

Risk Factors for Posterior Capsule Rupture and Vitreous Loss during Phacoemulsification

Mohammad Zare, MD; Mohammad-Ali Javadi, MD; Bahram Einollahi, MD
Ali-Reza Baradaran-Rafii, MD; Sepehr Feizi, MD; Victoria Kiavash, MD

Labbafinejad Medical Center, Shahid Beheshti University, MC, Tehran, Iran

Purpose: To determine the rate and risk factors of vitreous loss during phacoemulsification in patients with cataracts operated by ophthalmology residents and fellows at Labbafinejad Medical Center.

Methods: This prospective descriptive study included consecutive patients with cataracts undergoing phacoemulsification over a one year period. All patients were operated under local or general anesthesia using the divide and conquer technique. Preoperatively, all patients underwent a complete ocular examination including measurement of visual acuity, slitlamp biomicroscopy, intraocular pressure measurement, and dilated funduscopy. Main outcome measures included the rate of posterior capsular rupture and vitreous loss as well as associated risk factors such as surgical experience, ocular and systemic conditions, and type and severity of the cataract.

Results: Overall, 767 eyes of 767 patients with mean age of 63.7 ± 10.3 (range, 25-91) years were operated. The overall rate of vitreous loss was 7.9% which was 5-fold greater in the hands of residents as compared to fellows. Among different factors, older age, female sex, small pupil, small capsulorrhexis, presence of pseudoexfoliation, and high myopia were significantly associated with vitreous loss. The highest rate of vitreous loss occurred in patients with dense nuclear cataracts.

Conclusion: Considering the higher rate of vitreous loss in patients operated by ophthalmology residents; patients with known risk factors for vitreous loss should better be operated by more experienced surgeons.

Key words: Phacoemulsification; Posterior Capsule Rupture; Vitreous Loss

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Correspondence to: Mohammad Zare, MD. Associate Professor of Ophthalmology; Ophthalmic Research Center, No. 5, Boostan 9 St., Amir Ebrahimi St., Pasdaran Ave., Tehran 16666, Iran; Tel: +98 21 22585952, Fax: +98 21 22590607; e-mail: drzarea@yahoo.com

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INTRODUCTION

Phacoemulsification has become the procedure of choice for cataract surgery.¹ Vitreous loss is one of the most dreaded complications of cataract surgery which can lead to severe visual disability and sometimes blinding complications such as retinal detachment.² Early detec-

tion of vitreous loss can prevent more severe consequences such as nucleus drop into the vitreous cavity. Posterior capsular tears may occur at any stage of the operation including hydrodissection, phacoemulsification, irrigation and aspiration of cortical material, and intraocular lens (IOL) implantation.³

Poor visual outcomes following vitreous

loss are attributed to factors such as vitreous incarceration into the surgical wound, long-standing intraocular inflammation, and high astigmatism. Incarcerated vitreous strands within the surgical wound may predispose to epithelial and fibrous ingrowth, as well as introduction of microorganisms into the eye. Furthermore, retinal traction by vitreous strands increases the risk of cystoid macular edema and retinal detachment.⁴ Contact between vitreous strands and the corneal endothelium may lead to corneal decompensation.

Several ocular and systemic risk factors for vitreous loss have been recognized. Local factors consist of deep-set eyes, narrow palpebral fissures, high myopia, glaucoma, previous pars plana vitrectomy, and history of vitreous loss in the fellow eye; systemic conditions include severe obesity, Marfan syndrome, diabetes mellitus, and systemic hypertension.³ Surgical experience is another important factor influencing the incidence of vitreous loss which varies from 0.5% to 16%.⁵⁻⁷ The present study was conducted to compare the rate of posterior capsule rupture and vitreous loss during phacoemulsification by ophthalmology residents and fellows at an ophthalmology training hospital and to evaluate associated risk factors.

METHODS

This prospective comparative descriptive study included consecutive patients with significant lens opacity undergoing cataract surgery over a one year period from November 2006 to November 2007 at Labbafinejad Medical Center. Preoperatively, all patients underwent a comprehensive eye examination including measurement of uncorrected and best-corrected visual acuity (UCVA and BCVA), refraction, slitlamp biomicroscopy, intraocular pressure and dilated funduscopy. Patients with cataracts with or without pseudoexfoliation, high myopia, diabetes mellitus, and systemic hypertension were enrolled in the study. The presence of significant phacodonesis as well as history of previous intraocular surgery such as trabeculectomy or vitrectomy led to patient exclusion. Lens opacity was classified as cortical, posterior subcapsular, nuclear sclerosis, and mature

based on slitlamp examination and graded according to LOCS III classification.⁸ Anterior chamber depth was estimated by slitlamp examination and pupil diameter was measured after full dilatation using tropicamide 0.5% eye drops; the diameter of the capsulorrhexis was determined with calipers intraoperatively.

