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Original Research Article

Comprehensive Analysis of Postoperative Cystoid Macular Edema (CME) Incidence Following Cataract Surgery: Correlations with Diabetic Status, Retinopathy Grades, Surgical Complications, and NSAID Use

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Abstract:

Background: Cystoid Macular Edema (CME) is a significant postoperative complication following cataract surgery. This study aimed to comprehensively analyze the incidence of CME and its correlations with diabetic status, retinopathy grades, surgical complications, and Non-Steroidal Anti-Inflammatory Drug (NSAID) use.

Methods: A prospective cohort study was conducted at the Regional Institute of Ophthalmology, Trivandrum, spanning one year. The study included 325 patients aged over 40 years undergoing cataract surgery. Various factors, including diabetic status, retinopathy grading, surgical complications, and NSAID use, were assessed for their correlation with CME development.

Results: Analysis of the demographic data revealed a predominant representation of patients aged 50 to 69 years (72%) and a slightly higher proportion of females (59.4%). The study demonstrated a higher incidence of CME in diabetic patients across different postoperative intervals, with statistically significant differences observed at the 6th week (34.1%) and 3rd month (29.7%) compared to non-diabetic individuals. Moreover, associations were observed between previous uveitis, surgical complications, and increased risk of CME post-cataract surgery. The study highlighted a potentially reduced incidence of CME in patients using NSAIDs postoperatively, especially in the early postoperative period.

Conclusion: This study provides critical insights into the intricate associations between various factors and the incidence of CME following cataract surgery. The findings underscore the heightened risk of CME in diabetic patients and the potential impact of NSAID use, previous uveitis, and surgical complications.

Keywords: Cataract Surgery, Cystoid Macular Edema, Diabetic Status, Retinopathy Grades, Surgical Complications.

Introduction

Cataract surgery stands as one of the most prevalent and successful ophthalmic procedures globally, aimed at restoring visual acuity and quality of life for millions of individuals affected by cataracts. [1,2] Despite its general success, postoperative complications can arise, among which Cystoid Macular Edema (CME) is a particularly concerning condition due to its potential impact on visual outcomes.

CME occurs due to the accumulation of fluid in the macula, leading to central vision disturbances. Understanding the factors that contribute to the development of CME following cataract surgery is crucial for optimizing patient care, prognostication, and the implementation of preventive measures. [3,4] The incidence of CME following cataract surgery is not uniform, and its occurrence can be influenced by various patient-related and surgical factors. Previous studies have identified several potential risk factors associated with CME development, and this research aims to delve deeper into these factors to provide a more comprehensive understanding of their impact. [4,5]

According to recent global statistics, cataract surgery remains one of the most commonly performed ophthalmic procedures, with an estimated 20 million surgeries conducted annually. However, despite its high success rate, the development of postoperative complications, particularly Cystoid Macular Edema (CME),

presents a significant challenge. Studies indicate that the incidence of CME following cataract surgery varies, with reported rates ranging from 1% to 10%. This variability is influenced by several factors, including the patient's diabetic status. Notably, the global prevalence of diabetes stands at approximately 10.5% in adults aged 20-79 years, with a projected increase to over 700 million individuals by 2045. Among those undergoing cataract surgery, up to 30% may have pre-existing diabetes. Within the diabetic population, the incidence of CME post-surgery has been reported to be notably higher, reaching approximately 10-20%. [6-10]

One of the significant areas of interest is the relationship between diabetic status and the incidence of CME post-cataract surgery. Diabetes, a widespread systemic disease, has been recognized as a potential contributor to the development of CME due to its impact on retinal vasculature and macular function. Additionally, within the diabetic population, the severity of retinopathy has been suggested as a significant factor influencing the occurrence of CME. [11-13] Moreover, the surgical process itself presents various elements that could contribute to postoperative CME. Factors such as intraoperative complications, prolonged surgical duration, or specific surgical techniques have been speculated to have a bearing on CME occurrence. Understanding the implications of these factors could aid in refining surgical protocols and reducing the incidence of CME. [12,13]

Furthermore, the postoperative management of cataract surgery, including the use of Non-Steroidal Anti-Inflammatory Drugs (NSAIDs), has been a subject of interest in relation to CME. There have been contrasting reports on the efficacy and safety of NSAIDs in preventing CME, and a comprehensive analysis can provide clarity on their role in mitigating this complication. [14,15]

This research paper aims to address these complexities by conducting a thorough examination of the relationship between diabetic status, retinopathy grades, surgical complications, and NSAID use in the incidence of postoperative CME. By delineating these correlations, the study seeks to contribute to the development of more refined risk assessment strategies, improved patient care, and potentially better outcomes for individuals undergoing cataract surgery.

