ORIGINAL ARTICLE

Associated Factors for Poor Visual Outcome Post Cataract Surgery Complicated with Posterior Capsule Rupture

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ABSTRACT

Introduction: To identify the factors associated with poor post-operative visual outcome in cataract surgery complicated by posterior capsule rupture (PCR). **Materials and Methods:** This is a retrospective study among PCR cases in cataract surgery with IOL implantation in a tertiary centre, in Kelantan, Malaysia from 2018 to 2022. Data was retrieved from the web-based Malaysian Cataract Surgery Registry (CSR). Poor visual outcome was defined as those with best corrected visual acuity (BCVA) worse than 6/12 taken at 6 weeks onwards postoperatively. Factors affecting poor visual outcomes (age group, gender, place of operation, systemic comorbidity, duration of surgery, IOL location, and presence of other complications intraoperatively) were analysed using logistic regression to produce an adjusted odds ratio (OR) for variables of interest. **Results:** Out of 6181 cataract surgeries performed, 269 (4.35%) cases were complicated with PCR, of whom 172 qualified for our analysis. The proportion of poor visual outcomes was 26 (15.1%). Logistic regression analysis showed that zonular dehiscence [Adjusted OR 5.84 (95% CI 1.50, 23.74), p-value 0.013] was the only significant associated factor for poor visual outcome. **Conclusion:** Zonular dehiscence was the only factor identified as significantly associated with poor visual outcomes in cataract surgery complicated by PCR. However, caution is warranted in interpretation, as other potential factors may also contribute to visual outcomes.
Malaysian Journal of Medicine and Health Sciences (2025) 21(6):1-5. doi:10.47836/mjmhs.v21.i6.1415

Keywords: Posterior capsule rupture, Factors of poor outcome, Cataract surgery, Intraocular lens, Visual outcome, Zonular dehiscence

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INTRODUCTION

Posterior capsule rupture (PCR) is a common complication in cataract surgery with potentially significant impact on patient's postoperative visual outcome. Eyes with PCR have nearly four times the risk of achieving a final best-corrected visual acuity (BCVA) worse than 6/12 (1). PCR can occur at any stage of cataract surgery and complicates the process of inserting a posterior intraocular lens (PCIOL), which may affect the visual outcome. An improperly managed PCR may lead to other complications causing poor visual outcome. The overall incidence of PCR reported in the literature varies from 0.2% to 14%, but in the recent years, advanced techniques, instrumentation, and technology have reduced PCR rate to 0.45%–5.2% (2).

Singapore National Eye Center reported a PCR rate of 1.8% and the proportion of good outcome (post operative BCVA 6/12) was 93.8% (3). The identified significant risk factors for poor visual outcome were age older than 65 years old, cases with dropped nucleus, and additional complication. Siriraj Hospital, the oldest and largest hospital in Thailand, reported a PCR rate of 2.4 % (4). The Malaysian Cataract Surgery Registry reported a PCR rate of 3.2%, and the risk factors of developing PCR were advancing age, male gender, pseudoexfoliation, phacomorphic lens, diabetes mellitus, renal failure, combined vitreoretinal surgery and less experienced surgeon (5). Factors that contribute

to poor postoperative outcome of PCR cases in Malaysia has not been studied yet. Thus, this study aims to identify factors that predispose to suboptimal visual outcomes in PCR cases.

MATERIALS AND METHODS

This retrospective cohort study obtained data from the web-based Malaysian Cataract Surgery Registry on procedures performed between January 2018 and December 2022. Source data center was from a tertiary center, Hospital Raja Perempuan Zainab II, Kelantan, Malaysia. All data extracted were devoid of patient identifier. This study was approved by the Institutional Ethics Committee [NMRR ID-24-01495-UPD (IIR)] and adhered to the tenets of the declaration of Helsinki.

