Original Article

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Dropped Nucleus: Earlier the Vitrectomy Better the Results

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Abstract

Aim: To determine safety and efficacy of pars plana vitrectomy (PPV) for dropped nucleus after complicated cataract surgery and evaluate the correlation of final visual acuity with time interval lapsed till active intervention done. *Material and methods :* We did a retrospective analysis of patients who underwent PPV for dropped nucleus in cataract surgery from july 2014 to August 2018 at SGRRIM & HS, Dehradun, India. The data was recorded in terms of details of complicated cataract surgery , point of occurrence of dropped nucleus, time elapsed till PPV done, the intraoperative and postoperative complications. Final outcome measures were the best corrected visual acuity (BCVA) at three months follow up and its correlation with time at which PPV was done. *Results:* Out of 14 cases of dropped nucleus during this four year period of study 3 (21.4%) patients were referred from outside , while 11 patients (78.5%) had the complication in our hospital itself of total 5760 cataract surgeries done contributing to an incidence of 0.191%. PPV was done in the same sitting in majority of cases (57.1%) with BCVA, 6/18 or better at the last follow up. One eye had retinal detachment two months postoperatively for which fluid/gas exchange was performed. All patients (92.9%) had IOL implantation except one (7.1%) who had corneal decompensation. The correlation between BCVA at three months follow up and time interval between complicated cartaract surgery and PPV was statistically significant ($\chi 2 = 14.000$, $p = 0.003$) , all those patients (21.4%) who were referred late and operated after one week had vision less than 6/60. *Conclusion:* Though dropped nucleus is a sight threatening complication of cataract surgery, PPV if done on time is safe and effective and the final visual outcome is definitely better in patients who get intervened early. However future studies with larger sample size and longer follow up are required to confirm our results.

Keywords: Dropped Nucleus; Vitrectomy; Visual Acuity.

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Introduction

Dropped nucleus is a sight threatening complication of cataract surgery but fortunately not that common, with an incidence of approximately 0.2% to 1.5% worldwide [1]. Posterior capsule rent (PCR) during cataractv surgery if not recognised early by the surgeon and managed appropriately, can lead to a complete nucleus drop or fragments in the vitreous. The main causative factors which can threaten vision if the complication not handled timely, are severe intraocular inflammation resulting in secondary glaucoma, corneal decompensation, cystoid macular edema (CME), and retinal detachment (RD) [2,3]. The usual approach for surgical intervention in eyes with dropped nuclear fragments is standard three port PPV and release of vitreous adhesions to the dropped nucleus, followed by fragmentation and removal of nuclear material which is commonly achieved using a phacofragmatome [4]. Our basic purpose of this study is to evaluate the safety and efficacy of PPV in dropped nucleus and highlight the importance of role of cataract surgeon in assessing the situation and timely referral to the vitreoretinal surgeon for further management.

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Material and Methods

We reviewed fourteen patients of complicated cataract surgery who had undergone PPV for dropped nucleus between July 2014 to August 2018 after approval of the study from the Institutional Ethics Committee. The data was recorded in terms of patient demographics including age, sex , pre existing ocular morbidities, details of complicated cataract surgery specifically the stage at which nucleus dropped, anterior vitrectomy done or not and IOL placed in same sitting or not, visual acuity, IOP, slitlamp and fundus findings at the time of intervention done. The clinical details including left out lens matter, vitreous or fibrin in AC, hypopyon, corneal edema, uveitis, vitritis, vitreous hemorrhage, approximate size of nuclear fragments in the vitreous, retinal tear or retinal detachment were recorded. The time interval between the complicated surgery and PPV and the management details were documented. The intraoperative and postoperative complications of PPV with further management were also recorded.The postoperative vision was recorded at day one, 6 weeks and 3 months follow up. Final outcome measures of our study were BCVA at the last follow up and its correlation with time interval lapsed till PPV done. Surgical technique used was a standard three-port pars plana approach employing a 23 gauge system (Retikare vitrectomy system). After making standard 3 ports, triamcinolone acetonide was used for visualization of vitreous in AC and anterior vitrectomy with removal of the residual cortical lens matter was done using the vitrector in aspiration mode. Then th core vitrectomy was done followed by PVD (posterior vitreous detachment) induction and the peripheral vitrectomy was completed. Main 23 port was removed and enlarged with MVR blade and then phacofragmotome was inserted through wound and fragmentation of dropped nucleus material was completed. A full peripheral search was done to check the retina for any iatrogeni tears or dialysis and remaining fragments of the nucleus. We routinely use intracameral triamcinolone again at the end of the operation to ensure that there is no residual vitreous, including removal of vitreous base as far as possible. Then an intraocular lens (IOL) was inserted in sulcus whenever it was possible or an AC IOL (Kelman Multiflex) was placed in other cases and ports closed thereafter. Postoperative treatment consisted of prednisolone eye drops every 2 hrs, tapered over a month, moxifloxacin eye drops every 4 hours, homatropine and timolol eye drops twice daily.

