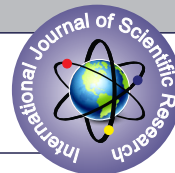


RATE OF POSTERIOR CAPSULAR OPACIFICATION IN HYDROPHILIC VERSUS HYDROPHOBIC INTRAOCULAR SINGLE PIECE ACRYLIC LENS IN PATIENTS UNDERGOING PHACOEMULSIFICATION.



Ophthalmology

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ABSTRACT

Background: The modern surgical techniques employed for cataract surgery are safe with few complications which include posterior capsule opacification, corneal edema, clinically apparent cystoid macular edema, retained lens fragment, retinal detachment, endophthalmitis & IOL dislocation. **Aim:** To compare the rate of posterior capsular opacification & visual outcome after implantation of hydrophilic and hydrophobic single piece acrylic intraocular lenses of the same edge design. **Materials & Methods:** This is a hospital-based prospective, comparative study conducted on 100 patients having uncomplicated senile cataract who after meeting inclusion & exclusion criteria, were divided into two groups of 50 cases each, all underwent phacoemulsification surgery with the implantation of either hydrophilic or hydrophobic single piece acrylic intraocular lenses. Visual acuity & best corrected visual acuity post-operatively 1st day, 1st, 4th, 12th & 24th week with the help of snellen's chart, Posterior capsule opacification classification after slit lamp examination were done in every case. **Results:** Out of the total of 100 cases, maximum no. were in age group of 51-60 years i.e. 37%, males 58% outnumbered females, 92% cases presented with pre-operative VA of $\leq 6/36$. The earliest development of PCO was seen in the 4th week in group 1 & at 24th week in group 2. Also, incidence of PCO increased from 4% to 30% in group 1 & 4% in group 2 over 24 weeks of follow up. The difference in BCVA in both the groups at the end of weeks was not significant. **Conclusion:** The present study concludes that PCO formation was more in cases having hydrophilic IOL as compared to hydrophobic IOL after phacoemulsification with PC-IOL cataract surgery. However no significant difference in the postoperative BCVA was found at 6 months in both the groups.

KEYWORDS

Hydrophilic/Hydrophobic, Posterior Capsular Opacification(PCO), Visual Acuity.

INTRODUCTION:

Any opacity in the lens is defined as cataract by DUKE ELDER, which is the most common & treatable cause of blindness.¹ Age-related cataracts are responsible for 51% of world blindness.² It is treated by surgery. Cataract surgery had undergone a tremendous metamorphosis from simple procedure of couching practiced by sushruta to latest method of phacoemulsification of Charles kelman.³ The modern surgical techniques employed for cataract surgery are safe with few complications, include posterior capsule opacification(PCO), corneal edema (0.03%-5.18% cases), clinically apparent cystoid macular edema (1.2%- 3.5% cases), retained lens fragments (0.45%-1.70% cases), retinal detachment (0.14%-0.90%), endophthalmitis (0.10%-0.20%) & IOL dislocation (0.19%-1.1 0%).⁴ Dietrich was the first to give description of posterior capsular opacification after performing extra-capsular extraction in animals.⁵ Soemmerring DW was the first person to notice PCO in man.⁶ Posterior capsular formation is a dynamic process & it results from continuous proliferation, migration & differentiation of residual lens epithelial cells that remain after removal of the nucleus & cortex of the lens in cataract surgery. Morphologically, there are two different types of PCO-fibrosis type & pearl type (Elschnig's pearls).⁷ Two principles for the prevention of PCO are:(1) Primary line of defense:To minimize the number of retained/regenerated cells & cortex in the capsular bag.(2) Secondary line of defense:If some cells do remain, the barrier effect offered by the intra-ocular lens works as a second line of defense & helps in preventing PCO by blocking the growth of cells from the equatorial region towards the centre of visual axis.⁸ Thus, the present study had been undertaken to compare the rate of PCO formation & visual outcome after implantation of hydrophilic & hydrophobic single piece acrylic intraocular lenses of same edge design in patients undergoing phacoemulsification surgery.

