Evaluation of Posterior Capsular Opacification following Phacoemulsification, Extracapsular and Small Incision Cataract Surgery

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Abstract

Background: Posterior capsular opacification is the most common complication of modern cataract surgery.

Methods: A prospective study was conducted on 150 patients (150 eyes) out of which 50 eyes each underwent cataract surgery by extracapsular cataract extraction, small incision cataract surgery and phacoemulsification technique. On postoperative follow up posterior capsular opacification and Neodymium: Yttrium Aluminium Garnet laser capsulotomy rate was evaluated.

Result: Posterior capsular opacification rate was significantly less ($p=0.03$) in eyes which had undergone phacoemulsification as compared to extracapsular cataract extraction. However capsulotomy rate was not statistically significant after comparison of the three surgical techniques of cataract surgery.

Conclusion: Posterior capsular opacification following cataract surgery can be minimized by the use of small incision cataract surgery and phacoemulsification.

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Key Words : Posterior capsular opacification; Capsulorrhexis; Hydrodissection

Introduction

Cataract is the most important cause of treatable blindness after the age of fifty years. Cataract surgery has come a long way from couching to phacoemulsification with foldable intraocular lens (IOL) implantation.

Extracapsular cataract extraction (ECCE) gained popularity in 1980's as it preserved the posterior capsule permitting IOL insertion in addition to being an inexpensive and relatively easy to learn technique. However a 10-11 mm incision with sutures is a prerequisite for this technique.

Small incision cataract surgery (SICS) became a good alternative for surgeons who did not have access to a phacoemulsification machine. Phacoemulsification technique reduced the size of incision further and foldable IOL came into use.

Posterior capsule opacification (PCO, secondary cataract, after cataract) is the most common complication of modern cataract surgery, occurring in upto 50% of patients by two years postoperatively [1]. PCO is caused by lens epithelial cells that remain in the capsular bag after cataract surgery. They migrate, proliferate and transform to produce Elschnig's pearls

and capsular fibrosis [2]. When PCO encroaches onto the visual axis, it produces light scattering and visual deterioration. Visually significant PCO is usually managed by creating an opening within the opaque posterior capsule using the Neodymium:Yttrium Aluminium Garnet (Nd: YAG) laser. With modern techniques and IOLs, the expected rate of PCO and subsequent Nd: YAG laser posterior capsulotomy rate is decreasing to less than 10% [3,4].

Material and Methods

A prospective study of 150 patients (150 eyes) was conducted. Cataract surgery, 50 each by ECCE, SICS and phacoemulsification with IOL implantation was carried out from Aug 2005 to Jul 2007. Thereafter every patient was followed up at one, three and six months after surgery for posterior capsule opacification (PCO). Eyes which had lost 2 or more lines of visual acuity with a clinically significant opaque capsule were labelled as clinically significant PCO and these were treated with Nd: YAG laser capsulotomy.

Patients with complicated cataract, vitreo-retinal diseases, posterior capsular tear, previous history of intraocular surgery / laser treatment / uveitis / injury were excluded from the study.

In cases who had undergone ECCE + IOL implantation a 10-11 mm midlimbal bevelled incision was made superiorly

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after making a fornix based conjunctival flap. Nucleus was delivered with the help of lens expressor after doing envelope capsulotomy. Non foldable 6.0 mm optic PMMA IOL was implanted in the capsular bag. Wound closure was accomplished with 5, 10-0 monofilament nylon, interrupted sutures.

In SICS+ IOL technique a sclerocorneal tunnel (1.5-2mm from limbus, 5-5.5mm in length, 3-4mm in width) was made after making a fornix based conjunctival flap. Continuous curvilinear capsulorhexis (CCC) 5-5.25 mm diameter was made and hydrodelineation / hydrodissection of nucleus was performed which enabled free rotation of nucleus. Nucleus was taken out with the help of vectis. A non foldable 5.25 mm optic PMMA IOL was placed in the capsular bag and the incision was not sutured. However two interrupted 10-0 monofilament nylon sutures were applied in 5 cases (10%) because the tunnel was unstable.

In the phacoemulsification method, a 2.8 mm scleral tunnel incision was made with keratome in superior quadrant (2 mm from limbus) after raising a fornix based conjunctival flap. A continuous curvilinear capsulorhexis (CCC) 5-5.5 mm was done and hydrodelineation/hydrodissection of lens was performed. Nucleus of the lens was removed using ultrasonic energy through the phacoprobe by Stop and Chop method. Cortical matter was aspirated with bimanual irrigation – aspiration cannula. No attempt was made to reduce lens epithelial cells by polishing the anterior capsule. Foldable 6.0 mm optic hydrophilic acrylic IOL was placed in the capsular bag with the help of injector / holder-folder instruments after enlarging the incision between 3.2-3.8 mm. No sutures were applied in this technique.

