Clinical Research

Incidence and associated factors of posterior capsule opacification in pseudophakic patients at Cipto Mangunkusumo Hospital

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ABSTRAK

Latar belakang: Posterior capsule opacification *(PCO) merupakan konsekuensi yang paling sering dijumpai pasca-operasi katarak, yang dapat menyebabkan penurunan tajam penglihatan. Insidens PCO di Indonesia belum pernah dilaporkan sebelumnya. Penelitian ini bertujuan untuk menilai insidens kumulatif PCO dan faktor-faktor yang berhubungan dengan insidens PCO di Rumah Sakit Cipto Mangunkusumo, Jakarta.*

Metode: *Penelitian ini merupakan penelitian deskriptif retrospektif pada pasien yang menjalani operasi katarak senilis selama tahun 2010. Data dikumpulkan dari rekam medis pada tahun 2013, meliputi karakteristik demografis, jenis operasi, karakteristik lensa intra-okular (LIO) yaitu materi,* optic edge design*, dan diameter. Dilakukan pencatatan waktu diagnosis PCO pertama kali (dalam bulan), dan tajam penglihatan terbaik dengan koreksi (TPDK) sebelum operasi, saat diagnosis PCO ditegakkan dan dua minggu setelah tindakan laser* Neodymium-doped yttrium aluminium garnet *(Nd:YAG) (dalam desimal).*

Hasil: *Penelitian ini melakukan observasi rekam medis pada 578 mata (485 pasien) katarak senilis. Insidens kumulatif PCO dalam tiga tahun sebesar 8,82% (51 mata). Tindakan fakoemulsifikasi dilakukan pada 496 (85,8%) mata. Median waktu saat diagnosis PCO ditegakkan adalah 21 bulan (rentang 1-34 bulan), dengan rerata TPDK 0,50 ± 0,26. Umur (<65 dan >65 tahun) tidak berhubungan dengan insidens PCO. Proporsi PCO yang lebih tinggi ditemukan pada jenis LIO akrilik hidrofilik (10,7%) dibandingkan LIO akrilik hidrofobik (6,2%). Setelah tindakan pasca-laser Nd:YAG TPDK meningkat menjadi 1,00.*

Kesimpulan: *Insidens kumulatif PCO selama tiga tahun adalah 8,82% (51 mata); tidak terdapat faktor yang berhubungan dengan terbentuknya PCO, namun persentase PCO yang lebih tinggi ditemukan pada LIO akrilik hidrofilik dibandingkan LIO akrilik hidrofobik.*

ABSTRACT

Background: Posterior capsule opacification (PCO) is the most common postoperative consequence of cataract surgery which may cause visual acuity reduction, yet the incidence in Indonesia has not been reported. The objectives of this study were to evaluate three years cumulative incidence of PCO and factors associated with PCO formation at Cipto Mangunkusumo Hospital, Jakarta.

Methods: This was a retrospective descriptive study on patients with uneventful senile cataract surgery during year 2010. All related data were retrieved from medical records in year 2013, which included patient demographics, type of surgery, intraocular lens (IOL) characteristics (material, optic edge design and diameter). Moreover, time to first PCO diagnosis (month), and best corrected visual acuity (BCVA) pre-operatively, at time PCO was diagnosed and two weeks after Neodymium-doped yttrium aluminum garnet (Nd:YAG) laser were noted (decimal).

Results: A total of 578 eyes (485 patients) were involved in this study. Three years cumulative incidence of the PCO was 8.82% (51 eyes). Phacoemulsification surgery was performed in 496 (85.8%) eyes. The median time to PCO diagnosis was 21 months (range 1 to 34 months), mean of BCVA was 0.50 ± 0.26. Age (<65 and >65 years old) was not associated to PCO. Higher incidence of PCO was found in patients using hydrophilic acrylic IOL (10.7%) than in hydrophobic acrylic (6.2%). After Nd:YAG laser was performed, BCVA was improved to 1.00.

Conclusion: Three years cumulative incidence of PCO was 8.82% and there was no defined factor related to PCO formation, but higher percentage of PCO occured in patients using hydrophilic acrylic IOL than in hydrophobic acrylic.