Material and method:

It is a hospital-based prospective, comparative study conducted in the department of Ophthalmology of a tertiary care hospital in Jammu over a period of 1 year wef Nov 2018 to Oct 2019 on patients with senile uncomplicated cataract who underwent phacoemulsification surgery with the implantation of either hydrophilic or hydrophobic single piece acrylic intraocular lenses of same edge design. The clearance for study was taken from the institutional Ethical committee (IEC/GMC/2019/903 dated 28-12-2019) & informed consent was taken from all patients. Cases were selected randomly & divided into two groups (Group 1 and Group 2) of 50 cases each.

GROUP 1: Cases underwent phacoemulsification surgery with

implantation of hydrophilic single piece acrylic intraocular lens.

GROUP 2: Cases underwent phacoemulsification surgery with implantation of hydrophobic single piece acrylic intraocular lens.

INCLUSION CRITERIA;

Patients aged ≥ 40 years of either sex with senile, uncomplicated cataract, intraocular lens same square edge design.

EXCLUSION CRITERIA;

Pupillary dialation less than 6.0 mm, previous intra-ocular surgery, traumatic cataract, pseudoexfoliation syndrome, uveitis, diabetic retinopathy, glaucoma, advanced macular degeneration, other disease that affect visual outcome, cases that had intra-operative complications like posterior capsule rupture, intra-operative hemorrhage & residual lens matter were excluded.

The study was carried out as follows: Baseline demographic & clinical details were recorded

I. Visual acuity determination with brief history of ocular complaints & present history regarding diminution of vision was taken, history of any refractive error etc.

II. General physical & systemic examination.

III. Ocular examination was done as following:

a) Visual acuity & best corrected visual acuity was obtained with the help of snellen's chart.b) Measurement of intraocular ocular pressure with help of non contact tonometre.c) Slit lamp examination:Any evidence of corneal edema/opacity or irregularity/anterior chamber reaction/size of pupil.d) Fundus examination (slit lamp biomicroscopy with 90D lens & indirect ophthalmoscopy).e) preoperative topical antibiotic drop & oral antibiotics were given one day before surgery.f) Mydriasis was achieved using topical 0.8% tropicamide & 5% phenylephrine.g) 4% xylocaine was instilled topically.h) All the patients were operated using peribulbar block.

PROCEDURE: Phacoemulsification with PC-IOL done in all cases.

Post-operative follow up: After the surgery the patients were evaluated on the first post-operative day, 1st, 4th, 12th & 24th post-operative week. Following parameters were evaluated:Uncorrected & best corrected visual acuity, SLE to rule out corneal striae/edema/anterior chamber reaction/pupillary reaction/any other pathology, intra-ocular

pressure with the help of non- contact tonometre, degree & type of PCO, Fundus glow.

Posterior capsule opacification(PCO) was classified on a 4 point scale after slit lamp examination based on the study by SELLMAN AND LINDSTROM 9 by a single examiner.

Grade 1 = NO or slight PCO without reduced red reflex, no pearls or pearls not to the IOL edge.

Grade 2 = mild PCO reducing the red reflex, Elschnig pearls to the IOL edge.

Grade 3 = moderate fibrosis or Elschnig pearls inside IOL edge but with clear visual axis.

Grade 4 = severe fibrosis or Elschnig pearls covering the visual axis and severely reducing the reflex.

An opacification was considered significant if it was of grade 3 and associated with a drop in more than 2 lines of snellen's visual acuity or its grade 4.

Statistical Analysis: The data was analysed using statistical software MS Excel / SPSS version 17.0 for windows. Data presented as percentage (%) and mean (SD) as discussed appropriate for quantitative and qualitative variables. Statistical significance between the groups was evaluated using student 't' test/chi square test. A p value <0.05 was considered as statistically significant and p value of <0.01 was considered statistically highly significant.

