ORIGINAL ARTICLE

Dropped Nucleus Following Phacoemulsification Cataract Surgery

I Tajunisah, FRCS, S C Reddy, MS (Ophth)

Department of Ophthalmology, Faculty of Medicine, University of Malaya, 50603 Kuala Lumpur

SUMMARY

Twenty two cases of dropped nucleus following 1,196 phacoemulsification procedures in cataract surgery were examined retrospectively to determine the incidence, predisposing factors and visual outcomes of this dreaded complication. All the cases underwent pars plana vitrectomy and the lens fragments were removed with phacofragmotome, vitrectomy cutter or delivered through limbus. The incidence of dropped nucleus was 1.84%. The predisposing factors were hard cataracts (13.6%), polar cataracts (9.1%), previously vitrectomized eyes (4.5%) and high myopia (4.5%). The final visual outcome was ≥ 6/12 in 10 eyes (45.5%); complications were seen in 5 eyes (22.7%). The interval between initial surgery and vitrectomy, the method of fragment removal and the type of lens implanted, did not influence the final visual outcome.

KEY WORDS:
Phacoemulsification, Dropped nucleus, Cataract, Pars plana vitrectomy

INTRODUCTION

Cataract surgery in Malaysia has evolved dramatically over the last ten years, largely as a result of technological advances as well as better training programmes for future eye surgeons. The surgery was initially carried out with a large wound and removal of cataract by intracapsular cataract extraction (ICCE). This progressed to a more controlled nucleus delivery but still through a large wound that needed suturing in the extracapsular cataract extraction (ECCE) technique. For the past ten years, many cataract surgeons in Malaysia have been moving towards small incision sutureless cataract surgery that uses ultrasound energy to emulsify the lens nucleus (phacoemulsification technique). As a result of this procedure, visual outcome and patients' convalescence have improved significantly following surgery when compared to the previous two techniques of cataract removal.

However, as a consequence of increased instrumentation and technology in phacoemulsification, surgeons have to face a learning curve to master this technique. As a result of this, there are some complications that are unique to phacoemulsification, the most dreaded of which is dropped nucleus, or dislocation of the entire nucleus or nuclear fragments into the vitreous cavity during the surgery [1,2,3]. This complication can occur at any stage of phacoemulsification (i.e. during hydrodisecction, sculpting or nuclear segment removal). It can even occur during phacoemulsification done by experienced surgeons. If left untreated, retained lens fragments can lead to severe intraocular inflammation, secondary glaucoma and retinal detachments. Some of these complications may lead to loss of useful vision as well as pain in the eye[1, 2, 3].

Reported incidence of this dreaded complication varies from 0.3%-2.7% in western studies[3] to 0.3-1.3% in Indian studies[4,5]. The National Eye database report on cataract surgeries performed at Ministry of Health (MOH) Hospitals during 2002 - 2004 showed the incidence of dropped nucleus in phacoemulsification to be between 0.1 and 0.3%[6]. With an increasing number of surgeons all over the country learning and performing phacoemulsification, documentation of the incidence of this complication in the Malaysian context, and analyzing the current trends in the management of this problem is deemed necessary. Therefore, a retrospective study of dropped nucleus following phacoemulsification procedure was carried out to determine its incidence and predisposing factors, as well as analyze the visual outcome following this complication.

MATERIALS AND METHODS

We retrospectively reviewed the medical records of 22 cases of dropped nucleus or retained lens matter following 1,196 cases of phacoemulsification performed over a period of five years (2001- 2005) in our centre. The surgeries were performed by one experienced consultant and several other specialists converting to phacoemulsification from the standard manual extracapsular cataract extraction. Patients with dropped nucleus were identified and reviewed in detail. The stage of the surgery when this complication occurred, the number of dislocated nuclear quadrants, the timing of intervention, mode of management, the type of intraocular lens (IOL) implanted, complications, and final visual outcomes were analyzed. Lens characteristics (nuclear sclerosis, posterior subcapsular cataract, posterior polar cataract, hard cataracts), subluxation of lens, and pseudoexfoliation were noted. A cataract with a nucleus sclerosis of grade 3 or 4 (determined by its density and colour in the slit lamp examination) was considered to be hard. Intraocular inflammation was defined as aqueous cells and flare 2+ or more. Uncontrolled glaucoma was defined as an intraocular pressure (IOP) of 25mmHg or higher. All the patients underwent vitrectomy for removal of nuclear material.

Pearson chi-square test was performed comparing: (1) the time interval between primary surgery and vitrectomy, and

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Corresponding Author: Tajunisah Iqbal, Department of Ophthalmology, Faculty of Medicine, University of Malaya, 50603 Kuala Lumpur
Email: tajun69@yahoo.com

best corrected visual outcome, and (2) the different types of IOLs and best corrected visual outcome. A p-value of <0.05 was considered as significant.