Keywords: incidence, intraocular lens, posterior capsule opacification

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Posterior capsule opacification (PCO) is the most common postoperative consequence of cataract surgery.[1] A cohort study by Fong, et al[2] reported that three years cumulative incidence of PCO was 38.5% (95% CI = 36.1-40.9) among 1,495 patients.

Posterior capsule opacification causes a reduction in visual acuity and contrast sensitivity, as well as glare and monocular diplopia[1,3,4] which might reduce the patient's quality of life and become an economic burden to the healthcare system.[5] Factors related to PCO formation mostly were the type of cataract surgery, intraocular lens (IOL) design and patients with systemic diseases. Opening a blocked visual axis with Neodymium-doped yttrium aluminum garnet (Nd:YAG) laser posterior capsulotomy will improve the visual acuity. However, in Indonesia, such procedure requires a referral to a tertiary hospital, which further increases the cost. Laser procedure itself has an inherited risk of complications such as IOL damage, increase of intraocular pressure, cystic macular edema, anterior vitreous surface disruption, and retinal detachment.[1,6]

Eventually, Department of Ophthalmology, Cipto Mangunkusumo Hospital (CMH) Jakarta had done a retrospective study by Anggraini and Hutauruk[7] and found that the incidence of PCO was 9.2% (47 of 513 eyes) in 2003 (unpublished data). Using modern cataract phacoemulsification machine, phacoemulsification has been performed increasingly with a better result regarding to visual acuity, small corneal incision, rapid wound healing and less complications. Also various better IOL material and design had been used in our hospital. However, there was no report of PCO incidence since then. The objective of this study was to evaluate three years cumulative incidence of PCO and factors associated with PCO formation.

METHODS

This was a retrospective descriptive study conducted in 2013. All data were retrieved from medical records period of January to December 2010. The inclusion criteria were all patients who had uneventful senile cataract surgery in 2010 at Department of Ophthalmology, Cipto Mangunkusumo Hospital (CMH), Jakarta, Indonesia. The exclusion criteria were patients with abnormalities other than PCO, which influence visual acuity, incomplete medical record data and post-operative follow-up of less than one month. A total sampling method was used in selection of the subjects. This study has been reported to CMH and confidentiality of subjects was guaranteed.

Collected data were focused on patient demographics, type of surgery (extra capsular cataract extraction [ECCE], phacoemulsification and small incision cataract surgery [SICS]), IOL characteristics (material, optic edge design and diameter), time to PCO diagnosis (duration between cataract surgery and diagnosis of PCO, in months). Best corrected visual acuity (BCVA) in decimal was noted at one month post-operatively, at time when PCO was diagnosed, and two weeks after Nd:YAG laser posterior capsulotomy. BCVA was classified based on the International Classification of Diseases-10 Clinical Modification (ICD-10 CM) revision.

Analysis was performed using SPSS 11.0 and Microsoft Excel 2011. We analyzed the proportions of PCO and compared it within phacoemulsification groups using Chi-square test.

RESULTS

There were 1,665 cataract surgeries performed during January–December 2010 in CMH. Ninety percent (1,498 cases) had a complete medical record, but only 1,104 cases (73.7%) could be accessed. Finally, 852 eyes met the inclusion criteria. Two hundred and seventy four cases (274) or 32.2% were excluded due to abnormalities other than PCO (138 cases) and 136 cases had incomplete required data. A total of 485 patients or 578 eyes (67.8%) were analyzed in this study. Demographic data of the patients can be seen in Table 1.

Pre-operative BCVA, one month post-operative BCVA and type of surgery performed can be seen in Table 2.

Cumulative incidence of PCO and clinical characteristics of PCO patients

PCO is the most common consequence after cataract surgery. Among 578 eyes, only 51 eyes had PCO. Cumulative incidence of PCO was 14 (2.42%) eyes at first year, 34 (5.88%) eyes in second year and 51 (8.82%) eyes in the third year.

