Biological and Clinical Sciences Research Journal
eISSN: 2708-2261; pISSN: 2958-4728
www.bcsrj.com
DOI: https://doi.org/10.54112/bcsrj.v2024i1.768
*Biol. Clin. Sci. Res. J., Volume, **2024**: 768*
Original Research Article

FREQUENCY OF CYSTOID MACULAR EDEMA ON OPTICAL COHERENCE TOMOGRAPHY IN TWO DIFFERENT TYPES OF CATARACT SURGERY

KAMRAN MS[*1], AHMAD W[2], KAMRAN MK[3], AHMAD M[4]

[1]*Department of Ophthalmology, Health Department, KPK, Pakistan*
[2]*Department of Ophthalmology, Al Shifa Trust Eye Hospital Kohat, Pakistan*
[3]*Department of Ophthalmology, Bannu Medical College, KGN Hospital MTI, Bannu, Pakistan*
[4]*Department of Ophthalmology, King Salman Armed Forces Hospital, Tabuk, Kingdom of Saudi Arabia*
**Corresponding author's email address: Shahidkamran484@gmail.com*

(Received, 08th December 2023, Revised 05th February 2024, Published 26th March 2024)

Abstract: *Cystoid macular edema (CME), also known as Irvine-Gass syndrome, has been recognized as a non-specific manifestation of various ocular conditions, with cataract surgery being a significant contributing factor. First reported by Sir Irvine in 1953 and further discussed by Sir Norton in 1966, CME following cataract surgery remains a topic of interest and concern in ophthalmology. The precise etiology of CME in post-cataract surgery patients remains elusive; however, it is widely accepted that post-surgical inflammation plays a pivotal role. To address this issue, we conducted a comparative study to assess the frequency of CME using spectral-domain optical coherence tomography (SD-OCT) in patients undergoing extracapsular cataract extraction (ECCE) versus phacoemulsification cataract surgeries. The study was conducted at the Department of Clinical Ophthalmology, Khyber Institute of Ophthalmic Medical Sciences; Medical Teaching Institute Hayatabad Medical Complex, Peshawar, over a period of 6 months. Utilizing a randomized controlled trial design and non-probability consecutive sampling, we determined a sample size of 70 patients, with 35 patients allocated to each group (Group A: ECCE, Group B: Phacoemulsification). The age of the participants ranged from 50 to 85 years, with a median of 60 years and a mean of 65±8 years. Our findings revealed that CME was observed in 11% of patients in Group A and 6% in Group B, indicating a lower frequency in post-operative cases. However, the difference in CME incidence between ECCE and phacoemulsification cases was not statistically significant. These results suggest that the risk of CME in post-operative cases may be influenced by various factors, including surgical technique and patient-specific variables. In conclusion, our study contributes to the understanding of CME following cataract surgery and underscores the importance of continued vigilance and further research in this area. Improved surgical techniques and perioperative management may help mitigate the risk of CME and enhance patient outcomes in the postoperative period.*

