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COMPARING THE DEVELOPMENT OF POSTERIOR CAPSULAR OPACIFICATION FOLLOWING CATARACT SURGERY USING HYDROPHILIC AND HYDROPHOBIC ACRYLIC POSTERIOR CHAMBER INTRAOCULAR LENSES.

Ophthalomology

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ABSTRACT

Posterior capsule opacification (PCO) is a common complication following cataract surgery with posterior chamber intraocular lens (PCIOL) implantation. This study aims to compare the development of PCO between hydrophilic and hydrophobic acrylic PCIOLs.Methods: An observational study was conducted over 12 months, involving patients with age-related cataract who underwent cataract surgery at KJ SOMAIYA Hospital. The patients were divided into two groups based on the type of PCIOL used: hydrophilic (Group I) and hydrophobic (Group II). PCO analysis was performed at one, three, and six months using retroilluminated images captured with slit lamp-guided anterior segment photography.Results: Among the 160 eyes included in the study, PCO grade 2 was the most common in both groups (56.25% in Group I and 66.25% in Group II). PCO grade 3 was observed in 35% of eyes in Group I and 17.5% of eyes in Group II, indicating a 2.7-fold higher incidence in Group I. PCO grade 3 was more prevalent in younger patients, individuals with diabetes, and patients with immature cataracts.Conclusion: The incidence of PCO is higher with hydrophilic IOLs compared to hydrophobic IOLs. However, this increased incidence is also associated with younger patient age, diabetes mellitus, and immature cataract grade, which are known risk factors for PCO.

KEYWORDS

Posterior Capsule Opacification, Cataract Surgery, Hydrophilic Intraocular Lens, Hydrophobic Intraocular Lens, Diabetes.

INTRODUCTION

Postoperative opacification of the posterior capsule, resulting from cell proliferation within the capsular bag, is the most common complication following cataract surgery with posterior chamber intraocular lens (PCIOL) implantation. This phenomenon, known as posterior capsule opacification (PCO), is a multifactorial physiological consequence of cataract surgery with PCIOL. The development of PCO is influenced by various factors, including patient age, preoperative cataract condition, diabetes, postoperative inflammation, PCIOL biomaterial, and duration of implantation. Surgical technique and choice of IOL biomaterial are particularly crucial in preventing or delaying PCO occurrence .

In recent years, improved understanding of the mechanisms underlying PCO formation, advancements in surgical techniques, and the introduction of superior acrylic IOLs have resulted in a reduction in PCO incidence to less than 10%. PCO has the potential to hinder the visualization and timely treatment of posterior segment pathologies such as diabetic retinopathy (DR) and macular edema.

There is a dearth of literature evaluating the development of PCO following implantation of single-piece hydrophobic and hydrophilic acrylic IOLs in relation to age, preoperative cataract condition, and diabetes.

Therefore, the purpose of this study is to compare the incidence of PCO formation following cataract surgery, considering age, preoperative cataract condition, and diabetes, with the use of hydrophobic and hydrophilic IOLs.

MATERIALS AND METHODS

This retrospective observational study was collected data over a 12-month period, from December 2021 to November 2022, at K J SOMAIYA MEDICAL COLLEGE AND HOSPITAL ,MUMBAI. The study was approved by the ethical committee, and all procedures were carried out in accordance with the Declaration of Helsinki. Written informed consent was obtained from all participating patients.

The study included patients who underwent cataract surgery. The following inclusion criteria were applied: patients with age-related cataract, preoperative pupil diameter of at least 6mm, and uneventful cataract surgery. Exclusion criteria encompassed patients with complicated cataract, history of prior ocular surgery or inflammation, significant corneal scarring, uveitis or trauma, and patients under the age of 40.

All the included patients had undergone Standardized Preoperative evaluations, including demographic information, relevant medical history, and subjective grading of cataract type based on the Lens Opacities Classification System III (LOCS III) . Additional examinations involved best corrected visual acuity, intraocular pressure (IOP) measurement using applanation tonometry, IOL biometry, slit lamp examination of the anterior and posterior segments, and B-scan ultrasonography if the posterior segment was not visible. Patients who were included underwent the surgical procedure, performed only by a single experienced surgeon to minimize bias, consisted of phacoemulsification followed by "in-the-bag" PCIOL implantation, following the standard technique .