Results Data was analyzed employing SSPV software and P values less than 0.05 were considered as significant. The mean age of the study group was 62.61 ± 5.84 years comprising of 6 females and 8males .Out of total 14 patients, 3 patients (21.4%)were referred from outside while other 11 patients (78.5%) had nucleus drop in our hospital itself out of 5760 cataract operations done contributing to an incidence of 0.191% during this four year period. All dropped nuclei occurred during phacoemulsification except one case which happened while performing SICS. Three nuclei dropped by trainee surgeons while others in the hands of consultants. Majority cataracts were of grade NS +1 to NS+ 2 (57.1%) with preoperative BCVA in the range of 6/24 to 6/60 (42.9%). None had ocular comorbidities such as high myopia, pseudoexfoliation, previous vitrectomy or any other posterior segment pathology but two patients were hypertensives and one was controlled diabetic (Table 1).

Table 1: Pre cataract surgery details

Variable	Mean (SD) or N (%) (n = 14)
Age (years)	62.61 (5.84)
Gender	
Male	8 (57.1%)
Female	6 (42.9%)
Grade of Cataract	
NS+1 to NS+2	8 (57.1%)
NS+3 to NS+4	1 (7.1%)
Brown Cataract	4 (28.6%)
Hypermature Cataract	1 (7.1%)
Pre-operative BCVA	
6/6 – 6/18	2 (14.3%)
6/24 – 6/60	6 (42.9%)
<6/60 – 3/60	4 (28.6%)
<3/60 (Blind)	2 (14.3%)
K1	42.7 (1.64)
K2	43.14 (1.81
Axl	23.16 (0.96)
IOP	12.10 (4.3)
IOL Power	23.10 (3.36)
Type of Cataract Surgery	
SICS	1 (7.1%)
PHACO	13 (92.9%)
Surgeon	
Trainee surgeon	3 (21.4%)
Consultant	11 (78.6%)

NS: nuclear sclerosis, BCVA: best corrected visual acuity, Axl; axial length, K_1 and K_2: keratometry, IOP: intraocular pressure, IOL: intraocular lens, PHACO: Phacoemulsification

The nucleus drop occurred at various stages, 2 cases during trenching in phaco in soft cataracts, one happened just after first piece was chopped, 6 cases during second segment removal and 4 during last piece removal. One case needs special mention which occurred while prolapsing nucleus in AC during SICS. PPV was done in 8 eyes in the same sitting (57.1%) and in 6 eyes (42.9%) in second sitting. Out of 14 eyes IOL was implanted in 13 eyes (92.9%) including 11 IOLs in sulcus and 2 ACIOL s while one eye (7.1%) was left aphakic (Tables 2 and 3).