Methodology:

Study Design: The research employed a prospective study design to investigate the incidence and associated factors of Cystoid Macular Edema (CME) following cataract surgery.

Study Setting: The study was conducted at the Regional Institute of Ophthalmology (RIO) in Trivandrum.

Study Duration: The research spanned a period of one year to collect and analyze data regarding the occurrence of CME post-cataract surgery.

Inclusion Criteria: Patients aged over 40 years presenting to RIO, Trivandrum for cataract surgery over the one-year study period were included. These patients met the requirements for evaluation and subsequent surgical procedures.

Exclusion Criteria: Several exclusion criteria were established to ensure the integrity of the study:

- Patients diagnosed with cystoid macular edema prior to cataract surgery due to other causes.
- Patients who underwent phacoemulsification or extracapsular cataract extraction (ECCE).
- Patients who underwent small incision cataract surgery (SICS) and were left aphakic post-surgery.
- Individuals with a refractive error greater than 6 diopters, intraocular pressure exceeding 21 mmHg, or having other macular lesions such as macular hole, age-related macular degeneration (ARMD).
- Diabetic patients with macular involvement prior to surgery (diabetic macular edema) or previous laser therapy.
- Patients who expressed unwillingness to participate in the study.

Sample Size: The sample size for the study was determined based on an anticipated incidence of CME at 4 weeks following cataract surgery at 30% and at 12 weeks at 14%. With an assumed error rate of 5% and a proportion of 30%, the sample size was calculated using the formula N= (1.96/E)^2p(1-p). The final calculated sample size was 325.

Methodology: The research commenced after obtaining informed consent from 325 eligible patients scheduled for cataract surgery at RIO, Trivandrum. Before surgery, patients' medical histories, including cataract progression, ocular health, use of medications, and systemic comorbidities (particularly diabetes and hypertension), were documented. Visual acuity, cataract type and grade, and fundus examinations were conducted to screen for diabetic retinopathy and to rule out pre-existing macular lesions. Fundus evaluations for patients with dense cataracts were performed on the first postoperative day. All patients underwent small incision cataract surgery involving continuous curvilinear capsulorhexis with posterior chamber intraocular lens implantation. Perioperative complications, such as

posterior capsular rent, vitreous loss, iris prolapse, or difficult nucleus delivery, were noted.

Postoperatively, patients received a regimen of topical steroid drops six times daily, non-steroidal anti-inflammatory drugs four times daily and topical antibiotics four times daily. Medication frequency was tapered and stopped after six weeks.

Follow-ups occurred at the 1st postoperative week, 6th week, 12th week (3 months after surgery), and 6th month after surgery. Visual acuity, fundus examination, and CME occurrence were documented at each visit.

CME was identified through OCT imaging, with macular thickness measurement in a 1mm central circle greater than 200 microns and cystic spaces.

Statistical Analysis:

Data analysis was performed using the Statistical Package for Social Sciences (SPSS) version 10, employing frequency and percentage, mean and standard deviation, chi-square ($\chi 2$) test, and Student's t-test for statistical evaluations. A significance level of $p < 0.05$ was considered statistically significant. This comprehensive methodology facilitated the collection, analysis, and assessment of factors associated with CME following cataract surgery, allowing for a detailed understanding of its occurrence and influencing factors.

Result

Table 1: Demographics of the Study

Age	Frequency	Percent
40 - 49	9	2.8
50 - 59	92	28.3
60 - 69	142	43.7
70 - 79	76	23.4
>= 80 yrs	6	1.8
Total	325	100

Demography of the study showing out of 325 samples, 43.7% was the highest rate at the age of 60-69 year and lower rate i.e. 1.8% rate at the age of more than 80 years, Table 1.

Table 2: Gender distribution

Gender	Frequency	Percent
Male	132	40.6
Female	193	59.4
Total	325	100

59. 4% of the study population was females and 40.6% of the subjects were males, Table 2 and Figure 1.