Patients were divided into two groups: group I who underwent cataract surgery with a hydrophilic PCIOL, and group II who underwent surgery with a hydrophobic PCIOL. Randomization of patients was carried out using the envelope technique by an individual not involved in the study.

Postoperatively topical antibiotic and steroid eye drops were prescribed for one month, and patients were scheduled for follow-up examinations at one, three, and six months to assess the development of PCO.

PCO analysis was performed during subsequent follow-ups by a single experienced individual who was not associated with the study and was blinded to the patient groups to prevent bias. Retroilluminated images were captured using slit lamp-guided anterior segment photography for further analysis. PCO was graded as Grade 1 - no or slight PCO with a normal red reflex and no Elschnig pearls near the IOL edge, Grade 2 - mild PCO causing a reduction in the red reflex and Elschnig pearls extending up to the IOL edge, Grade 3 - moderate fibrosis or Elschnig pearls inside the IOL edge but with a clear visual axis, Grade 4 - severe Elschnig pearls or fibrosis obstructing the visual axis and red reflex.

Statistical Analysis

The collected data were initially entered into an Excel spreadsheet and later imported into SPSS software for analysis. Descriptive statistics, including mean ± standard deviation (SD) and percentages, were used to present the results. The chi-square test was employed to compare categorical variables. Binary logistic regression analysis was conducted to assess the strength of associations, and odds ratios (OR) with 95% confidence intervals (CI) were calculated to determine the magnitude of the associations between dichotomous variables. A p-value of less than 0.05 was considered statistically significant.

RESULTS

A total of 160 eyes from 140 patients were included in the study, with 80 eyes (50%) in Group I and 80 eyes (50%) in Group II. The age distribution showed that 75% of eyes in Group I and 83.75% of eyes in Group II were between the ages of 50-70 years. Age ≤50 years accounted for 10 eyes (12.5%) in Group I and 5 eyes (6.25%) in Group II, while age >70 years included 10 eyes (12.5%) in Group I and 8 eyes (10%) in Group II. The mean age was 61.66±7.24 years in Group I and 63.45±7.68 years in Group II. There was no statistically significant difference in the age distribution between the two groups (p>0.08).

Group I had a higher proportion of females (62.5%), while Group II had a higher proportion of males (58.75%). The difference in gender distribution between the two groups was statistically significant (p=0.03).

The presence of diabetes was observed in 18.75% of eyes in Group I and 20% of eyes in Group II, with no statistically significant difference between the groups (p>0.05). There was no statistically significant difference in cataract grading between the groups (p>0.05).

At 6 months postoperatively, the comparison of PCO between the two groups showed that PCO grade 2 was the most common in both Group I (58.75%) and Group II (62.5%) eyes. PCO grade 3 was observed in 30 eyes (37.5%) in Group I and 14 eyes (17.5%) in Group II, with Group I having a 2.7 times higher incidence of grade 3 PCO compared to Group II. Although Group I had more eyes with severe PCO compared to Group II, the difference was not statistically significant (p>0.05).

When comparing PCO grades with age at 6 months, PCO grade 1 was most commonly seen in the age >70 years group in both groups, with no significant difference. The chance of developing PCO grade 3 was 2 times higher in Group I eyes compared to Group II eyes in the <50 years age group, but there was no significant difference in PCO grades with age between the groups (p>0.05).

The comparison of PCO prevalence among diabetic patients' eyes at 6 months between the groups showed a higher prevalence of grade 3 PCO in Group I (80%) compared to Group II (58.3%). Among diabetic patients' eyes, PCO grade 3 was more prevalent than grade 2, regardless of the groups.

The comparison of PCO grades with preoperative cataract grade between the groups at 6 months revealed that Group II had a 0.36 times higher chance of developing PCO grade 2 compared to Group I. Among eyes with PCO grade 3, all eyes in both groups had cataract grades ≤NO3 NC3 C3 P3. There were twice as many eyes in Group I compared to Group II that developed PCO grade 3, but the difference was not statistically significant.