Keywords: Cataract, Cystoid Macular Edema, Visual Acuity, Irvine-Gass Syndrome

Introduction

The Irvine-Gass syndrome (macular edema occurring post cataract surgery) was initially reported in 1953 by Irvine and discussed along with Norton in 1966 (Simons et al., 2022). Cystoid Macular Edema (CME) is the cumulation of fluid in the form of cystic spaces in the outer plexiform and inner nuclear layers of the retina. The process begins as swelling of the muller cells which later on rupture, coalesce, and then result in the formation of cystic spaces (Kanski et al., 1997).CME is a non-specific manifestation of different types of eye diseases. One of the important causes is cataract surgery (Kanski et al., 1997). The exact etiology of CME in post-cataract surgery patients is not known, however, the idea of post-surgical inflammation is generally accepted as the cause. Other causes include increased vascular permeability, light toxicity from operating microscope, and vitreomacular tractions (Grzybowski et al., 2016). Different pre-operative risk factors have been studied for the development of CME in post-cataract patients. The relative risk (RR) was high in cases with pre-operative posterior capsular rupture with or without vitreous loss (RR, 2.61; 95% confidence interval [CI]), a previous diagnosis of epiretinal membrane (RR, 5.60; 95% CI), uveitis (RR, 2.88; 95% CI), retinal vein occlusion (RR, 4.47; 95% CI), or retinal detachment repair (RR, 3.93; 95% CI), however high myopia, age-related macular degeneration or prostaglandin analog use were not associated with increase the risk (Chu et al., 2016). Cataract surgery in patients with diabetes in comparison to non-diabetic patients is related to higher risks of complications such as capsular contraction and pacification as well as post-surgical CME or worsening of macular edema resulting from diabetes (DME). The incidence of CME in post-cataract surgery patients varies in different studies in the presence or absence of the above-mentioned risk factors. Walkden A. et al did a consecutive analysis of the incidence of CME in patients using prostaglandin analogs who have undergone phacoemulsification cataract surgery using spectral domain optical coherence tomography (SD-OCT). There were no cases of clinically significant CME but 2 patients out of 48 (3.3%) had CME on SD-OCT which was statistically significant ($p<0.05$) (Walkden et al., 2017). In another study by Ewe SY et al, the researchers compared the incidence of CME in femtosecond laser-assisted cataract surgery (FLACS) versus manual phacoemulsification and they found that CME was detected in 0.8% of patients in FLAC surgery while it was 0.2% in manual phacoemulsification surgery (Ewe et al., 2015). Levitz L et al showed the incidence of CME in the FLACS group to be 1.18% while it was 0.98% in phacoemulsification group 8. Grzybowski et al

[Citation: Kamran, M.S., Ahmad, W., Kamran, M.K., Ahmad, M. (2024). Frequency of cystoid macular edema on optical coherence tomography in two different types of cataract surgery. *Biol. Clin. Sci. Res. J.,* **2024***: 768*. doi: https://doi.org/10.54112/bcsrj.v2024i1.768]

reported that the incidence of CME in extra-capsular cataract extraction (ECCE) was up to 32.2%; using fundus fluorescein angiography (FFA) as no data was available with spectral domain optical coherence tomography (SD-OCT) use for CME detection while the incidence was up to 41% in phacoemulsification procedures using SD-OCT technology for detection of CME (Grzybowski et al., 2016).

Post-cataract surgery CME is one of the main causes resulting in decreased visual acuity following uneventful cataract surgery. This study aims to detect CME using SD-OCT in patients who underwent two different types of cataract extraction procedures i.e. ECCE (extra-capsular cataract surgery) and phacoemulsification so that we have an idea of which cataract surgery has a higher frequency of this complication i.e. cytoid macular edema and thus can be prescribed prophylactic treatment for it. Thus this study aimed to compare the frequency of CME using SD-OCT in post-operative patients of ECCE and phacoemulsification cataract surgeries.

Methodology

The study was conducted at the Ophthalmology unit of the Khyber Institute of Ophthalmic Medical Sciences, located within the Medical Teaching Institute Hayatabad-Medical Complex in Peshawar. The duration of the study spanned six months and adopted a randomized controlled trial design. A non-probability consecutive sampling technique was employed to recruit participants.

The sample size was determined using Open Epi software, with P1 representing the proportion of cystoid macular edema (CME) in the extracapsular cataract extraction (ECCE) group (33.3%) and P2 representing the proportion in the phacoemulsification group (3.05%). With a desired power of 90% and a significance level of 5%, the calculated sample size was 35 patients per group, resulting in a total sample size of 70 patients.

Inclusion criteria encompassed patients who underwent uneventful ECCE or phacoemulsification cataract surgery for uncomplicated age-related cataracts, with participants of both genders and aged over 50 years. Patients were required to be six weeks post-operative, as this period is associated with the highest incidence of CME. Exclusion criteria included patients with pre-operative risk factors for developing CME, per-operative complications, postoperative complications, or those who were left aphakic.