RESULTS

The overall incidence of dropped nucleus or retained lens matter following phacoemulsification in our center was 1.84% (22 cases in 1,196 procedures). There was an equal distribution of 11 males and 11 females in our series, of which five patients were Malay, nine were Chinese and eight were Indians. The age range of the patients was 52 to 84 years with eight patients (36.4%) above the age of 70 years (Table I). Out of 22 eyes with dropped nucleus, hard cataract was noted in three eyes and posterior polar cataract in two eyes. One patient had high myopia. Another patient had vitrectomy done for vitreous haemorrhage prior to cataract surgery. There were no subluxated lens or pseudoexfoliation cases in this series.

Out of 22 patients, five had preoperative vision better than 6/12 and six had vision of 6/60 or worse. Five patients (22.7%) had mainly nuclear sclerotic type of cataract, another 5 (22.7%) had mainly posterior subcapsular type of cataract, 3 (13.6%) had dense hard cataracts and 7 (31.8%) had a combination of the above.

The majority of the dropped nucleus occurred during sculpting (15 eyes, 68.2%). The other common surgical steps when dropped nucleus occurred were during fragment removal (four eyes, 18.2%), during hydrodissection (two eyes, 9.1%) and during tricky last fragment removal (one eye, 4.5%). The whole nucleus was dislocated posteriorly into the vitreous in five eyes. In the remaining eyes, one nuclear quadrant dropped posteriorly in six eyes, two nuclear quadrants in five eyes and three nuclear quadrants in one eye. In another five eyes only pieces of the epinucleus dislocated posteriorly after the nuclear fragments were removed.

All cases underwent three-port pars plana vitrectomy (PPV) for removal of nuclear material by one of the two vitreoretinal surgeons in our center. The timing of the intervention surgery varied between same day and two months. Eight eyes had PPV done on the same day, five eyes within one week of the initial surgery, two eyes within two weeks and seven eyes after two weeks of initial surgery. The indications of vitrectomy were inflammation in nine cases (40.9%), raised IOP in nine cases (40.9%) and corneal oedema in eight cases (36.4%). Seven cases had both corneal oedema and inflammation. The nuclear fragments were removed using a phacofragmatome in ten eyes, with the vitrectomy cutter in nine eyes and perfluorocarbon liquid (PFCL) in three eyes. The PFCL was used to float the nucleus in the anterior chamber, after which it was delivered through a limbal incision.

Intraocular lens was implanted in 21 eyes; it was implanted at the time of phacoemulsification (primary) in ten eyes, at the time of vitrectomy (secondary) in 11 eyes, and one eye was left aphakic. Of the 21 IOLs implanted, nine were PCIOLs,

Table I: Demography of patients, time interval between phacoemulsification and vitrectomy, method of removal of nucleus, IOL status and best corrected visual outcome in dropped nucleus cases.

Sex/Age/Race	Timing of vitrectomy	Method of nucleus removal during PPV	IOL status	Pre-op VA	Post-op BCVA	Post operative associated findings
6/12 or better						
1. M/67/In	Same day	Fragmotome	PCIOL	6/18	6/9	
2. M/68/In	6 days	Vitrectomy cutter	SFPCIOL	6/18	6/9	
3. M/56/In	10 days	Fragmotome	ACIOL	6/18	6/9	
4. M/83/Ch	21 days	Vitrectomy cutter	ACIOL	6/9	6/9	
5. M/52/In	35 days	Vitrectomy cutter	PCIOL	6/12	6/9	
6. F/82/Mly	Same day	Fragmotome	PCIOL	CF	6/12	
7. F/84/Ch	Same day	PFCL	ACIOL	6/12	6/12	
8. M/60/Mly	15 days	Fragmotome	PCIOL	6/36	6/12	
9. M/55/Mly	30 days	Fragmotome	ACIOL	6/18	6/12	
10. M/78/In	30 days	Vitrectomy cutter	PCIOL	6/36	6/12	
6/18 — 3/60						
11. F/83/Ch	4 days	Vitrectomy cutter	ACIOL	6/9	6/18	
12. F/73/Ch	6 days	Vitrectomy cutter	PCIOL	6/24	6/18	
13. F/69/Ch	60 days	Fragmotome	PCIOL	6/12	6/18	
14. F/73/In	Same day	Fragmotome	PCIOL	1/60	6/24	
15. F/59/Ch	2 days	Vitrectomy cutter	SFPCIOL	HM	6/24	
16. M/79/Mly	8 days	PFCL	PCIOL	6/36	6/24	
17. F/66/Ch	Same day	Vitrectomy cutter	ACIOL	6/18	6/36	High astigmatism
18. F/68/In	2 days	Fragmotome	ACIOL	6/36	6/60	High astigmatism
19. M/65/Mly	21 days	Vitrectomy cutter	ACIOL	6/60	6/60	Optic atrophy
20. M/63/Ch	Same day	PFCL	ACIOL	6/36	4/60	Worsening of DR
< 3/60						
21. M/65/In	Same day	Fragmotome	ACIOL	5/60	CF	Worsening of DR
22. F/67/Ch	Same day	Fragmotome	Aphakia	PL	HM	Old macula scar