All cases of cataract surgery with primary intraocular lens (IOL) implantation complicated with PCR were included in the study. Confounding factors that may contribute to poor final visual outcome such as ocular comorbidity and past ocular surgery were excluded. Cases with missing postoperative data were also excluded. Poor postoperative visual outcome was defined as a BCVA worse than 6/12, measured from six weeks postoperatively onward, in accordance with the Key Performance Indicator established by the National Eye Database (6).

Data collected were analysed using IBM SPSS Statistics 26. Categorical data were presented by frequency and percentage. Logistic regression analysis was used to identify factors that contribute to the poor postoperative outcome.

RESULT

PCR cases were 269 (4.35%) out of 6181 cases of total cataract surgery performed from January 2018 to December 2022. After excluding based on the exclusion criteria, the final PCR cases included were 172 cases.

Table I: Demographic data of cataract surgery with posterior capsule rupture (n = 172)

Characteristic	N	%
Age		
40 – 59	43	25.0
60 – 79	117	68.0
80 - 99	12	7.0
Gender		
Male	84	48.8
Female	88	51.2
Race		
Malay	161	93.6
Chinese	8	4.7
Indian	0	0
Others	3	1.7

Demographic detail of the participants showed in Table I. Most of the participants were aged between 60 to 79 years old (68.0%) and were of Malay ethnicity (93.6%). Male to female ratio was 1:1.

Clinical and operative characteristic of cataract surgery with PCR were presented in Table II. The most common systemic comorbidity was hypertension (70.3%) followed by diabetes mellitus (48.8%). Presenting visual acuity showed bimodal distribution in which 70.9% presented with uncorrected visual acuity (UCVA) worse than 3/60 and another peak at UCVA 6/24 to 6/60 (21.5%). Most

Table II: Clinical and operative characteristic of cataract surgery with posterior capsule rupture (n=172)

Characteristic	n	%
Systemic comorbidity		
Diabetes	84	48.8
Hypertension	121	70.3
Renal failure	8	4.7
CVA	9	5.3
COAD/Asthma	2	1.2
Other	20	11.6
Pre operative UCVA		
6/6 to 6/12	2	1.2
6/18	7	4.1
6/24 to 6/60	37	21.5
5/60 to 3/60	4	2.3
2/60 and worse	122	70.9
Surgeon status		
Specialist	124	72.1
Gazetting specialist	15	8.7
Medical officer	33	19.2
Duration of surgery		
< 60 minutes	88	51.2
≥ 60 minutes	84	48.8
Type of surgery		
Phacoemulsification	101	58.7
ECCE	71	41.3
IOL location		
IOL in bag	120	69.8
Sulcus IOL	13	7.5
ACIOL	39	22.7
Additional complication		
Vitreous loss	80	46.5
Zonular dehiscence	12	7.0
Drop nucleus	10	5.8
Post operative BCVA		
6/12 and better	146	84.9
6/18 and worse	26	15.1

UCVA = Uncorrected visual acuity, BCVA = Best corrected visual acuity, ECCE = Extracapsular cataract extraction, IOL = Intraocular lens, ACIOL = Anterior chamber IOL

of the surgeries were performed by specialists (72.1%), followed by medical officers (19.2%) and gazetting specialists (8.7%). Phacoemulsification was the most commonly (58.7%) performed type of surgery. IOL were implanted mostly in the capsular bag (69.8%), followed by anterior chamber (22.7%) and sulcus (7.5%). Additional complication that occurred were vitreous loss (46.5%), zonular dehiscence (7.0%) and dropped nucleus (5.8%). Most of the patients achieve good visual outcome where 146 (84.9%) of them achieved BCVA 6/12 and better postoperatively, and whereas 26 (15.1%) achieved BCVA of 6/18 or worse postoperatively.

Logistic regression analysis showed that zonular dehiscence was the only factor associated with poor visual outcome. Cases with zonular dehiscence had 5.84 higher odds compared to cases without zonular dehiscence to have poor visual outcome (95% CI: 1.50 to 23.74, p-value = 0.013) when adjusted for age, type of surgery, duration of surgery, IOL location, vitreous loss and drop nucleus (Table III).

