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Intraoperative and postoperative complications of phacoemulsification in cataract eyes with pseudoexfoliation syndrome

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Introduction/Objective Pseudoexfoliation syndrome (PEX) is an age-related systemic disorder characterized by deposition of fibrillary white flaky material mainly on the lens capsule, corneal endothelium, zonules, ciliary body, iris, and pupillary margin. Zonular weakness progressively increases along with the hardness of the lens, patient's age, and the presence of glaucoma.

The objective of the study is to compare the intraoperative and postoperative complications of phacoemulsification in cataract eyes with PEX with cataract eyes without PEX.

Methods The study enrolled 300 eyes with consequently operated senile cataract and PEX and 300 consequently operated eyes with cataract without PEX who underwent phacoemulsification performed by one experienced surgeon (single-surgeon series). A complete ophthalmological examination of all patients was performed preoperatively, as well as on the first, seventh, and 180th day postoperatively.

Results Significant statistical differences between the observed groups were the following: patients with PXF were older (74.2 ± 8 ; range 56–82 years vs. 68.1 ± 9.6 ; range 56–79 years), had smaller pupil diameter, and higher intraocular pressure (IOP) preoperatively (16.1 ± 4.1 vs. 13.8 ± 3.7 mmHg). There were no differences between the groups regarding intraoperative complications. Early postoperative complications were a significant rise of IOP (33 vs. six patients; $p < 0.001$), more frequent postoperative corneal edema (36 vs. 21 patients; $p < 0.036$), and anterior chamber inflammation (17 vs. seven patients; $p < 0.037$) in the PEX group, comparing to the control group. The significant late postoperative complication was elevated IOP (24 vs. five patients; $p < 0.0002$) in patients with PEX.

Conclusion In the hands of an experienced and careful surgeon, phacoemulsification is a safe and beneficial surgery to treat cataract with associated pseudoexfoliation. The greatest problem a surgeon faces is a narrow pupil and zonule instability, and difficulty in recognizing eyes that are particularly at risks, such as those having glaucoma and phacodonesis.

Keywords: phacoemulsification; pseudoexfoliation syndrome; senile cataract

INTRODUCTION

Pseudoexfoliation syndrome (PEX) is an age-related systemic disorder characterized by the presence of fibrillar material that targets all ocular tissue such as lens and iris pigment epithelium, lens capsule, ciliary body, zonules, corneal endothelium, and iris, but it also involves organs other than the eye [1, 2]. Whitish dusty deposits (fibrillary residue) can be observed on the anterior lens capsule, pupillary margin, corneal endothelium, along Schwalbe's line and trabecular meshwork, on the zonules, and vitreous body. Although understanding of this disease has increased considerably, the exact etiology and the structure of the pseudoexfoliative material is still unknown. [3]. It may be a generalized disorder involving abnormal production or turnover of extracellular matrix in the basement membrane [1, 3]. Patients with PEX demonstrated significantly higher zinc and copper levels in aqueous humor; higher copper content in lenses, as well as higher levels of iron and copper in serum were significantly increased in PEX group compared to cataract patients without PEX [4]. There are some re-

ports indicating that infrared radiation contributes to capsular delamination [5].

It has been believed for many years that cataract surgery in patients with PEX carries an increased risk of intraoperative and postoperative complications, thus requiring additional caution and presenting a challenge to the surgeon, especially when extracapsular cataract surgery was performed [6]. Some authors reported a lower rate of intraoperative and postoperative complications when comparing outcome of a modern phacoemulsification with the extracapsular cataract extraction technique [7, 8]

As phacoemulsification surgical technique using ultrasound technology has been the most commonly performed cataract procedure in recent years, the results of this method in patients with PEX have been the subject of many studies. The reports of authors on the incidence of intraoperative and postoperative complications in the eyes with PEX are rather controversial. A few studies that analyzed the results after phacoemulsification cataract surgery indicate that during the surgery certain problems occur due to poorly dilated pupils, weak zonulae, and fragile anterior lens capsule, resulting in

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increased percentage of complications in these eyes [8, 9, 10]. A few recent studies show that phacoemulsification cataract surgery in patients with PEX is a more complicated surgery compared to cataract surgery in a non-PEX eye, but if performed by an experienced surgeon it does not present a significantly higher risk for patients [11, 12].