The following parameters were tested :

- Distant and near visual acuity, unaided and aided.
- Slit lamp biomicroscopy for evaluation of anterior segment.
- Direct and indirect ophthalmoscopy to assess media clarity and retinal pathology.
- PCO was determined by calculating the area of opacity from a retroillumination image.

Table 2
Group A (ECCE)

Follow up	Number of eyes (%)	Visual acuity (aided)	Number of eyes (%)	PCO present number of eyes (%)	Number of Nd :YAG laser capsulotomies (%)
1 month	50 (100)	<6/60 6/60-6/18 6/12-6/6	3 (6) 13 (26) 34 (68)	Nil	Nil
2 months	48 (96)	<6/60 6/60-6/18 6/12-6/6	2 (4.2) 9 (18.8) 37 (77)	Nil	Nil
3 months	47 (94)	<6/60 6/60-6/18 6/12-6/6	2 (4.3) 9 (19.1) 36 (76.6)	3 (6.4)	1 (2.1)
6 months	46 (92)	<6/60 6/60-6/18 6/12-6/6	1 (2.2) 13 (28.3) 32 (69.5)	10 (21.7)	9 (19.6)

Nd : YAG laser capsulotomy was done in cases with visually significant PCO. After the procedure, patient was put on topical antiglaucoma medication and steroid for a week and reviewed thereafter for visual acuity assessment and refractive correction if required.

The patients were divided into three groups depending on the type of cataract surgery performed. Group A comprised of 50 patients having undergone ECCE, Group B had 50 patients who underwent SICS and Group C comprised of 50 patients who underwent phacoemulsification surgery. The three groups were comparable with regards to age and sex distribution (Table 1). For establishing statistical associations, Z statistics (Two-tailed test) was used where applicable.

Results

In group A (ECCE) (Table 2), Group B (SICS) (Table 3) and Group C (phaco) (Table 4) cases which did not undergo Nd:YAG laser capsulotomy did not have visually significant PCO.

In our study overall PCO rate was 28.1% in Group A, 15.4% in Group B and 9.1% in Group C. Using Z statistics (Two-tailed test) where $p < 0.05$ was considered as significant and after comparing the three groups, it was seen that PCO rates in Group A vs Group B ($p = 0.69$), Group B vs Group C ($p = 0.13$) were not significant. However in Group A vs Group C ($p = 0.03$) PCO rate was significant. This was probably as a consequence of CCC, hydrodissection with nucleus rotation and in-the-bag placement of IOL done in cases of phacoemulsification.

In our study overall Nd: YAG laser capsulotomy rate was 21.7% for Group A, 13.2% for Group B and 6.8% for Group C. Using Z statistics (Two-tailed test) where $p < 0.05$ was

Table 1
Sample characteristics

Type of procedure	Age group (in years)	Number of patients (%)		Total
		Male	Female	
Group A	59-85	22 (44)	28 (56)	50
Group B	50-80	21 (42)	29 (58)	50
Group C	48-80	25 (50)	25 (50)	50
Total		68 (45.3)	82 (54.7)	150

Table 3**Group B (SICS)**

Follow up	Number of eyes (%)	Visual acuity (aided)	Number of eyes (%)	PCO present Number of eyes (%)	Number of Nd :YAG laser capsulotomies (%)
1 month	50 (100%)	< 6/60	2 (4)	Nil	Nil
		6/60-6/18	10 (20)		
		6/12-6/6	38 (76)		
2 months	48 (96%)	< 6/60	1 (2.1)	Nil	Nil
		6/60-6/18	7 (14.6)		
		6/12-6/6	40 (83.3)		
3 months	47 (94%)	< 6/60	1 (2.1)	1 (2.1)	1 (2.1)
		6/60-6/18	6 (12.7)		
		6/12-6/6	40 (85.2)		
6 months	45 (90%)	< 6/60	1 (2.2)	5 (13.3%)	4 (11.1)
		6/60-6/18	8 (17.8)		
		6/12-6/6	36 (80)		