Table 2: Stages at which nucleus dropped

Stage	N (%) (n = 14)
During Trenching (PHACO)	2 (14.3%)
During Chopping (PHACO)	
After 1st Piece Removal	1 (7.1%)
During Last Piece Removal	4 (28.6%)
During 2nd Segment Removal	6 (42.9%)
Prolapsing the Nucleus in AC in SICS	1 (7.1%)

SICS: small incision cataract surgery, PHACO: Phacoemulsification, AC: anterior chamber

Table 3: Management details of PPV

Stage	N (%) (n = 14)
Same sitting Anterior Vitrectomy with PPV with IOL in sulcus	7 (50%)
Same Sitting Anterior Vitrectomy PPV with AC-IOL	1 (7.1%)
Second sitting PPV with Sulcus IOL within 48 hours	3 (21.4%)
PPV with Sulcus IOL placed after 1 week	1 (7.1%)
PPV with AC-IOL after 1 week	1 (7.1%)
PPV with no IOL after 1 week	1 (7.1%)
PPV Done in Same Sitting	8 (57.1%)
PPV Done in Second Sitting	6 (42.9%)

PPV: pars plana vitrectomy

Among those patients (6 eyes) in whom PPV was done in second sitting, BCVA was less than 3/60 to hand movements in 3 eyes and less than 6/60 in other 3 eyes. All the 6 eyes had vitreous in AC, 2 patients had raised IOP, 3 had significant uveitis and vitritis, one case of vitreous hemorrhage, and 4 cases had corneal edema. Majority of eyes (57.1%) were operated in the same sitting, 3 eyes (21.4%) within 48 hrs and the other 3 eyes after one week (21.4%) (Table 4).

Table 4: Timing of PPV and the findings at presentation

Variable	N (%) (n = 14)
Preoperative vision (PPV done in second sitting)	
<6/60 – 3/60	3 (21.4%)
<3/60 - HMCF	3 (21.4%)
Findings at presentation	
IOP Rise	2 (14.3%)
Corneal Edema	4 (28.6%)
Vitreous in Anterior Chamber	6 (42.9%)
Uveitis	3 (21.4%)
Vitritis	3 (21.4%)
Vitreous Hemorrhage	1 (7.1%)
Time Interval Between PPV and Complicated Cataract Surgery	
Same Sitting	8 (57.1%)
< 48 Hours	3 (21.4%)
48 Hours - 1 Week	0 (0%)
> 1 Week	3 (21.4%)

IOP: intraocular pressure, HMCF: hand movement close to face

Visual acuity increased after PPV in all except one eye. Though the postoperative UCVA at day one was less than 3/60 in majority of eyes (50%) but vision improved to 6/18 or better in 8 eyes (57.1%) at 3 months follow up. Three eyes (21.4%) had vision in range of 6/60-6/24 and two eyes (14.3%) remained visually impaired (<6/60) and one patient (7.1%) practically blind with vision reduced to hand movements close to face. (Table 5, Fig. 1)

Table 5: Post PPV visual acuity

Variable	Mean (SD) or N (%) (n = 14)
Post-operative UCVA at 1 Day	
6/6 – 6/18	0 (0%)
6/24 – 6/60	2 (14.3%)
<6/60 – 3/60	5 (35.7%)
<3/60 – HMCF	7 (50%)
Post-operative BCVA at 6 Weeks	
6/6 – 6/18	6 (42.9%)
6/24 – 6/60	4 (28.6%)
<6/60 – 3/60	3 (21.4%)
<3/60 – HMCF	1 (7.1%)
Post-operative BCVA at 3 Months	
6/6 – 6/18	8 (57.1%)
6/24 – 6/60	3 (21.4%)
<6/60 – 3/60	2 (14.3%)
<3/60 – HMCF	1 (7.1%)

HMCF: hand movement close to face, BCVA: best corrected visual acuity, UCVA: uncorrected visual acuit

The correlation between BCVA at three months follow up and time interval between complicated cartaract surgery and PPV was statistically significant ($\chi 2 = 14.000$ $p = 0.003$), all those patients who were intervened after one week (21.4%) had vision less than 6/60 (Table 6).