Table III: Factors associated with poor visual outcome post cataract surgery with posterior capsule rupture

Variables	Simple logistic regression			Multiple logistic regression[a]		
	Crude OR	95% CI	*p*-value	Adj. OR	95% CI	*p*-value
Age group						
<60 years	1			1		
≥ 60 years	1.48	0.52, 4.19	0.450	2.04	0.59, 7.03	0.238
Gender						
Female	1					
Male	1.27	0.55, 2.92	0.579			
Type of surgery						
Phaco	1			1		
ECCE	2.19	0.94, 5.11	0.067	2.01	0.73, 5.56	0.174
Diabetes						
No	1					
Yes	1.06	0.46, 2.43	0.898			
Hypertension						
No	1					
Yes	1.49	0.56, 3.95	0.416			
Duration of surgery						
< 60 minutes	1			1		
≥ 60 minutes	1.76	0.73, 4.24	0.203	1.22	0.61, 4.28	0.688
IOL location						
PCIOL	1			1		
ACIOL	3.09	1.28, 7.45	0.014	1.80	0.64, 5.76	0.300
Vitreous loss						
No	1			1		
Yes	1.70	0.73, 3.95	0.215	0.92	0.39. 3.12	0.865
Zonular dehiscence						
No	1			1		
Yes	7.00	2.06, 23.83	0.003	5.84	1.50, 23.74	**0.013**
Drop nucleus						
No	1			1		
Yes	1.44	0.29, 7.18	0.669	2.20	0.23, 13.19	0.427

ECCE = Extracapsular cataract extraction, IOL = Intraocular lens, PCIOL = Posterior chamber IOL, ACIOL = Anterior chamber IOL

[a]Enter method was applied

[a]No multicollinerity and no interaction

[a]Hosmer and Lemeshow Test, p-value = 0.804

[a]Classification table 85.4% correctly classified

[a]Area under Receiver Operating Characteristic (ROC) curve was 72.8%

DISCUSSION

PCR represents a concerning complication of cataract surgery for surgeons due to its potential to cause suboptimal visual outcomes. The rate of PCR in our study is 4.35% which is comparable to a local tertiary centre (4.8%) but slightly higher compared to national rate of PCR (3.2%) (5,7). Local and international studies agree that the experience and seniority of the surgeon was significantly associated with PCR (5,8). Nevertheless, the Singapore National Eye Center observed that the incidence of PCR among cases involving residents and faculty members did not demonstrate statistical significance, with rates recorded at 3.4% and 1.4% respectively. Interestingly, both groups attained comparable visual outcomes, a phenomenon credited to diligent supervision and meticulous case selection (3). PCR can occur at various step of phacoemulsification. In a study involving only ophthalmology residents, PCR mostly occurred during quadrant removal (44%), cortex removal (21%), followed by IOL insertion (14%) (9).

PCR, regardless of vitreous loss, increases the risk of developing hyphema, persistent postoperative inflammation, uveitis, retained cortical matter, corneal edema, corneal decompensation, postoperative endopthalmitis, cystoid macular oedema (CMO), aggravation of diabetic retinopathy, glaucoma, and dislocated intraocular lenses (IOLs) and retinal detachment, all of which may affect final visual outcome (10-12). Contact between vitreous strands and the corneal endothelium may induce corneal decompensation (2,10). Vitreous strands trapped

within the surgical wound may predispose to epithelial and fibrous ingrowth, as well as ocular infiltration by microorganisms predisposing to endophthalmitis (10). Retinal traction by vitreous strands increases the risk of CMO and retinal detachment (2, 10).

Even with PCR and vitreous loss, various studies reported good post operative visual outcome (1, 13, 14). In a study among patients with no ocular premorbidity, Amin et al. showed that almost 80% of patients with PCR had good visual outcome (15). The remaining 20% of patients had poorer visual outcome due to CMO, prolonged inflammation, high astigmatism, anterior corneal opacity, retinal detachment, and lens opacity. Thevi et al. found that reasons for poor visual acuity following PCR are high astigmatism (4.0%), CMO (1. 1%), posterior capsular opacity (PCO) (0. 8%), cornea decompensation (0. 3%), retinal detachment (0. 3%), infective endophthalmitis (0.2%) and IOL decentration / dislocation (0. 2%) (16).