Informed consent was obtained in writing from all patients and operations were performed by fellows in training or ophthalmology residents. Eyes which developed posterior capsule rupture and vitreous loss were compared to those who had uncomplicated surgery. The two groups were compared in terms of age, sex, presence of diabetes mellitus, systemic hypertension, type and severity of lens opacity, corneal opacity, axial length, glaucoma, pseudoexfoliation, anterior chamber depth, surgeon's experience, and type of anesthesia. Chi-square test and *t*-test were employed to compare the study groups with significance set at 0.05. In case of significant differences, the correlation between each independent risk factor and vitreous loss was assessed using linear regression analysis.

Surgical Technique

Surgery was performed under local anesthesia using retrobulbar or peribulbar injections unless there was a certain indication for general anesthesia such as poor cooperation. Two stab incisions were made 90 degrees apart to inject intracameral adrenaline 1/10,000 and viscoelastic material (Coatel, Bausch & Lomb, Waterford, Ireland). After performing a continuous curvilinear capsulorrhexis, a 2.8 to 3.5 mm clear corneal incision was made using a keratome superiorly or temporally, based on surgeon's preference or amount and meridian of keratometric astigmatism. Hydrodissection and hydrodelineation were performed followed by phacoemulsification using the divide and conquer technique; cortical material was removed by manual irrigation and aspiration. A one-piece foldable acrylic IOL (AcrySof SA60AT, Alcon Laboratories, Fort Worth, Texas, USA) was implanted into the capsular bag and viscoelastic material was completely removed thereafter. The anterior chamber was formed with

balanced salt solution and the clear corneal incision was hydrated to become water-tight. In case of wound leakage, the incision was closed using one or more 10-0 nylon sutures as necessary. At the end of the procedure, cefazolin (100 mg) and betamethasone (4 mg) were injected subconjunctivally. In case of posterior capsule tear and vitreous loss, anterior vitrectomy was performed and a posterior chamber intraocular lens was inserted in the ciliary sulcus over remnants of the capsular bag; in case of inadequate capsular support, an iris-claw anterior chamber IOL (Artisan aphakic IOL, Ophtec, Florida, USA) was implanted.

RESULTS

Overall, 767 eyes of 767 patients including 421 (55%) male and 346 (45%) female subjects with mean age of 63.7±10.3 (range, 25-91) years were

enrolled for the study. Sixty-one (7.9%) eyes developed posterior capsule tears and vitreous loss which occurred during phacoemulsification (n=23), irrigation and aspiration (n=17), posterior capsule polishing (n=4), or IOL insertion (n=17). Among complicated eyes, posterior chamber IOL implantation was feasible in 54 (88.5%) eyes, while 7 (11.5%) eyes required anterior chamber IOLs because of poor capsular support. Statistically significant risk factors associated with vitreous loss included surgical experience, older age, female sex, small pupil, small capsulorrhexis, presence of pseudoexfoliation, and high myopia (Table 1).

Considering the type and severity of cataract, the highest rate of vitreous loss occurred in eyes with dense nuclear cataracts (16.4%) followed by severe posterior subcapsular cataracts (15.6%) and severe cortical cataracts (14.5%).

Table 1 Demographic features and risk factors for vitreous loss in complicated versus uncomplicated eyes

Variable	Complicated group (n=61)	Uncomplicated group (n=706)	P value**
Age (years)*	66.8±9.9	62.4±7.3	0.02
Male/Female	24/37	397/309	0.03
Right/Left Eye	27/34	335/371	0.2
Weight (kilograms)*	71.8±11.1	73.4±12.8	0.5
Surgeon: Resident/Fellow	56/5	282/424	<0.001
Capsulorrhexis ≤ 5 mm (%)	25.4	19.2	0.002
Pupil Diameter ≤ 6 mm (%)	54.2	38.6	0.003
Axial Length ≥ 26 mm (%)	8.5	4.5	0.04
Pseudoexfoliation (%)	15.3	11.0	0.03
Shallow Anterior Chamber (%)	11.3	7.6	0.2
Diabetes Mellitus (%)	15.3	16.2	0.7
Systemic Hypertension (%)	18.6	18.8	0.23
Anesthesia: Local/General	58/3	672/34	0.7