The aim of this study is to compare the intraoperative and postoperative complications of phacoemulsification in cataract eyes with PEX syndrome with cataract eyes without PEX.

METHODS

In total, 600 eyes with senile cataract that underwent phacoemulsification with implantation of intraocular lenses were included in this study. Patients were divided into two groups: the first group was the group with senile cataract and PEX (300 eyes), and the second, control group (300 eyes), were senile cataract patients without PEX. Phacoemulsification was performed by one surgeon in the period from May 2005 to January 2011 at the Ophthalmology Clinic of the Niš Clinical Center.

Exclusion criteria were traumatic cataract, high values of IOP in patients requiring a previous antiglaucomatous surgery, uncontrolled diabetes and acute cardiovascular events (hypertension resistant to therapy, arrhythmia etc.). The complete ophthalmologic examination was done preoperatively, on the first and the seventh day, as well as six months after the cataract surgery.

All the surgeries were performed using the Millennium apparatus (Bausch & Lomb, Bridgewater, NJ, USA) with “burst” mode and implantation of hydrophilic acrylic flexible lenses. Local peribulbar anesthesia was performed in all the patients, with corneal incision of 3 mm and application of cohesive viscoelastic for performing continuous capsulorhexis.

Student’s t-test and χ^2 test were used for statistical analysis of clinical demographic characteristics and frequency of operative complications.

RESULTS

Phacoemulsification was performed in 600 eyes with senile cataract. The group of patients with PEX comprised 180 female and 120 male patients with mean age of 74.2 ± 8 years (range of 56–82 years), and the control group of patients with senile cataract without PEX included 170 female and 130 male patients with mean age of 68.1 ± 9.6 years (range of 56–79 years). The patients in the group with cataract associated with PEX were significantly older in comparison to the control group ($p < 0.01$), but there is no difference in sex distribution ($p < 0.793$).

Pupil diameter and intraocular pressure (IOP) were measured preoperatively. No patients had phacodonesis or lens dislocation, which are parameters that could affect surgery outcome. Patient in the control group preoperatively demonstrated lower IOP and larger pupil diameter,

Table 1. Preoperative clinical findings in cataract patients with and without PEX

Clinical findings	Senile cataract with PEX (n = 300 eyes)	Senile cataract without PEX (n = 300 eyes)	p-value
IOP (mmHg)	16.1 ± 4.1	13.8 ± 3.7	< 0.001*
Pupil diameter ¹	105 (35%)	38 (12.6%)	< 0.001*
Elevated IOP	30 (10%)	14 (4.7%)	< 0.012*

PEX – pseudoexfoliation syndrome; IOP – intraocular pressure; ¹ Considered to be 5 mm

Table 2. Intraoperative complications in cataract patients with and without PEX who underwent phacoemulsification

Complications	Senile cataract with PEX (n = 300 eyes)	Senile cataract without PEX (n = 300 eyes)	p-value
Incomplete capsulorhexis	9 (3%)	3 (1%)	0.080
Posterior capsule rupture	3 (1%)	1 (0.35%)	0.315
Zonular rupture	3 (1%)	2 (0.7%)	0.563
Vitreous body prolapse	3 (1%)	1 (0.35%)	0.315
HypHEMA	1 (0.35%)	0 (0%)	0.316
Residual lens masses	3 (1%)	1 (0.35%)	0.315

PEX – pseudoexfoliation syndrome

Table 3. Early postoperative complications in cataract patients with and without PEX who underwent phacoemulsification (seventh day postoperatively)