Observation & Results:

Following observations were made during study period:

Table no 1, shows that out of the total of 100 cases in Group 1 & 2, maximum no. were in age group of 51-60 years i.e 37% followed by 25% in 61-70 years. The mean age in Group 1 was 60.68±9.60 & in Group 2 was 59.72±9.56. Males 58% outnumbered females in present study. The maximum i.e 92% cases presented with its VA of ≤6/36

Table No. 2, shows that the earliest development of PCO was seen in the 4th week in group 1 and at 24th week in group 2. The maximum number of patients had PCO at 24 week in both the groups. Regarding severity of PCO, in group 1, 10% patients had grade 1 PCO, 4% patients grade 2 & 2% patients had grade 3 posterior opacification whereas in group 2, only 4% had grade 1 PCO. More severe grades of PCO i.e grade 3 was seen in group 1 only.

Table No. 3, shows that at the end of 1ST week, uncorrected visual acuity of 6/6-6/12 was seen in 44% of the patients in group 1 & 52% patients in group 2 whereas BCVA of 6/6-6/12 was found in 52% in group 1 & 56% in group 2. Also at the end of 4th week, uncorrected visual acuity of 6/6-6/12 was seen in 56% of the patients in group 1 & 76% patients in group 2 whereas BCVA of 6/6-6/12 was found in 76% in group 1 & 80% in group 2. Further at the end of 12th week, uncorrected visual acuity of 6/6-6/12 was seen in 60% of the patients in group 1 & 84% patients in group 2 whereas BCVA of 6/6-6/12 was found in 92% in group 1 & 96 % in group 2. Again at the end of 24th week, uncorrected visual acuity of 6/6-6/12 was seen in 80% of the patients in group 1 & 96% patients in group 2 whereas BCVA of 6/6-6/12 was found in 96% in group 1 & 98% in group 2. The difference in BCVA in both the groups at the end of week was not significant as shown in table.

The intra-operative period was uneventful in both the groups. The most common complication was striate keratitis 6% & uveitis 3% in both the groups. Moreover not much difference was seen in visual acuity on 1st postoperative day & week so visual acuity of 1st postoperative day was not included in table.

DISCUSSION:

Trivedi RH et al. proposed two principles for the prevention of PCO: Primary line of defense & Secondary line of defense. They also identified surgery related & intraocular lens related factors regarding prevention of PCO. (A) Surgery related factors—(1) Hydrodissection enhanced cortical cleanup-It helps in efficient removal of cortex/cells & hence lessens the chances of PCO formation. (2) In the bag (capsular fixation)-The primary function of bag fixation is to provide efficient intraocular barrier & is considered maximum when the lens optic is

fully in the bag in direct contact with the posterior capsule. (3) Capsulorrhexis edge on the intra-ocular lens surface-making a continuous circular capsulorrhexis diameter slightly smaller than the intraocular lens optic places the cut anterior capsule edge on the anterior surface of the optic providing a tight fit (analogous to shrink wrap), therefore helping to sequester the optic in the capsular bag from the surrounding aqueous humour. (B) Intraocular lens related factors- (1) Biocompatibility-Defined by many criteria such as the ability to inhibit stimulation of epithelial cellular proliferation: lesser the proliferation, the lesser the chance for PCO formation. (2) Maximal intraocular lens optic-This makes a shrink wraps effect, a tight fit on the posterior capsule against the back of the intraocular lens optic. (3) Barrier effect of the intraocular lens optic-The concept of barrier effect of an intraocular lens is an established one dating back to Ridley H.⁸