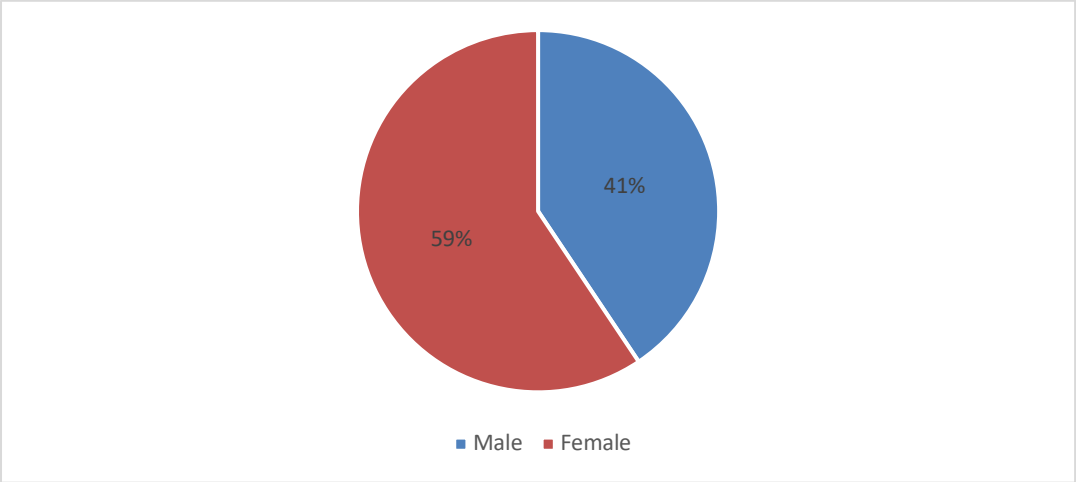

Figure 1: Gender distribution

Table 3: Eyes Evaluated

Eye	Frequency	Percent
Right	181	55.7
Left	144	44.3
Total	325	100

Of the 325 eyes included in the study, in 181 subjects, the right eye was evaluated and in 144 subjects the left eye was evaluated for the development of cystoid macular edema, Table 3 and Figure 2.

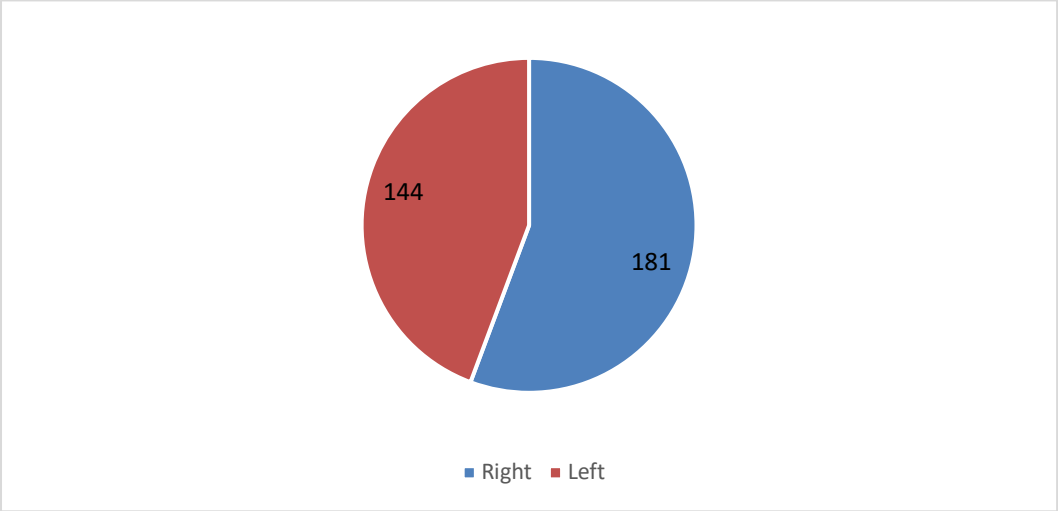

Figure 2: Eyes Evaluated

Table 4: Diabetic status of the study population

Diabetic status (ETDRS)	Frequency	Percent
Diabetic, no DR	71	21.8
Mild NPDR	5	1.5
Moderate NPDR	10	3.1
Severe NPDR	5	1.5
Not diabetic	234	72
Total	325	100

In the study population, 72% were not diabetic. 21.8% were diabetic, but did not have diabetic retinopathy. 1.5% had mild non proliferative diabetic retinopathy, 3.1% had moderate non proliferative diabetic retinopathy, and 1.5 % had severe diabetic retinopathy. Proliferative diabetic retinopathy was not present among the study population, Table 4.