IOL=intraocular lens, VA= visual acuity, BCVA= best corrected visual acuity, PCIOL= posterior chamber intraocular lens, ACIOL=anterior chamber intraocular lens, SFPCIOL= scleral fixated posterior chamber intraocular lens, PFCL= perfluorocarbon liquid, PL= perception of light, HM= hand movements, DR= diabetic retinopathy, M=male, F=female, In= Indian, Ch= Chinese, Mly= Malay.

Table II: Best corrected visual acuity and the time interval between phacoemulsification and vitrectomy in eyes with dropped nucleus.

Best Corrected Visual Acuity	Time interval			p value
	≤ 7 days (n= 13)	8-30 days (n=7)	>30 days (n=2)	
6/12 or better	4 (30.8%)	5(71.4%)	1 (50%)	
6/18 to 3/60	7 (53.8%)	2(28.6%)	1 (50%)	0.63
< 3/60	2 (15.4%)	0	0	

Table III: Best corrected visual acuity and the IOL status in eyes with dropped nucleus

Best corrected Visual acuity	IOL Status				
	PCIOL (n=11)	ACIOL (n=8)	SFPCIOL (n=2)	Aphakia (n=1)	p value
6/12 or better	5 (45.5%)	4 (50%)	1(50%)	0	
6/18 – 3/60	6 (54.5%)	3 (37.5%)	1(50%)	0	0.51
< 3/60	0	1 (12.5%)	0	1 (100%)	

IOL=intraocular lens, PCIOL= posterior chamber intraocular lens, ACIOL=anterior chamber intraocular lens, SFPCIOL= scleral fixated posterior chamber intraocular lens,

ten were ACIOLs and were were scleral fixated PCIOLs. In one patient, no IOL was implanted (aphakia) as she had poor visual prognosis due to macular scar.

All the patients were followed up weekly for three visits, then once every two weeks till two months. They were then seen between 1 and 3 monthly depending on visual outcome. During each visit, visual acuity, corneal status, IOL position, intraocular pressure (IOP) and retina status were recorded and any new complication post surgery was also noted. The duration of follow-up in these patients ranged from one month to two years, with a mean follow-up of 9 months. One patient defaulted follow-up after the first month. There were no postoperative complications in 15 eyes. Two eyes had worsening of diabetic retinopathy, two eyes developed glaucoma and one eye had increased astigmatism. One eye had macular scar and another eye had pre-existing optic atrophy which was not detected pre-operatively due to dense cataracts (Table I).

In this study, the best corrected visual acuity was taken at eight weeks after operation. A best corrected visual acuity (BCVA) of 6/12 or better was achieved in 10 eyes and of 6/18 to 3/60 in 10 eyes. In the remaining 2 eyes, BCVA was worse than 3/60 because of progression of diabetic retinopathy causing macular oedema in one eye, and presence of an old macular scar in another eye. The time interval between the initial cataract surgery and vitrectomy did not influence the visual outcome significantly (Table II). Similarly, the type of IOL used did not significantly affect the final visual outcome (Table III).

DISCUSSION

There is no published report from Malaysia on the incidence and management of dropped nucleus following phacoemulsification. This is a serious complication because of the morbidity to the patient and the increase in cost and time due to repeat surgeries. With an increasing number of Malaysian cataract surgeons using this technique, it is timely for such data to be made available to alert surgeons of the risk factors, timing of intervention, the methods of intervention and the visual outcomes following this complication.

The overall incidence of dropped nucleus among patients who underwent phacoemulsification at our training center is 1.84%. This is higher than the incidence reported from India (0.3-1.3%)[4,5], USA (0.3 %)[7], and the figures reported in the National Cataract Surgery Registry (NCSR) (0.1- 0.3%)[6]. We must bear in mind that this procedure is relatively new in Malaysia and many surgeons are in the converting stage (learning curve) whereas the two previous countries mentioned had embraced this technology a few decades ahead of us. The NCSR included many experienced surgeons all over the country whereas our center started doing phacoemulsification only recently thus the learning period was longer. With the availability of state-of-the-art phaco machines, improved surgical skills, and an increased awareness of the factors predisposing to dropped nucleus, it is hoped that the incidence of this complication will become less in the coming years.