In the present study, earliest development of PCO was seen in the 4th week in group 1 & at 24th week in group 2. The maximum number of patients had PCO at 24 week in both the groups. Also, incidence of PCO increased from 4% to 30% in group 1 & 4% in group 2 over 24 weeks of follow up. Thus incidence of PCO formation is more with hydrophilic as compared to hydrophobic lenses in the present study. The PCO occurred more frequently with hydrophilic compared to hydrophobic IOLs because a hydrophilic surface provides a foundation for lens epithelial cell proliferation & migration whereas a hydrophobic surface adheres tightly to the posterior capsule due to its highly bio-adhesive nature. Another important cause of PCO in hydrophilic IOLs is due to their high water content which does not allow as sharp a posterior edge as can be achieved in hydrophobic IOLs. 10 Ursell PG et al., did a prospective, randomized study on 90 eyes to determine the influence of polymethylacrylate (PMMA), silicone & hydrophobic (acrSof) lenses on PCO formation & found that hydrophobic lens material was associated with less PCO formation (11.75%) than PMMA (43.65%) and silicone (33.50%) lenses. 11 Hollick et al. did a study & found PCO formation was less in polyacrylic (10%) than silicone (40%) & PMMA (56%). 12 Formanek CA et al. in his study concluded that the incidence of PCO was lowest in the hydrophobic IOL groups especially in groups with a sharp edged optic. 13 Hayashi K & Hayashi H compared the degree of PCO in eyes implanted with hydrophilic acrylic IOLs & eyes with hydrophobic acrylic IOLs & found that PCO formation was more extensive in case of hydrophilic IOL as compared to hydrophobic IOL. 14 Heatley et al. did a study on 53 postoperative cataract patients to compare PCO formation rates between hydrophilic & hydrophobic single piece acrylic IOLs & found median percentage area of PCO was 50.3% in the hydrophilic IOL group & 4.9% in the hydrophobic group. 15 Kugelberg M et al., did a comparative study on 120 senile cataract patients to evaluate PCO formation after implantation of hydrophilic or hydrophobic acrylic intraocular lens after cataract surgery & found patients implanted with hydrophilic lens had greater percentage area and severity of PCO than hydrophobic IOL patients. 16 Iwase T et al. conducted a study & concluded the PCO value in the hydrophilic group increased significantly with time & was statistically significantly greater than in the hydrophobic group. 17 Saeed MU et al., conducted a study to report the incidence of PCO in 45 patients who were implanted hydrophilic acrylic IOL in one eye & hydrophobic IOL in other eye after cataract surgery & found the incidence of PCO in hydrophilic IOL implanted eyes was high (40%) as compared to hydrophobic implanted eyes (8%). 18 Chang A & Kugelberg M did a study after phacoemulsification to compare the development of PCO implantation of a hydrophilic or hydrophobic lens. This study revealed more & denser PCO development in hydrophilic IOL than in case of hydrophobic IOL. 19 Ozyol P did a comparative study regarding the biocompatibility of intraocular lens materials & found low rate of PCO formation in hydrophobic acrylic & silicone intraocular lenses than hydrophilic & PMMA lenses. 10 Zhao Y et al. included a total of eleven studies & did a meta-analytical comparison study of hydrophobic & hydrophilic lenses in preventing (PCO) after cataract surgery. The overall analysis revealed that in general, PCO scores & the rate of Nd:YAG laser capsulotomy were influenced by intraocular lens biomaterial. The lenses made of hydrophobic biomaterial were over all superior in lowering the PCO score. 20 Vasavada AR et al., did a prospective randomized clinical trial & concluded that PCO was significantly less with the Acrys of hydrophobic acrylic IOL.²¹

In the present study, on presentation in Group 1, there were maximum 58% cases with VA of ≤6/60 followed by 38% cases with VA of 6/36-6/60 while in Group 2, there were 54% cases with VA of 6/36-6/60. Thus, out of the total 100 cases, the maximum 92% cases presented