Table 5: Incidence of CME in diabetic patients

CME	Diabetes Mellitus		Total	Chi Square	P value
	No DM	DM			
Post OP 1st Week	0	0	0	0.000	> 0.05
	0.00%	0.00%	0.00%		
Post OP 6th Week	30	31	61	19.397	< 0.001
	12.80%	34.10%	18.80%		
Post OP 3rd Month	16	27	43	29.754	< 0.001
	6.80%	29.70%	13.20%		
Post OP 6th Month	6	11	17	11.988	< 0.01
	2.60%	12.10%	5.20%		

In the study population, none of the subjects developed CME in the first postoperative week.

In the 6th post-operative week, 34.10% diabetic patients developed CME while only 12.8% of the non-diabetic patients developed CME. In the third month after surgery, 29.7% of the diabetic patients developed CME, while only 6.8% non-diabetic patients had CME. After 6 months, 12.10% of the diabetic patients had CME while only 2.6% had CME among the non-diabetic patients.

The differences were statistically significant, Table 5.

Table 6: Incidence of CME in patients with previous uveitis

CME	History of Uveitis		Total	Chi Square	P value
	No	Yes			
Post OP 1st Week	0	0	0	0.000	> 0.05
	0.00%	0.00%	0.00%		
Post OP 6th Week	60	2	62	3.280	< 0.05

	18.80%	33.40%	18.80%		
Post OP 3rd Month	42	1	43	0.063	> 0.05
	13.20%	16.70%	13.20%		
Post OP 6th Month	16	1	308	0.037	> 0.05
	5%	16.70%	94.80%		

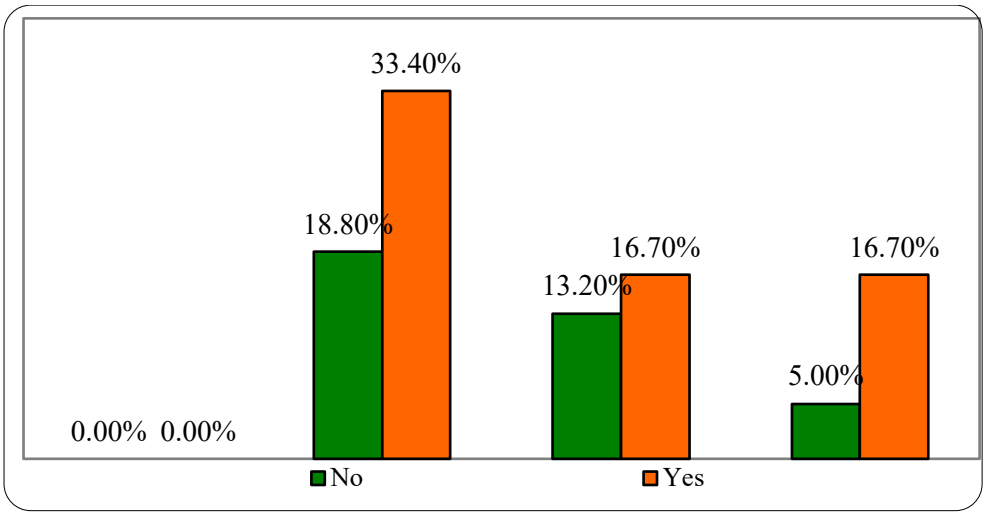

Figure 3: CME and history of uveitis

The incidence of CME in the 6th postoperative week was 33.4% in patients with previous history of uveitis while it was only 18.8% in patients without uveitis. The incidence of CME in the 3rd postoperative month was 16.7% in subjects with history of uveitis while only 13.2% had in the study population without history of uveitis. 6 months after surgery, CME was again seen in more number of patients with history of uveitis when compared to those without, Table 6 and Figure 3.