Table 1. Patient demographics and clinical characteristics of pseudophakic patients {n=485 patients (578 eyes)}

Variable	n (%)
Laterality	
Unilateral	392 (80.8%)
Bilateral	93 (19.2%)
Sex	
Male	242 (49.9%)
Female	243 (50.1%)
Age (median;range)	65 (42 - 87) years

Table 2. Clinical characteristics of pseudophakic eyes (n=578)

Variable	Variables
Pre-op BCVA (in decimal)	0.07 (0.00-0.90)
No visual impairment (> 0.5)	127 (22.0%)
Mild visual impairment (≥ 0.3 – ≤ 0.5)	48 (8.3%)
Moderate visual impairment (≥ 0.1 – < 0.3)	102 (17.6%)
Severe visual impairment (≥ 0.05 – < 0.1)	39 (6.7%)
Blind category 3 (< 0.05 – ≤0.02)	129 (22.3%)
Blind, category 4 (< 0.02 – light perception)	133 (23.0%)
Post-op BCVA at 1 month (in decimal)	1.00 (0.30-1.20)
No visual impairment (> 0.5)	577 (99.8%)
Mild visual impairment (≥ 0.3 – ≤0.5)	1 (0.2%)
Type of surgery	
Phacoemulsification	496 (85.8%)
ECCE	77 (13.3%)
SICS	5 (0.9%)

*BCVA = best corrected visual acuity
*ECCE = extracapsular cataract extraction
*SICS = small incision cataract surgery

The mean age of PCO patients was 63.57 ± 8.20 year old, younger than other pseudophakic patients. Formation of PCO was most common in SICS eyes, but the number of SICS was only five compared to the most common surgical technique, which was phacoemulsification (in 496 eyes). The most common symptom of PCO was blurred vision, and median time to PCO diagnosis was 21 months or 1.75 years with a range of one to 34 months (Table 4).

Table 3. Clinical characteristics of PCO eyes (n=51)

Variable	
Age	63.57 ± 8.20 years old
Surgical technique	
Phacoemulsification	49 /496 (9.9%)
ECCE	1/ 77 (1.3%)
SICS	1/ 5 (20.0%)
BCVA at PCO diagnosis (in decimal)	0.50 ± 0.26
No visual impairment (> 0.5)	34 (66.7%)
Mild visual impairment (≥ 0.3 – ≤ 0.5)	6 (11.7%)
Moderate visual impairment (≥ 0.1–< 0.3)	8 (15.7%)
Severe visual impairment (≥ 0.05 – < 0.1)	3 (5.9%)
Symptoms of PCO	
Blurred vision	39 (76.5%)
Blurred vision and diplopia	2 (3.9%)
Foggy view	2 (2.0%)
Blurred vision and glare	1 (3.9%)
No symptoms	7 (13.7%)
Time of PCO diagnosis	21 (1 - 34) months

*PCO = posterior capsule opacification
*ECCE = extracapsular cataract extraction
*SICS = small incision cataract surgery
*BCVA = best corrected visual acuity

Table 4. Nd:YAG laser posterior capsulotomy

Variable	
Nd:YAG performed	37 (72.5%)
Nd:YAG not performed	14 (27.5%)
BCVA at PCO diagnosis (Nd:YAG performed, n=37)	0.43 ± 0.24
BCVA at PCO diagnosis (Nd:YAG not performed, n=14)	0.66 ± 0.24
BCVA at two weeks post Nd:YAG	1.00 (0.70 - 1.00)

*Nd:YAG = Neodymium-doped yttrium aluminium garnet
*BCVA = best corrected visual acuity
*PCO = posterior capsule opacification

Nd:YAG laser posterior capsulotomy is needed to improve the visual acuity by opening the visual axis. Table 5 shows that Nd:YAG laser posterior capsulotomy was only performed in 72.5% of eyes. After Nd:YAG laser posterior capsulotomy was performed, the BCVA showed better result with a range of 0.70-1.00 (Table 5). No complications were found on two-weeks follow-up.

Intraocular lens characteristics

Many efforts had been done to minimize PCO formation, so that studies on the possible cause are very important. Several types of IOL material and design may be related to PCO formation[1]. This study found hydrophilic acrylic IOL was the most used. The foldable design of this material is appropriate with the width of incision in phacoemulsification. In 2010, hydrophobic acrylic was still minimally being used due to the more expensive price. This material type of IOL was mainly used in patients who had certain health insurance in our hospital. Square optic edge was the majority of the optic edge design and all eyes used one piece IOL (Table 5).