with VA of $\leq 6/36$. Table No. 3, shows that at the end of 1ST week, uncorrected visual acuity of 6/6-6/12 was seen in 44 % of the patients in group 1 & 52 % patients in group 2 whereas BCVA of 6/6-6/12 was found in 52% in group 1 & 56 % in group 2. At the end of 4th week, uncorrected visual acuity of 6/6-6/12 was seen in 56 % of the patients in group 1 & 76 % patients in group 2 whereas BCVA of 6/6-6/12 was found in 76% in group 1 & 80 % in group 2. At the end of 12th week, uncorrected visual acuity of 6/6-6/12 was seen in 60 % of the patients in group 1 & 84 % patients in group 2 whereas BCVA of 6/6-6/12 was found in 92% in group 1 & 96 % in group 2. At the end of 24th week, uncorrected visual acuity of 6/6-6/12 was seen in 80 % of the patients in group 1 & 96 % patients in group 2 whereas BCVA of 6/6-6/12 was found in 96% in group 1 & 98 % in group 2. The difference in the BCVA was not significant. The results are comparable with many studies in the literature. Heatley CJ et al. in study of comparison between the hydrophilic & hydrophobic acrylic single piece lenses found no significant difference between the best corrected visual acuity at 6 months & 1 year postoperative period.¹⁵ Zemaitiene R et al., in his study on 72 patients scheduled for cataract surgery, found no significant differences in best corrected visual acuity (BCVA) after implantation of hydrophilic acrylic or hydrophobic acrylic intraocular lenses at 1-year follow up.²² Zhao Y et al., included a total of 11 studies & did a meta-analytical comparison study of hydrophobic & hydrophilic lenses in preventing (PCO) after cataract surgery. The overall analysis revealed that in general, PCO scores & the rate of Nd:YAG laser capsulotomy were influenced by intraocular lens biomaterial. The lenses made of hydrophobic biomaterial were over all superior in lowering the PCO score & the Nd:YAG laser capsulotomy rate, but not visual acuity. ²⁰ Therefore, in our study we observed significant difference in terms of the rate and severity of posterior capsular opacification between hydrophilic single piece acrylic round edge intraocular lens and hydrophobic single piece acrylic round edge intraocular lens after phacoemulsification cataract surgery. There was no statistically significant difference in terms of BCVA.

CONCLUSION:

From present study, we may conclude that PCO formation was more in cases having hydrophilic IOL as compared to hydrophobic IOL & is a significant postoperative factor leading to low vision even after phacoemulsification with PC-IOL cataract surgery. However no significant difference in the postoperative best corrected visual acuity at 6 months in both the groups were found. Hence, Intraocular lens material is an important variable in the development of posterior capsule opacification.

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Declaration:

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Conflict of interest: None declared

Table No. 1 Distribution of studied subjects according to age,sex & pre-operative visual acuity.

	Group I	Group 2
Age(in years)	No. of patients(%age)	No. of patients(%age)
41-50	9(18)	8(16)
51-60	17(34)	20(40)
61-70	13(26)	12(24)
≥ 71	11(22)	10(20)
Sex		
Males	28(56)	30(60)
Females	22(44)	20(40)
Pre-operative visual acuity		
$\geq 6/24$	2(4)	6(12)
6/36-6/60	19(38)	27(54)
$< 6/60$	29(58)	17(34)

Table 2: Incidence & Severity of posterior capsule opacification.

	Group I	Group 2
Incidence of posterior capsular opacification	No. of patients(%age)	No. of patients(%age)
4 th week	2(4)	0
12 th week	7(14)	0
24 th week	15(30)	2(4)

Grades of posterior capsular opacification		
Grades 1	5(10)	2(4)
Grades 2	2(4)	0
Grades 3	1(2)	0
Grades 4	0	0

Table 3 Post-operative uncorrected & best corrected visual acuity at the end of 1st, 4th, 12th, 24th week.

Group	visual acuity at 1 st week			
	6/6-6/12		6/18-6/36	
	Uncorrected	Best corrected	Uncorrected	Best corrected
Group I No. of patients (%age)	22(44)	26(52)	28(56)	24(48)
Group 2 No. of patients (%age)	26(52)	28(56)	24(48)	22(44)
Group	visual acuity at 4 th week			
	6/6-6/12		6/18-6/36	
	Uncorrected	Best corrected	Uncorrected	Best corrected
Group I No. of patients (%age)	28(56)	38(76)	22(44)	12(24)
Group 2 No. of patients (%age)	38(76)	40(80)	12(24)	10(20)
Group	visual acuity at 12 th week			
	6/6-6/12		6/18-6/36	
	Uncorrected	Best corrected	Uncorrected	Best corrected
Group I No. of patients (%age)	30(60)	46(92)	20(40)	4(8)
Group 2 No. of patients (%age)	42(84)	48(96)	8(16)	2(4)
Group	visual acuity at 24 th week			
	6/6-6/12		6/18-6/36	
	Uncorrected	Best corrected	Uncorrected	Best corrected
Group I No. of patients (%age)	40(80)	48(96)	10(20)	2(4)
Group 2 No. of patients (%age)	48(96)	49(98)	2(4)	1(2)

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