The study received approval from the hospital's ethical committee before commencement. Patients meeting the inclusion criteria were recruited from the outpatient department. Examination with a slit lamp was conducted to rule out surgical complications as outlined in the exclusion criteria. Participants were randomly allocated to either Group A (ECCE surgery) or Group B (phacoemulsification surgery) using a lottery method.

The diagnosis of CME was made using spectral-domain optical coherence tomography (SD-OCT) six weeks post-surgery, following an operational definition for both ECCE and phacoemulsification procedures. Patients were provided with detailed explanations regarding the study's aim and advantages, and written informed consent was obtained.

Complete history-taking, clinical examinations using a slit lamp, and routine investigations were conducted to rule out confounders and bias in the study results. In ECCE surgery, a 6mm incision was made at the limbus, followed by cataract extraction and polymethyl methacrylate (PMMA) intraocular lens (IOL) implantation, with wound closure using a 10/0 nylon suture. Phacoemulsification surgery involved a 3.2mm incision at the superior limbus, followed by cataract emulsification and soft IOL implantation.

Data collection was performed by the researcher, including patient demographics and relevant clinical information, recorded in a pre-designed proforma. Data analysis was conducted using SPSS version 20, with frequency and percentages calculated for categorical variables and mean ± standard deviation calculated for continuous variables. The Chi-squared test was employed to compare the occurrence of CME between the two groups, stratified by sex and age, with a significance level set at $p < 0.05$. Results were presented through tables and charts/graphs following international standards.

Results

The age distribution of patients in the study is summarized in Table 1. Among the 70 patients included, the majority (57%) fell into the age group of 50-60 years, followed by 33% in the age group of 61-70 years, and 10% in the age group of 71-85 years. This distribution provides an overview of the age demographics of the study population. Gender distribution is shown in figure 1.

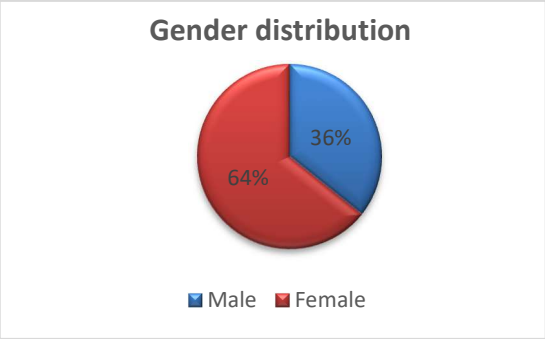

Figure . 1 Gender distribution

Table 2 presents the occurrence of cystoid macular edema (CME) among patients undergoing Extra-capsular Cataract Surgery (ECCE) and Phacoemulsification Surgery. In ECCE, CME was noted in 4 patients (11%), while in Phacoemulsification Surgery, 2 patients (6%) experienced CME. This comparison highlights the incidence of CME in different surgical procedures.

The comparison between CME occurrence in ECCE and Phacoemulsification Surgery is detailed in Table No. 3. The total occurrence of CME across both surgeries was 8.6%, with no significant difference observed between the two procedures, as indicated by the calculated P value.

Stratification of CME occurrence based on age is presented in Tables 4 and 5 for ECCE and Phacoemulsification Surgery, respectively. These tables illustrate the number of

[Citation: Kamran, M.S., Ahmad, W., Kamran, M.K., Ahmad, M. (2024). Frequency of cystoid macular edema on optical coherence tomography in two different types of cataract surgery. *Biol. Clin. Sci. Res. J.,* **2024***: 768*. doi: https://doi.org/10.54112/bcsrj.v2024i1.768]

patients with and without CME in different age groups. The P values suggest a significant association between age and CME occurrence in both surgical procedures, emphasizing the impact of age on CME development.

Tables No. 6 and No. 7 stratify the occurrence of CME based on gender for ECCE and Phacoemulsification Surgery, respectively. While the distribution of CME among male and female patients is outlined, the calculated P values indicate no significant association between gender and CME occurrence in either surgical procedure.