Table 6: Correlation of BCVA at 3 months with timing of PPV

		BCVA at 3 months		Strength of Association
Timing of PPV	< 1 Week	11	> 6/60	$\chi 2 = 14.000$
	> 1 week	3	< 6/60	p = 0.003*

p*= statistically significant, PPV; pars plana vitrectomy, BCVA; best corrected visual acuity

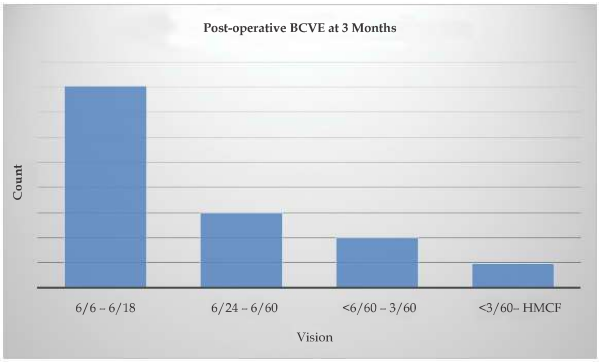

Fig. 1: showing post operative BCVA at 3 months

Retinal hemorrhage was the only intraoperative complication noticed in one eye which resolved spontaneously. No instance of scleral wound burn was observed. The treatable postoperative complications of PPV included secondary glaucoma in 2 eyes, uveitis in 7 eyes, corneal epithelial erosions in 3 eyes, striate keratitis in 6 eyes and CME was reported in one case. One eye had a rhegmatogenous retinal detachment (RRD) two months post PPV for which fluid/gas (PFCL) exchange together with 360-degree endolaser photocoagulation was performed and the patient is maintaining 6/18 vision now. One eye had corneal decompensation and was left aphakic (Table 7).

Table 7: Complication profile of PPV

	N (%)
Intraoperative Complications	
Retinal Hemorrhage	1 (7.1%)
Retinal Tear	0 (0%)
RRD	0 (0%)
Postoperative Complications	
Corneal Epithelial Erosion	3 (21.4%)
Striate Keratitis	6 (42.9%)
Uveitis	7 (50%)
Raised IOP	2 (14.3%)
CME	1 (7.1%)
RRD	1 (7.1%)
Corneal decompensation	1(7.1%)

CME: cystoid macular edema, RRD: rhegmatogenous retinal detachment

Discussion

"A dropped nucleus is a nightmare for any cataract surgeon but as in all surgeries, complications are unavoidable what is important is to recognize the occurrence of complications and to identify the causes and take measures to prevent them in future. A trainee surgeon should have a high index of suspicion of a PCR when there is sudden deepening of anterior chamber, tilting of the nucleus, brightening of the fundus glow and visible vitreous in AC. Predisposing factors are glaucoma , small pupil size, pseudoexfoliation, high myopia (Axial length ≥ 26 mm), subluxated lens, hard brown cataract or hypermature white cataract with week zonules." [5]. Robert Osher carried out a series of experiments on cadaveric eyes and concluded that in most cases the nucleus will sit supported by the vitreous if undisturbed but the post-occlusion surge due to high vacuum settings, can easily pull the vitreous supporting the nucleus toward the phaco tip, allowing the nucleus to drop. Also the turbulence created by phacoemulsification further increases risk of vitreous traction [6].

Anterior-segment surgeon can reduce the complications associated with dropped nucleus . Once PCR with vitreous prolapse is identified, bottle height level should be decreased, the second instrument should be withdrawn first and then a viscoelastic agent should be injected to tamponade the vitreous in the area of PCR followed by withdrawl of phaco probe from the paracentesis wound. This will prevent further anterior migration and incarceration of vitreous in the corneal wound and the risk of retinal tear [7]. Preservative-free triamcinolone acetonide may be useful to stain the vitreous and ensure that the anterior segment and all surgical wounds are clean by the conclusion of the anterior vitrectomy. Once the anterior chamber is free of prolapsed vitreous, any smaller nuclear or epinuclear fragments still available anterior to the posterior lens capsule may be carefully removed. The surgeon should ensure that all wounds are watertight before case is referred to vitreoretinal surgeon [8]. There is no universal agreement on when PPV should be performed. According to a British study presented at Pan Arab African Congress of Ophthalmology by Ibraheem El Ghrably of the Royal Victoria Infirmary, Newcastle, UK. All cases of posteriorly dislocated lenses should be referred promptly to a specialist vitreoretinal team, since the size of the fragments may be underestimated [9].