DISCUSSION

The present study demonstrates that there is a slightly higher incidence of PCO formation in eyes implanted with hydrophilic IOLs compared to eyes implanted with hydrophobic IOLs. Furthermore, PCO was found to be more prevalent in young individuals, diabetic patients, and eyes with preoperative immature cataracts (≤NO3 NC3 C3 P3) at the six-month follow-up period. While the higher incidence of PCO in hydrophilic IOLs compared to hydrophobic IOLs has been extensively investigated, it is important to consider patient factors such as age, diabetes, and preoperative cataract status when interpreting these findings.

Consistent with previous studies, the current study found that hydrophilic IOLs were associated with a higher incidence of PCO formation than hydrophobic IOLs at the six-month postoperative period. Both types of IOLs had a single-piece design with square-edged optics and no haptic angulation. Previous studies by Kugelberg et al. (2006) and Vasavada et al. reported similar findings, demonstrating a greater percentage area and severity of PCO in patients with hydrophilic acrylic IOLs compared to those with hydrophobic acrylic IOLs at one year and three years postoperatively, respectively .

The hydrophobic nature of the IOL material, characterized by a higher contact angle, may hinder Lens Epithelial Cell (LEC) migration on the IOL surface, contributing to the protective effect against PCO formation. The square-edged design of the IOLs seems to have a more pronounced protective effect against PCO when combined with a hydrophobic material.

In the present study, a higher incidence of grade 3 PCO was observed among patients with presenile cataracts (age <50 years). This can be attributed to the higher proliferative capacity of LECs and increased inflammatory response in younger individuals, leading to a greater tendency for PCO formation. Similar findings have been reported by Jamal Solomon et al. and Pandey et al., highlighting younger age as a significant risk factor for PCO development . The present study also compared the incidence of PCO development between hydrophilic and hydrophobic IOLs based on age and found a 2-fold increased risk of grade 3 PCO among eyes with hydrophilic IOLs in the age group younger than 50 years. This may be attributed to the more proliferative nature of LECs in young individuals and the reduced adhesive properties of hydrophilic IOLs in preventing PCO formation. To the best of our knowledge, no previous study has been published comparing the incidence of PCO formation between IOL biomaterials with age as a confounding factor.

In the present study, diabetic patients were found to have a higher risk of developing grade 3 PCO at the six-month follow-up. The compromised blood-aqueous barrier in diabetic eyes, along with the additional surgical invasion, leads to increased postoperative inflammation and LEC proliferation, contributing to PCO formation. Hayashi et al. reported a significantly higher risk of PCO development in diabetics compared to controls at three years postoperatively, and Praveen et al. demonstrated that the duration of diabetes increased the incidence of PCO at four years .

Furthermore, the present study confirmed that eyes with cataract grades >NO3 NC3 C3 P3 (mature cataracts) had a lower tendency to develop PCO. This can be explained by alterations in the anterior lens epithelium, which normally contributes to the regenerative capabilities of lens equatorial cells. Some studies have reported that senile complete cataracts (mature cataracts) have a significantly lower tendency to develop postoperative capsular opacification compared to other cataract types (nuclear, cortical, posterior subcapsular) . In the present study, a 2-fold increased risk of grade 3 PCO was observed among eyes with hydrophilic IOLs. This is one of the few studies comparing the incidence of PCO formation between IOL biomaterials with preoperative cataract grade as a confounding factor.

Overall, the findings of this study emphasize the importance of considering patient factors, such as age, diabetes, and preoperative cataract status, when evaluating the incidence of PCO and its association with IOL biomaterial. These factors should be taken into account in clinical decision-making to optimize outcomes following cataract surgery.

CONCLUSION

In conclusion, the findings of this study indicate that the incidence of PCO is higher in eyes implanted with hydrophilic IOLs compared to hydrophobic IOLs. However, it is important to note that this increased incidence can also be attributed to patient factors such as age, diabetes mellitus, and cataract status, which are known to be associated with a higher risk of PCO development. Therefore, when considering the choice of IOL material, it is crucial to take into account these patient factors to optimize postoperative outcomes and minimize the risk of PCO formation.

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