Table 1: Age distribution

Age groups	Frequency	Percentage
50-60 years	40	57%
61-70 years	23	33%
1-85 years	7	10%

Table 2 CME in Extra-capsular Cataract Surgery (ECCE) and Phacoemulsification surgery

Type of surgeries	CME	Frequency	Percentages
Extra-capsular Cataract Surgery	Yes	4	11%
	No	31	89%
Phacoemulsification surgery	Yes	2	6%
	No	33	94%
CME (cystoid macular edema), %= Percentage			

Table 3: Comparison between CME in ECCE and Phacoemulsification surgery

CME	ECCE	PHACO	Total / %age	P value
Yes	4	2	6 (8.6%)	0.393
No	31	33	64 (91.4)	
Total	35	35	70 (100%)	
CME (cystoid macular edema), %= Percentage, P value= Probability value				

Table 4: Stratification of CME in ECCE against age

Age groups	CME in ECCE		Total
	Yes	No	
50-60 years	1	15	16
61-70 years	0	14	14
71-85 years	3	2	5
P value 0.005			
CME (cystoid macular edema), P value= Probability value			

Table 5: Stratification of CME in Phacoemulsification against Age

Age groups	CME in Phacoemulsification		Total
	Yes	No	
50-60 years	0	24	24
61-70 years	0	9	9
71-85 years	2	0	2
P value 0.0016			
CME (cystoid macular edema), P value= Probability value			

Table 6: Stratification of CME in ECCE against gender

Gender	CME in ECCE		Total
	Yes	No	
Male	1	14	15
Female	3	17	20
P value 0.41			
CME (cystoid macular edema), P value= Probability value			

Table 7: Stratification of CME in Phacoemulsification against Gender

Gender	CME in Phacoemulsification		Total
	Yes	No	
Male	1	11	12
Female	1	22	23
P value 0.606			
CME (cystoid macular edema), P value= Probability value			

[Citation: Kamran, M.S., Ahmad, W., Kamran, M.K., Ahmad, M. (2024). Frequency of cystoid macular edema on optical coherence tomography in two different types of cataract surgery. *Biol. Clin. Sci. Res. J.*, **2024***: 768*. doi: https://doi.org/10.54112/bcsrj.v2024i1.768]

Discussion

Cataract is a common cause of decreased vision worldwide, and the treatment for cataracts is surgical removal (Song et al., 2014).

CME is one of the potential complications following uncomplicated cataract surgery in patients that can cause unwanted visual outcomes (Romero-Aroca, 2010).

Some processes may underlie pathogenic mechanisms of macular thickening such as post-operative inflammation caused by surgically damaged tissues, the breakdown of blood-retinal and blood-aqueous barriers, and the release of prostaglandins and vascular endothelial growth factors (VEGF) (Chae et al., 2014). Two mechanisms may proceed to macular edema following surgery. One is Irvine–Gass syndrome (transient pseudophakic edema), which usually resolves spontaneously, and the other is an actual progression of diabetic maculopathy (Dowler et al., 1995; Gass and Norton, 1966; Schepens et al., 1984; Zaczek et al., 1999).

In our study frequency of CMO in ECCE was 11 %, in 4 patients.

Poliner et al. show that the incidence of CMO after ECCE in normal subjects is higher 4-12 weeks after surgery, although CMO may occur months or even years later (Poliner et al., 1985). Clinical CMO after ECCE and posterior chamber IOL implantation becomes chronic in almost 1% of cases (Stark Jr et al., 1984), causing a progressive impairment of vision. The incidence of CMO in phacoemulsification was 6%, 2 patients, in this study.

The application of phacoemulsification can lead to inflammation due to the release of inflammatory substances directly involved in the thickening of the macula, including prostaglandins (Chen et al., 2012). It has been reported that after phacoemulsification without complications, an inflammation response triggered by surgery led to early edema in the macula (Miyanaga et al., 2009).