Our study was a retrospective analysis of 14

dropped nucleus, 11 in our department itself contributing to an incidence of 0.191% during this period, while 3 cases were outside referrals. PPV was done in 8 eyes in the same sitting (57.1%) and in 6 eyes (42.9%) in second sitting. Out of 14 eyes IOL was implanted in 13 eyes (92.9%) including eleven IOLs in sulcus and two ACIOL s while one eye (7.1%) was left aphakic. Majority of cases who underwent PPV in the same sitting (57.1%) had good visual outcome (6/18 or better). The correlation between BCVA at three months follow up and time interval between complicated cartaract surgery and PPV was statistically significant ($\chi 2 = 14.000$, $p = 0.003$), all those patients who were intervened after one week (21.4%) had vision less than 6/60.

A study done by Thevi etal reported an incidence of 0.6% and poor visual outcomes was delayed PPV leading to rise in intraocular pressure with resultant punctate epithelial erosions and retinal detachment [5]. "Another study reported an incidence of 0.2% and the mean follow-up was 5.6 months. A total of 48% cases were referred on the same day while 37% within one week and 66% of cases achieved a final visual acuity of 6/12 or better. Capsulorhexis complications, small pupils or improper surgical manipulation were the main causes and the optimum time for vitrectomy was as soon as possible ,preferably within 48 hours of the displacement," [9]. At the same time a large retrospective series reported no difference in visual acuity outcomes and complication rates between same-day and deferred PPV [12].

The RD rate in our study has come out to be 7.1% as compared to 8% reported by Smiddy et al. [13] and 5.5% by Moore et al [14]. A study conducted in 2003 by I.U. Scott et al. at the Bascom Palmer Eye Institute in Miami, Florida on 343 patients who underwent pars plana vitrectomy for retained lens fragments revealed that the" most important predictor of final visual acuity after PPV is a less complicated clinical course, specifically, no suprachoroidal haemorrhage, no retinal detachment, no cystoid macular oedema and no additional surgery. The most common cause of decreased final vision was cystoid macular oedema" [15]. The complication profile depends on the surgical competence and it was variable in different studies conducted so far. [16,17,18].

A study done by Al Amri AM etal recommends that to be on safer side vitrectomy should be extended peripherally using scleral depression to remove the nuclear fragmenrt that must have got embedded into the vitreous base. One should avoid retinal trauma by keeping phacofragmentation to minimum [19]. Also, as there is no counter-resistance by the capsular bag, it is essential to use a pulse or micropulse setting on the fragmatome, with low to moderate vacuum, to avoid bouncing the nuclear fragments around the vitreous cavity due to the repulsion caused by ultrasound energy. It is essential to keep potential future complications in mind when dealing with a perioperative complication. "A common misconception among anterior segment surgeons is that PFCL is used to float the nucleus into the anterior chamber from where it can be extracted through a limbal or corneal incision. In fact, the majority of displaced nucleus fragments can be dealt with safety in the posterior segment, with the PFCL acting only as a cushion to the macula while nuclear fragments are addressed with the fragmatome"[20].

Conclusion Therefore we conclude that though complications like dropped nucleus should be avoided, anterior segment surgeon can save eye from sight threatening consequences by detecting PC rupture early, immediately stopping phacoemulsification , performing a careful anterior vitrectomy and timely referral to vitreoretinal surgeon for pars plana vitrectomy which is safe and effective for visual rehabilitation of the patient.

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