Table 7: The incidence of CME in patients with surgical complications

CME	Surgical Complication		Total	Chi Square	P value
	No Surgical Complication	Surgical Complication			
Post OP 1st Week	0	0	0	0.000	> 0.05
	0.00%	0.00%	0.00%		
Post OP 6th Week	50	11	61	11.308	< 0.01
	16.70%	44.00%	18.80%		
Post OP 3rd Month	36	7	43	5.146	< 0.05
	12.00%	28.00%	13.20%		
Post OP 6th Month	12	5	17	11.917	< 0.01
	4.00%	20.00%	5.20%		

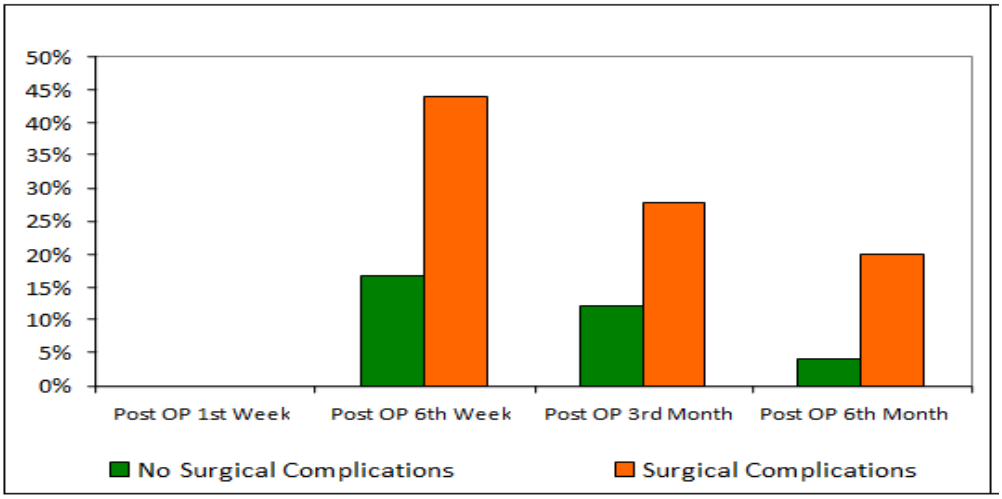

Figure 4: CME and surgical complications

Among the study population, 6 weeks after surgery, 44% of those with surgical complications developed CME while only 16.7% had among those with no surgical complications.3 months after surgery,28% of those with surgical complications had CME while only 12% of those with no surgical complications had CME. 6 months after surgery, 20% of those with complicated surgery had CME while only 4% among the others had CME, Table 7 and Figure 4.

Table 8: Incidence of CME in patients not on topical NSAID

CME	Post OP NSAID Use		Total	Chi Square	P value
	No	Yes			
Post OP 1st Week	0	0	0	0.000	> 0.05
	0.00%	0.00%	0.00%		
Post OP 6th Week	1	60	61	1.287	> 0.05
	50.00%	18.60%	18.80%		
Post OP 3rd Month	2	41	43	13.197	< 0.001
	100.00%	12.70%	13.20%		
Post OP 6th Month	0	17	17	0.111	> 0.05
	0.00%	5.30%	5.20%		

The incidence of CME was 50% among those not on topical NSAID postoperatively while it was only 18.6% in those on regular topical NSAID. The incidence of CME was high among those not on regular NSAID use 3 months after surgery. 6 months after surgery, there was no much difference in incidence among the 2 groups, Table 8.

Table 9: Incidence of CME and Grade of Diabetic Retinopathy

CME	Diabetic Retinopathy					Total	Chi Square	P value
	No DR	Mild DR	Moderate DR	Severe DR	No DM			
Post OP 1st Week	0	0	0	0	0	0	0.000	> 0.05
	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		
Post OP 6th Week	24	2	3	2	30	61	19.741	< 0.01
	33.80%	40.00%	30.00%	40.00%	12.80%	18.80%		
Post OP 3rd Month	18	3	4	2	16	43	36.307	< 0.001
	25.40%	60.00%	40.00%	40.00%	6.80%	13.20%		
Post OP 6th Month	9	1		1	6	17	16.248	< 0.01
	12.70%	20.00%		20.00%	2.60%	5.20%		

Study of incidence of cystoid macular edema among different grades of diabetic retinopathy showed that although the incidence of CME was more in diabetic patients, the severity of diabetic retinopathy was not directly related to the incidence of CME, Table 9.

Discussion

The demographics of the study population revealed that the majority of participants were within the age range of 50 to 69 years (72%), with a slightly higher representation of females (59.4%) compared to males (40.6%). The study predominantly involved the evaluation of the right eye (55.7%) over the left eye (44.3%). The analysis of diabetic status and the occurrence of Cystoid Macular Edema (CME) post-cataract surgery demonstrated a notable association.