Pseudophakic CME is known to show regression within a period of 1 month (when associated with Irvine Gass syndrome) (Akkaya and Ozkurt, 2018).

Following modern cataract surgery, the development of CME with a reduction in visual acuity has been reported from 0.2% to 14% (Wegener et al., 1998). In American studies, it was noted that angiographically, edema may occur in 60% of intracapsular surgeries, and in extra-capsular surgeries with variation between 15-30% and 4-11% in phacoemulsification (Bélair et al., 2009).

In our study difference between CMO in ECCE and Phaco has a P value = 0.393, which was statistically insignificant. It was more in the age group 71-85 years, maybe because of older age, it was common in both Groups A & B. CME was noted more in female gender, maybe because number of female patients were more.

Conclusion

In our study, the frequency of CME was noted less in numbers in post-operated cases. The difference between CME in extra-capsular cataract extraction and phacoemulsification cases was not significant. The risks of CME in post-operated cases depend on the surgeon's hands.

Declarations

Data Availability statement

All data generated or analyzed during the study are included in the manuscript.

Ethics approval and consent to participate

Approved by the department Concerned.

Consent for publication

Approved

Funding

Not applicable

Conflict of interest

The authors declared absence of conflict of interest.

Author Contribution

MUHAMMAD SHAHID KAMRAN (FCPS, OPHTH)
Study Design, Review of Literature.
Conception of Study, Development of Research Methodology Design, Study Design,, Review of manuscript, final approval of manuscript.
WAQAS AHMAD (FCPS, OPHTH)
Coordination of collaborative efforts.
Conception of Study, Final approval of manuscript.
MUHAMMAD KASHIF KAMRAN (FCPS, OPHTH)
Coordination of collaborative efforts.
Manuscript revisions, critical input.
Manuscript drafting.
MAQSOOD AHMAD ((FCPS, Oculoplastic)
Data entry and Data analysis, drafting article.
Data acquisition and analysis.
Coordination of collaborative efforts.

References

Akkaya, S., and Ozkurt, Y. (2018). Changes in Central Macular Thickness after Uncomplicated Phacoemulsification Surgery in Diabetic and Non Diabetic Patients. *Beyoglu Eye Journal* **3**, 13-19.

Bélair, M.-L., Kim, S. J., Thorne, J. E., Dunn, J. P., Kedhar, S. R., Brown, D. M., and Jabs, D. A. (2009). Incidence of cystoid macular edema after cataract surgery in patients with and without uveitis using optical coherence tomography. *American journal of ophthalmology* **148**, 128-135. e2.

Chae, J. B., Joe, S. G., Yang, S. J., Lee, J. Y., Sung, K. R., Kim, J. Y., Kim, J.-G., and Yoon, Y. H. (2014). Effect of combined cataract surgery and ranibizumab injection in postoperative macular edema in nonproliferative diabetic retinopathy. *Retina* **34**, 149-156.

Chen, D., Zhu, J., Li, J., Ding, X.-X., Lu, F., and Zhao, Y.-E. (2012). Effect of simulated dynamic intraocular pressure on retinal thickness measured by optical coherence tomography after cataract surgery. *International Journal of Ophthalmology* **5**, 687.

Chu, C. J., Johnston, R. L., Buscombe, C., Sallam, A. B., Mohamed, Q., Yang, Y. C., and Group, U. K. P. M. E. S. (2016). Risk factors and incidence of macular edema after cataract surgery: a database study of 81984 eyes. *Ophthalmology* **123**, 316-323.

[Citation: Kamran, M.S., Ahmad, W., Kamran, M.K., Ahmad, M. (2024). Frequency of cystoid macular edema on optical coherence tomography in two different types of cataract surgery. *Biol. Clin. Sci. Res. J.,* **2024***: 768*. doi: https://doi.org/10.54112/bcsrj.v2024i1.768]

Dowler, J., Hykin, P., Lightman, S., and Hamilton, A. (1995). Visual acuity following extracapsular cataract extraction in diabetes: a meta-analysis. *Eye* **9**, 313-317.