In our study, the proportion of poor visual outcome (BCVA worse than 6/12) among PCR cases with no ocular comorbid was 15.1%. This is comparable to another local study which reported 19.5% (16). However, this is substantially higher if compared to other international centers (3, 10). Our study identified zonular dehiscence as the only significant associated factors for poor visual outcome among PCR cases. Those with zonular dehiscence are 5.84 higher odds of having poor visual outcome compared to those without zonular dehiscence ($p = 0.011$). This can be explained as zonular dehiscence has been shown to increase vitreous loss in PCR, thus further increasing the risk of developing the complications mentioned above (17). Chan et al also found that vitreous loss is a risk factors for a poor visual outcome in PCR, aside from more advanced age, presence of coexisting ocular pathology, extracapsular cataract extraction, implantation of an anterior chamber IOL (10). Ti et al. identified that age older than 65 years old, dropped nuclei, and postoperative retinal, corneal, and IOL complications to be associated risk factors for poor vision in patients with PCR (3). Other factors associated with poor post operative visual acuity in PCR include corneal opacities, poor preoperative visual acuity and white cataract (18).

Surgeons for cataract surgery in many local centres consists of medical officers, gazetting specialists and specialists. Cataract surgery is one of the core competencies embedded within the ophthalmology training curriculums and require extensive experience. The risk of PCR can be reduced by proper preoperative and intraoperative preparation. Preoperative phase includes risk stratifying the patients and better case selection, where the surgeons can be assigned accordingly with respect to required level of competency, with straight forward cases given to medical officers and gazetting specialists, and high-risk patients assigned to specialists. Other preoperative measures include wet-labs, well-grounded surgical curriculum and virtual reality simulator to accommodate the learning process of junior surgeons. Intraoperative measures include using single-piece IOLs for easier manipulation in the capsular bag and using preloaded IOLs which requires less IOL manipulation. Having a senior surgeon in the operating theatre allows for consultation during the operation, as well as taking over if the operation becomes complicated. The effectiveness of these measures has been demonstrated in Kymenlaakso Central Hospital, Kotka, Finland through a span of 9 years (2009 to 2017) with a total of 14,520 cataract surgeries (19). Capsular bag-related complication rates dropped from 0.36% to 0.32% for senior surgeons, and from 7.03% to 1.32% for resident surgeons.

Studies reporting the visual outcomes of zonular dehiscence detected at cataract surgery are limited (20). In our study, among the patients with PCR who had poor visual outcome, 6 (23.1%) cases had zonular dehiscence, which was a significant association for poor visual outcome ($p = 0.013$). Zonular dehiscence may be inherited, acquired or result from excessive iatrogenic stress (21). Ocular and systemic conditions may result in zonular weakness, including pseudoexfoliation syndrome, hypermature cataract, Marfan syndrome or previous trauma (21,22). Large studies show that zonular dehiscence is rare, with an incidence 0.46%-0.50% (8, 21, 22). A local study showed an incidence of 1.1%, which was consistent with the Malaysian National study at 1.3% (5, 7). In our study which only included eyes with PCR without any ocular comorbidity, zonular dehiscence incidence was at 7.0% (12 eyes), which can be explained as PCR itself can cause zonular dehiscence.

CONCLUSION

This study identified zonular dehiscence as the only significant factor associated with poor postoperative visual outcomes in cataract surgery complicated by posterior capsule rupture. However, caution is warranted in interpretation, as other unrecognized factors may also contribute to visual prognosis. Early recognition and timely management of posterior capsule rupture remain crucial in minimizing complications that could further compromise visual outcomes.

ACKNOWLEDGEMENTS

We acknowledge the general support given by Head of Ophthalmology Department from Hospital Raja Perempuan Zainab II (HRPZII), Kota Bharu, Dr Tengku Norina Tuan Jaafar.

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