Throughout the study, the incidence of CME was higher among diabetic patients compared to non-diabetic individuals. The difference was statistically significant at various postoperative intervals, with a considerable increase in CME incidence in diabetic patients, particularly at the 6th week (34.1%) and 3rd month (29.7%) after surgery, compared to non-diabetic individuals (12.8% and 6.8%, respectively). This data suggests a clear association between diabetes and the increased risk of developing CME after cataract surgery.

The analysis also examined the association between a history of uveitis and the occurrence of CME. The findings suggested a higher incidence of CME in patients with a previous history of uveitis compared to those without, particularly at the 6th week after surgery. Additionally, the presence of surgical complications demonstrated a similar trend, where individuals with surgical complications exhibited a higher incidence of CME compared to those without complications at various postoperative intervals. These observations imply that both a history of uveitis and surgical complications may contribute to an increased risk of CME following cataract surgery. In a similar study by Eriksson U et al, 6 weeks after cataract

surgery, there was a significantly low visual acuity among the diabetic patients when compared to the control group. [16] The incidence of CME in relation to postoperative non-use of topical NSAIDs was also a focus of analysis. The findings revealed a higher incidence of CME among individuals not using regular topical NSAIDs postoperatively, particularly at the 6th week after surgery. However, the difference was not significant at later intervals, indicating a potential role of NSAID use in reducing the risk of CME, especially in the early postoperative period.

When evaluating the incidence of CME across different grades of diabetic retinopathy, an interesting observation emerged. Despite the higher incidence of CME among diabetic patients, the severity of diabetic retinopathy did not show a consistent correlation with the occurrence of CME. Although diabetic patients had a higher incidence of CME, the severity of diabetic retinopathy did not exhibit a linear relationship with the incidence of CME. This indicates that the severity of diabetic retinopathy might not be a sole predictive factor for CME following cataract surgery. In a study by Soon Kwon et al 41 of changes of macular thickness in diabetic retinopathy after cataract surgery, the association between the severity of diabetic retinopathy and macular edema was not statistically significant (p= 0.116). [17]

In summary, this comprehensive analysis provides valuable insights into the various factors influencing the occurrence of CME post-cataract surgery. The study highlights the increased risk of CME among diabetic patients, the potential impact of previous uveitis and surgical complications, and suggests a potential role of NSAID use in reducing CME incidence, especially in the early postoperative period. Moreover, the findings regarding the association between diabetic retinopathy grades and CME underscore the complexity of the relationship between diabetic status and the development of CME following cataract surgery. These insights are crucial for improved risk assessment and management strategies in the postoperative care of cataract patients.

The study had limitations including a single-center design, potentially limiting the generalizability of findings to other settings. Additionally, the relatively short follow-up duration might not capture long-term occurrences or evolving trends in Cystoid Macular Edema post-cataract surgery. The exclusion of specific subgroups such as patients with severe systemic conditions might impact the broader applicability of the results.

For future directions, multi-center studies involving diverse demographics and prolonged follow-up periods could provide a more comprehensive understanding of Cystoid Macular Edema post-cataract surgery. Additionally, investigating the impact of evolving surgical techniques, advanced imaging modalities, and tailored medication regimens could offer insights into optimizing preventative strategies and personalized postoperative care, thereby enhancing visual outcomes for patients undergoing cataract surgery. Furthermore, exploring the role of emerging technologies, such as artificial intelligence in early CME detection, and conducting randomized controlled trials for more definitive conclusions on the efficacy of NSAIDs in preventing CME could further advance the field.

Conclusion

In conclusion, this detailed study provides valuable insights into the multifaceted landscape of Cystoid Macular Edema (CME) following cataract surgery. The associations observed between diabetic status, previous uveitis, surgical complications, and the incidence of CME highlight the complexity of risk factors influencing postoperative outcomes. The study's results underline the significance of continued exploration in optimizing postoperative care strategies, including potential benefits from NSAID use, while emphasizing the need for more extended and multi-center investigations to enhance the robustness and applicability of findings. Understanding these complex interrelations is pivotal in refining risk assessment protocols, tailoring postoperative care, and ultimately enhancing visual prognosis for patients undergoing cataract surgery. This research opens avenues for further exploration and underscores the necessity for ongoing efforts to enhance patient outcomes and refine management strategies in the realm of cataract surgery.

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