Phacoemulsification was the most common type of surgery performed in this series. To minimize bias from different types of surgery, cross tabulation of IOL characteristics was made only in phacoemulsification group. However, p-value was not tested due to unequal sample between groups. No significant difference was found in the percentage of PCO between age groups. Higher percentage of PCO was found in hydrophilic acrylic than in hydrophobic acrylic. Percentage of PCO among type of IOL on optic diameter and optic edge were almost the same (Table 6).

Table 5. IOL characteristics in pseudophakic eyes (n=578)

Variable	Frequency(%)
IOL material	
Polymethylmethacrylate (PMMA)	204 (35.3%)
Acrylic	
Hydrophilic acrylic	309 (53.5%)
Hydrophobic acrylic	65 (11.2%)
IOL design	
1-piece	578 (100.0%)
3-pieces	0 (0.0%)
Optic edge design	
Square	378 (65.4%)
Round	200 (34.6%)

*IOL = intraocular lens

Table 6. Cross-tabulation of age and IOL characteristics with PCO incidence in phacoemulsification group (n=496)

Variable	PCO		No PCO		p
	n	%	n	%	
Age					
< 65 years	25	10.7	208	89.3	0.704*
≥ 65 years	24	9.1	239	90.9	
IOL characteristics					
Acrylic-PMMA					
Acrylic	37	9.9	337	90.1	NT
PMMA	12	9.8	110	90.2	
Acrylic					
Hydrophilic	33	10.7	276	89.3	NT
Hydrophobic	4	6.2	61	93.8	
Optic diameter					
5.25-5.50 mm	11	9.2	108	90.8	NT
6.00-6.50 mm	38	10.1	339	89.9	
Optic edge					
Square	37	9.8	339	90.2	NT
Round	12	10	108	90	

*Chi Square test. NT: not tested for p value
*IOL = intraocular lens
*PCO = posterior capsule opacification

DISCUSSION

Our study revealed that modern cataract surgeries with a better IOL design and material may decrease the incidence of PCO formation from 9.2% in our previous unpublished data in year 2003, to 8.82% in year 2010. The use of cutting-edge technology in cataract surgery has resulted in a less complication rate in long-term follow-up for pseudophakic eyes. Following the excellent results, phacoemulsification has become the standard of care for cataract surgery in our hospital. This study also showed that most of our cataract patients' condition was in blind category four and they were relatively young. Shah, et al[8] in collaboration with World Health Organization (WHO) analyzed 11,408 patients who have had cataract surgery from 50 countries in 2008 also found that the median age was 65 years, majority had severe visual impairment, which was mostly related to senile degenerative cataract and strong correlation into ultraviolet exposure.

Phacoemulsification was the most common surgical technique performed in this study (85.8%) and our result resembles the result of Gollogly, et al[9] study, which reported that 99.5% out of 8,012 cataract eyes underwent phacoemulsification from 2005 to 2011 in Minnesota, USA. That type of surgery has several

advantages such as faster achievement of good visual acuity and wound healing, closed system surgery and a safe surgical technique.[10] It was showed in this study that post-operative BCVA achieved optimal target visual rehabilitation. A regular follow-up post-operatively is important to evaluate surgical success and to observe the possibility of further complication and PCO is the most common.

Three-year cumulative incidence of PCO reported by Fong, et al[2] was 38.5% (95% CI = 36.1-40.9) among 1,495 patients, and was higher than the result of our study. This difference may be caused by larger sample size, different study design, and a long and equal follow-up time in their study. Variability in the follow-up period may result in a bias in determining the PCO incidence in our study. We assumed that patients with only one month duration of follow-up will not have any visual problem. This condition might also reflect a lower incidence in our study.

We found that PCO formation was found mostly in younger patients among all our pseudophakic patients. Age is an important factor to PCO formation according to Wormstone, et al[11] study. They had concluded that younger age had a potency of faster epithelial lens growth.[11] Epithelial lens migration and proliferation from equator to central may block visual axis and causes reduction in visual acuity.[1] Most of our PCO patients experienced blurred vision. Their visual acuity was reduced to 0.5±0.26, but still in the category of mild visual impairment. It was comparable with Van Bree, et al[3] study (0.20 ± 0.23 logMAR or 0.64 ± 0.60) and Anggraini and Hutauruk[7] reported (0.47 ± 0.46). Decreasing BCVA to 0.5 will significantly cause visual impairment to the patient. In this study, duration to PCO diagnosis was 21 months or 1.75 years, which was comparable to Khan, et al[12] and Khanzada, et al[13] which reported a duration of 23 months (two until 24 months) and 2.06 years, respectively.

