, 51 (45.95%) were male and 60 (54.05%) were female, with a male-to-female ratio of 1:1.2. Mean pre-therapy CMT was 211.40 ± 10.98 µm and post-therapy was 237.48 ± 9.79 µm. Frequency of macular oedema after uncomplicated phacoemulsification was seen in 20 (18.02%) patients. One study reported that the mean CMT was 214±42 pm at baseline, which insignificantly grows at 3 months ($p>0.05$).(7) Another study reported that the mean macular thickness was 222.1±22.8 µm preoperatively versus 234.6±25.2 µm postoperatively ($P = 0.0003$).(8)

In a single-centre study of 50 eyes, Kim et al.(24) reported an incidence rate of 22% (95% CI, 13%-35%) for DME exacerbation (defined as ≥30% increase in OCT centre-point thickness compared with pre-surgical OCT) 1 month after cataract surgery. Two mechanisms may lead to macular oedema after surgery. One is Irvine–Gass syndrome (transient pseudophakic oedema), which usually resolves spontaneously, and the other is actual progression of diabetic maculopathy. Kim et al (24) revealed a short-term increase in macular thickness after cataract surgery in diabetic patients.

Oh et al. (25) showed that diabetic patients may be susceptible to developing postoperative subclinical retinal swelling or clinical ME after cataract surgery. Dowler et al. (26) showed 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. Moreover, the study has demonstrated that MFT in nondiabetic patients after uncomplicated phacoemulsification increases significantly at 1 month postoperatively, and MFT increases more significantly in diabetic patients than in the control group at 1 month postoperatively.

The pathogenesis of ME is associated with the destruction of the blood–aqueous barrier and the blood–retinal barrier induced by prostaglandins or other inflammatory mediators.(27) Elevated levels of angiogenic factors, inflammatory cytokines, chemokines, and growth factors in the aqueous humour may play a role in the breakdown of the vascular barrier. (28) El-Sobkya et al. (29) 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 (29).

Conclusion

This study concluded that the frequency of macular oedema after uncomplicated phacoemulsification is quite high. So, we recommend that some pre-operative and post-operative measures should be taken in these particular patients to reduce the incidence of macular oedema, which will in turn reduce the morbidity of our population.

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