Table 4**Group C (PHACO)**

Follow up	Number of eyes (%)	Visual acuity (aided)	Number of eyes (%)	PCO present Number of eyes (%)	Number of Nd :YAG laser capsulotomies (%)
1 month	49 (98%)	< 6/60	2 (4.1%)	Nil	Nil
		6/60-6/18	8 (16.3%)		
		6/12-6/6	39 (79.6%)		
2 months	47 (94%)	< 6/60	1 (2.1%)	Nil	Nil
		6/60-6/18	6 (12.8 %)		
		6/12-6/6	40(83.1%)		
3 months	47 (94%)	< 6/60	1 (2.1%)	Nil	Nil
		6/60-6/18	5 (10.6 %)		
		6/12-6/6	41 (87.3%)		
6 months	44 (88%)	< 6/60	0 (0 %)	4 (9.1%)	3 (6.8%)
		6/60-6/18	5 (11.4 %)		
		6/12-6/6	39 (88.6%)		

considered as significant, it was seen that Nd: YAG capsulotomy rates in Group A vs Group B ($p=0.27$), Group B vs Group C ($p=0.72$) and Group A vs Group C ($p=0.77$) were not significant.

Discussion

Visually significant PCO develops in more than 25% of patients having undergone ECCE or phacoemulsification with posterior chamber IOL implantation in the first five years after surgery [5]. Some studies correlate a large incision with increased postoperative blood-aqueous barrier damage and thus an increased risk of PCO [6,7].

Cortical cleaving hydrodissection of nucleus followed by its rotation during SICS and phacoemulsification results in removal of maximum lens fibres and epithelial cells at the equator of the capsular bag, thereby reducing the chances of PCO. By freeing and rotating the lens nucleus, hydrodissection facilitates lens nucleus and cortex removal without zonular- capsular rupture [8].

The presence of a postoperative Soemmering's ring

is of clinical importance in that the E- cells that form it are the direct precursor cells to those that migrate across the visual axis, creating PCO. The formation of Soemmering's ring is not significantly influenced by the haptic fixation pattern. It is much more dependent on the quality and thoroughness of surgical cortical cleanup [9]. Reduction of Soemmering's ring is an important goal.

In our study PCO rate in phacoemulsification was marginally less than that in SICS (but not statistically significant) possibly due to bimanual irrigation/aspiration technique used in phacoemulsification which enables a surgeon to remove equatorial lens cells and fibres thereby reducing the incidence of PCO formation.

The in- the- bag fixation of IOLs occurs about 60% of time in non-phaco ECCE. In many cases this is due to combination of rigid design IOLs and can-opener anterior capsulotomy. In case one or both haptics are not placed in the capsular bag, a potential space is created allowing an avenue for cells to grow posteriorly towards the visual axis. With modern foldable lens implantation, in-the- bag fixation has increased to over 90%. In-the-

bag placement of IOL in SICS and phacoemulsification creates a barrier effect of IOL which results in hindrance to migration of equatorial lens epithelial cells over posterior capsule. Nishi et al [10] support a physiological barrier to cellular migration through the phenomenon of contact inhibition and this factor certainly plays a role in prevention of PCO.

Continuous curvilinear capsulorrhexis of anterior capsule of moderate diameter just overlapping the optic which was done in cases of SICS and phacoemulsification creates a barrier effect for formation of PCO by a “shrink wrap” effect [11]. For eg, if the IOL optic were 6.0 mm, the capsulorrhexis diameter would ideally be slightly smaller, perhaps 5.0-5.5mm. This mechanism may support protecting the milieu within the capsule from some potential deleterious factors within the aqueous.

Visually significant PCO is usually managed by creating an opening within the opaque posterior capsule using the Nd:YAG laser. This procedure is an effective alternative to surgical discission avoiding such complications as endophthalmitis and vitreous loss [12]. Some authors have reported a PCO rate of 11.1% two years after phacoemulsification and acrylic IOL implantation [13], which is comparable with our study showing PCO rate of 9.1% at six months.

In some studies eyes who had undergone phacoemulsification with acrylic IOLs, Nd: YAG laser capsulotomy was required in only 1 of the 4 patients developing PCO [14] whereas in our study 3 out of 4 cases of PCO required Nd : YAG laser capsulotomy.

The limitation of the present study is the short term follow up of the patients. The authors acknowledge the need for longer follow up of the patients.

The findings of the present study indicate that posterior capsule opacification is one of the complications of cataract surgery which can be minimized by the technique of small incision cataract surgery and phacoemulsification. This is probably due to three important steps being followed in both the techniques like continuous curvilinear capsulorrhexis, hydrodissection and in -the -bag placement of IOL.

Conflicts of Interest

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Intellectual Contribution of Authors

Study Concept : Col PS Moulick, Col FEA Rodrigues (Retd), Lt Col K Shyamsundar

Drafting & Manuscript Revision : Col PS Moulick

Statistical Analysis : Col PS Moulick

Study Supervision : Col PS Moulick, Lt Col K Shyamsundar

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