*Mean± standard deviation. **Chi-square test for frequency values and *t*-test for mean values

DISCUSSION

Phacoemulsification has become the procedure of choice for cataract surgery; it allows cataract extraction through a small incision thereby providing faster visual rehabilitation and less induced astigmatism.⁹ Due to the small incision, surgery is facilitated in eyes with positive vitreous pressure and the risk of suprachoroidal hemorrhage is reduced.¹⁰

Several factors predispose to vitreous loss during cataract surgery; one of which is sur-

geon's experience. In this study, vitreous loss was 5 times more common in the hands of ophthalmology residents as compared to fellows (13.4% vs 2.7%, respectively). This finding is in good accordance with other studies evaluating the influence of surgical experience on the rate of vitreous loss. Posterior capsule rupture rates in the hands of residents has been reported from 0.5% to 16%, varying according to experience.^{11,12} Tarbet et al⁵ reported a rate of 5.3% among second-year residents but 1.3% among third-year residents. In a retrospective analysis

of 396 patients, Corey et al⁷ reported an incidence of 1.8% by residents. They also observed a trend toward a lower incidence of vitreous loss with increasing surgeon skill: 2.5% by second-year versus 1.0% by third-year residents. Such a low rate can be attributed to training in a wet lab setting and practicing on cadaver eyes before beginning phacoemulsification on patients, furthermore, all residents were closely supervised by experienced anterior segment surgeons. These findings imply that less experienced residents require close supervision by attending physicians.

In the present study, pseudoexfoliation was a significant risk factor associated with vitreous loss. The risk is increased through several mechanisms including zonular weakness and poor pupil dilatation. Abbasoglu et al¹³ reported a 2.5-fold risk of vitreous loss in eyes with pseudoexfoliation. This risk, proposed as the most important risk factor for vitreous loss by Lumme et al,¹⁴ has been 4- to 5-fold in some studies.^{15,16}

There is no consensus on the effect of systemic hypertension on the rate of vitreous loss. Several studies, as well as ours, have found no association.^{14,17} But, Abbasoglu et al¹³ reported a 1.7-fold increase in the rate of vitreous loss with systemic hypertension. They attributed this phenomenon to the use of retrobulbar anesthesia without adrenaline which reduces the effectiveness and duration of local anesthesia. Diabetes mellitus may indirectly influence the rate of posterior capsular rupture through different mechanisms including rigid pupil and previous pars plana vitrectomy. Since we excluded vitrectomized eyes and hence severe cases of diabetes, we cannot evaluate the possible effect of diabetes on the rate of vitreous loss.

In the current study, age and sex significantly influenced the incidence of vitreous loss such that it was more common among older female subjects. The effect of age may be explained by co-existing conditions such as small pupil, pseudoexfoliation, glaucoma and harder nucleus. These findings are consistent with the study by Drolsum et al¹⁸ who reported a significant correlation between age, glaucoma, pseudoexfoliation, nuclear sclerosis and

inadequate mydriasis on one hand, and complication rate, on the other. However, Kuchle et al¹⁷ reported an increased risk of vitreous loss in patients younger than 41 years. No correlation between age and vitreous loss has been reported by other large series.^{14,19,20}

Inadequate mydriasis increases the risk of intraoperative complications because it limits visibility making capsulorrhexis, phacoemulsification and irrigation/aspiration difficult. Intracameral adrenaline injection, stretch pupilloplasty and iris retractors can facilitate the operation in such cases. In a study by Dada et al²¹ the most common reason for converting phacoemulsification to extracapsular cataract surgery was miosis. High myopia is also a well-known risk factor for vitreous loss.^{14-17,19,20} Performing phacoemulsification in a deep anterior chamber makes nucleus handling difficult and thereby increases the rate of vitreous loss especially in the hands of less experienced surgeons.

In conclusion, this study underscores the importance of patient selection to ensure optimal outcomes in phacoemulsification performed by residents. Residents should begin phacoemulsification by practicing on eyes with moderate cataracts, widely dilated pupils, and no comorbid conditions. At the same time, they should receive close supervision by an experienced surgeon throughout the operation.

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