Treatment with Nd:YAG laser posterior capsulotomy in PCO is needed to clear the visual axis. In this study, not all patients underwent Nd:YAG laser, not only because of weakness in our management protocol, but also due to patients' refusal of having a laser treatment due to accepted BCVA or financial problem. During a posterior capsulotomy, by amplification and focusing of 1,064 nanometers (nm) infrared light, which electrons are ripped away from nuclei, forming energy plasma and corresponding shock wave. The plasma formation is known as optical breakdown and cut the target. When pressure wave created on the anterior vitreous side of the capsule, the laser breaks the posterior capsule.[14] In this study, after the opening of visual axis, the BCVA achieved 1.00, which was the same as BCVA on one month post-operative. This result was similar to Van Bree, et al[3] (0.001 ± 0.12 logMAR or 1.0) and Khanzada, et al[13] studies (74.4% cases achieved 6/9 to 6/6).

Several studies related to risk factors of the formation of PCO had been done and some studies had concluded that age and IOL material and design might be associated with PCO formation.[1,13,15] In 2003, Anggraini and Hutauruk[7] reported that majority of patients used polymethylmethacrylate (PMMA) IOL (97%) and only 2.7% used acrylic IOL, at CMH Jakarta. In 2010, a transition into acrylic IOL had occurred. Acrylic IOL was used in the majority of cases i.e. 374 (64.7%), whereas PMMA IOL in 204 of cases (35.3%).

Other studies reported that surgical technique, including cortical cleaving hydrodissection and rotation, cortical clean up, in-the-bag fixation of IOL, and smaller capsulorhexis size than optic diameter of IOL seem to correlate with PCO formation. Those procedures' factors could be minimized by doing phacoemulsification.[5,16] In this study, the cross tabulation evaluated IOL factors in phacoemulsification group only. It was considered to minimize bias due to surgical technique difference. P-value was not analyzed because of the unequal sample size between groups of IOL characteristics. Acrylic material particularly hydrophobic has been identified as a preventing factor in PCO formation. Linnola, et al[17] found that acrylic had stronger adhesion with fibronectin and laminin compared to PMMA and silicone. It caused stronger adhesion of IOL and posterior capsule, therefore it would inhibit epithelial lens migration and proliferation. Hydrophobic acrylic has better capsular biocompatibility than hydrophilic acrylic. In this study, a higher proportion of PCO was found in hydrophilic acrylic than hydrophobic acrylic. Several studies also reported higher proportion of PCO in hydrophilic acrylic (42.0%-

64.4%) compared to hydrophobic acrylic (8.9%-34.4%).[2,18,19]

Optic diameter is still a mater of debate in the prevention of PCO formation. In this study, percentage of PCO in a small and a large diameter seems to be the same. Meacock, et al[20] reported that optic diameter of 6 mm (1.5%) had lower proportion of PCO than 5 mm (6.9%). In contrast, Nishi and Nishi[21] reported that larger optic diameter inhibit IOL adhesion to posterior capsule and capsular bend formation.

Capsular bend formation is identified as an important factor in prevention of PCO. Square optic edge IOL may form a good capsular bend, which therefore inhibit epithelial lens migration to posterior capsule. In this study, a higher percentage of PCO was found in round optic edge IOL, but the difference was very small. It was similar with the percentage of PCO in PMMA and acrylic. Most of PMMA had round optic edge while most of acrylic had square optic edge. Several studies also reported higher percentage of PCO in round optic edge (13.0%-38.7%) than square optic edge (1.4%-3.4%).[22-24]

In conclusion, three years cumulative incidence of PCO in Cipto Mangunkusumo Hospital, Jakarta was 8.82%, with median time to PCO diagnosis of 21 months (1.75 years). There was no defined related factor to PCO reformation, but higher incidence of PCO was found in hydrophilic acrylic IOL than in hydrophobic acrylic IOL. Nd:YAG laser posterior capsulotomy was performed in 72.5% of eyes and showed good results.

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Conflicts of Interest
The authors affirm no conflict of interest in this study.

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