In our analysis, hard cataracts, polar cataracts, previously vitrectomized eyes and high myopia, were the common predisposing factors to dropped nucleus. Similar factors have been reported in earlier studies [4,8,9,10]. Hard and mature cataracts cause difficulty during capsulorhexis and nuclear emulsification, which increases the risk of dropped nucleus, as evidenced in three patients in our series. Posterior polar cataracts are well known to predispose to posterior capsular dehiscence soon after hydrodisecction[8], as occurred in two of our cases. Hydroprocedures, performed before nuclear emulsification to dissect the posterior polar opacity which is firmly adherent to the posterior lens capsule, can result in posterior capsule dehiscence. Eyes following vitrectomy and high myopia can be equally challenging to operate on because the anterior chamber in these eyes are unusually deep, the zonules are weak, and in vitrectomised eyes,the posterior capsule is excessively flaccid secondary to reduced vitreous support. One case each of dropped nucleus in our series occurred in a virectomized and high myopic eye.

The optimal timing of vitrectomy for removal of retained lens fragments is still controversial[2,10,11]. The best timing for vitrectomy is probably the same sitting as the cataract surgery as this negates the need and costs for repeat surgeries[10,11,12]. Furthermore, a few studies have reported that eyes undergoing vitrectomy immediately after cataract extraction

achieved a vision of 6/12 or better compared to eyes that were operated on later [10,12,13]. However, the option of same sitting surgery may not always be available as not all eye centers in our country has a vitreoretinal surgeon. Besides that, in most instances, following a complicated and prolonged cataract surgery, patients usually have oedematous cornea, marked inflammation and poor visualization of the fundus. In such cases, it would be safer to delay vitrectomy to allow medical therapy to control inflammation and IOP that may clear the cornea, allowing better visualization and safer vitrectomy [14,15]. A few studies have found no statistical difference in visual acuity between early vitrectomy and vitrectomy done at a later time [15,16,17]. Similarly, our current series revealed that there was no statistically significant difference in final visual outcome between early and late vitrectomy groups (Table II).

There is also the debatable question of whether to implant an IOL after the initial cataract surgery or to delay the implantation until after vitrectomy. Previous studies revealed no correlation between the IOL placement, the type of IOL and the final visual outcomes[13,15,17]. In our experience, if there was adequate capsular support, PCIOL was inserted on the capsular remnant or sulcus. However, if capsular support was inadequate, an ACIOL or scleral fixated PCIOL was used. In cases where there was a lot of trauma and manipulation at the time of cataract surgery, the eyes were left aphakic for a secondary IOL implantation later. Ten eyes in our series had primary IOL implantation and 11 eyes had secondary IOL implantation. The advantage of primary IOL insertion is rapid visual rehabilitation and avoiding the secondary IOL implantation in an inflamed eye at the time of vitrectomy[13,15,17]. Our study showed no significant correlation between type of IOL implanted and the final visual outcome (Table III).

The proper management guideline for retained lens fragments after phacoemulsification depends on the size of the dislocated matter, the access to vitreoretinal expertise and presence of complications directly related to the retained fragments. If there is no excessive inflammation or glaucoma, small fragments can be managed by observation alone. Larger fragments, however, can induce sight-threatening inflammation, glaucoma, retinal breaks, and detachment [1,2,3,4,5]. In these instances PPV is needed with subsequent lens removal techniques that are dependent on the amount and hardness of retained lens fragments. The vitrectomy instrument is usually used to remove softer lens material and phacofragmatome is usually used to remove hard nucleus fragments. In cases of very hard fragments or entire nucleus drop, using perfluorocarbon liquid (PCFL) represents the safest and most efficient way to deliver the fragment or whole nucleus through a limbus incision [18].

CONCLUSION

The overall incidence of dropped nucleus or retained lens matter following phacoemulsification in our center was 1.84%. The common associated factors were hard cataracts, posterior polar cataracts, high myopia and vitrectomised eyes. Despite this dreaded complication, 10 eyes achieved better than 6/12 best corrected vision. The adverse effects of dropped nucleus following phacoemulsification can be lessened if cataract surgeons recognize the risk factors that can lead to this complication and practice the appropriate management technique if this complication occurs. We advocate proper preoperative counseling; thorough explanation and discussion with patients concerning the possibility of this complication occurring, and the need for consecutive surgery at the initial visit when phacoemulsification procedure is advised to the patient.

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