Ewe, S. Y., Oakley, C. L., Abell, R. G., Allen, P. L., and Vote, B. J. (2015). Cystoid macular edema after femtosecond laser–assisted versus phacoemulsification cataract surgery. *Journal of Cataract & Refractive Surgery* **41**, 2373-2378.

Gass, J., and Norton, E. (1966). Cystoid macular edema and papilledema following cataract extraction: a fluorescein fundoscopic and angiographic study. *Archives of Ophthalmology* **76**, 646-661.

Grzybowski, A., Sikorski, B. L., Ascaso, F. J., and Huerva, V. (2016). Pseudophakic cystoid macular edema: update 2016. *Clinical interventions in aging*, 1221-1229.

Kanski, J. J., Nischal, K. K., and Farrell, T. A. (1997). Clinical ophthalmology. *Archives of Ophthalmology-Chicago* **115**, 692-692.

Miyanaga, M., Miyai, T., Nejima, R., Maruyama, Y., Miyata, K., and Kato, S. (2009). Effect of bromfenac ophthalmic solution on ocular inflammation following cataract surgery. *Acta Ophthalmologica* **87**, 300-305.

Poliner, L. S., Christiansen, D. J., Escoffery, R. F., Kolker, A. E., and Gordon, M. E. (1985). Neovascular glaucoma after intracapsular and extracapsular cataract extraction in diabetic patients. *American journal of ophthalmology* **100**, 637-643.

Romero-Aroca, P. (2010). Targeting the pathophysiology of diabetic macular edema. Vol. 33, pp. 2484-2485. Am Diabetes Assoc.

Schepens, C. L., Avila, M. P., Jalkh, A. E., and Trempe, C. L. (1984). Role of the vitreous in cystoid macular edema. *Survey of Ophthalmology* **28**, 499-504.

Simons, R. W., Wielders, L. H., Nuijts, R. M., Veldhuizen, C. A., van den Biggelaar, F. J., Winkens, B., Schouten, J. S., Dirksen, C. D., and Group, E. P. S. (2022). Economic evaluation of prevention of cystoid macular edema after cataract surgery in diabetic patients: ESCRS PREMED study report 6. *Journal of Cataract & Refractive Surgery* **48**, 555-563.

Song, E., Sun, H., Xu, Y., Ma, Y., Zhu, H., and Pan, C.-W. (2014). Age-related cataract, cataract surgery and subsequent mortality: a systematic review and meta-analysis. *PLoS One* **9**, e112054.

Stark Jr, W. J., Maumenee, A. E., Fagadau, W., Datiles, M., Baker, C., Worthen, D., Klein, P., and Auer, C. (1984). Cystoid macular edema in pseudophakia. *Survey of ophthalmology* **28**, 442-451.

Walkden, A., Porter, L. F., Morarji, J., Kelly, S. P., and Sioras, E. (2017). Pseudophakic cystoid macular edema and spectral-domain optical coherence tomography–detectable central macular thickness changes with perioperative prostaglandin analogs. *Journal of Cataract & Refractive Surgery* **43**, 1027-1030.

Wegener, M., Alsbirk, P. H., and Højgaard-Olsen, K. (1998). Outcome of 1000 consecutive clinic-and hospital-based cataract surgeries in a Danish county. *Journal of Cataract & Refractive Surgery* **24**, 1152-1160.

Zaczek, A., Olivestedt, G., and Zetterström, C. (1999). Visual outcome after phacoemulsification and IOL implantation in diabetic patients. *British journal of ophthalmology* **83**, 1036-1041.

[Citation: Kamran, M.S., Ahmad, W., Kamran, M.K., Ahmad, M. (2024). Frequency of cystoid macular edema on optical coherence tomography in two different types of cataract surgery. *Biol. Clin. Sci. Res. J.,* **2024***: 768*. doi: https://doi.org/10.54112/bcsrj.v2024i1.768]