Complications	Senile cataract with PEX (n = 300 eyes)	Senile cataract without PEX (n = 300 eyes)	p-value
Corneal edema	36 (12%)	21 (7%)	0.036*
Elevated IOP	33 (11%)	6 (2%)	< 0.001*
Anterior chamber inflammation	17 (5.7%)	7 (3.3%)	0.037*
Fibrinous exudation	5 (1.7%)	3 (1%)	0.476
HypHEMA	2 (0.7%)	0 (0%)	0.156
Lens dislocation	3 (1.0%)	0 (0%)	0.082
Cystoid macular edema	5 (1.7%)	2 (0.7%)	0.254

PEX – pseudoexfoliation syndrome; IOP – intraocular pressure

which was a significant difference comparing to the senile cataract group with PEX, who had statistically significantly higher frequency of elevated IOP (≥ 22 mmHg), as shown in Table 1.

Table 2 lists intraoperative complications in both groups. As it has been shown, there is no statistically significant difference between observed groups regarding incomplete capsulorhexis, zonular rupture, and vitreous body prolapsed. Anterior chamber lens implantation was performed on all patients with posterior capsule rupture.

The patients were postoperatively followed up for six months. Detailed findings are shown in Tables 3 and 4, presenting early and late postoperative complications (on the seventh and 180th postoperative day).

As it has been shown in Table 3, patients with PEX demonstrated significant rise of IOP and more frequent postoperative corneal edema and anterior chamber inflammation compared to the control group in the early postoperative period.

Table 4. Late postoperative complications in cataract patients with and without PEX who underwent phacoemulsification (180th day postoperatively)

Complications	Senile cataract with PEX (n = 300 eyes)	Senile cataract without PEX (n = 300 eyes)	p-value
Postoperative keratopathy	2 (0.7%)	1 (0.35%)	0.562
Elevated IOP	24 (8%)	5 (1.7%)	0.0002*
Lens dislocation	3 (1%)	0 (0%)	0.082
Posterior capsule opacification	7 (2.3%)	5 (1.7%)	0.559
Anterior capsular constriction	2 (0.7%)	0 (0%)	0.156
Macular edema	1 (0.3%)	0 (0%)	0.316

PEX – pseudoexfoliation syndrome; IOP – intraocular pressure

Six months after surgery it was found that 24 patients in the PEX group still had glaucoma, but the number was significantly reduced ($p < 0.01$) in comparison to preoperative findings ($n = 30$ patients), as shown in Table 4.

DISCUSSION

Patients with pseudoexfoliation syndrome were significantly older, had smaller pupil diameter and higher IOP than controls. These findings are similar to recently published study results [13]. Out of 300 patients with cataract and pseudoexfoliation syndrome, 30 (10%) had capsular glaucoma, which is statistically significantly more frequent than in controls. Mean values of IOP were higher in the group with PEX, which correlates with results from other studies and at the same time justifies the attitudes that strategies should be directed at reducing IOP with medical therapy in patients with elevated IOP in preoperative management treatment.

In 105 patients with cataract and pseudoexfoliation, pupils were less than 5 mm in diameter despite administration of two mydriatics, which imposes a significant problem to the surgeon because it makes the properly sized capsulorhexis more difficult to perform. Apart from the problems concerning capsulorhexis performance, other phases of the surgery are also challenging, considering the tendency of subsequent narrowing of the pupil during the surgery.

In practice, small-sized pupils can be enlarged by high-density viscoelastic agents to perform viscomydriasis, as well as by the use of iris retractors, in order to perform properly sized capsulorhexis. A very important stage in performing ultrasound cataract surgery is continuous curvilinear capsulorhexis, which has been considered to be of great importance, especially in eyes with pseudoexfoliation, zonule laxity, and anterior capsule fragility. In these patients, irregular capsulorhexes and uncontrolled anterior capsule tears that may compromise surgery course have often been described. We performed anterior capsule staining in most patients and achieved significantly better visualization, enabling the surgeon to work more safely

and comfortably. Nevertheless, 3% of patients with PEX had incomplete capsulorhexis, which is slightly higher incidence in comparison to the controls. Posterior capsule rupture occurred during lens chopping and anterior chamber intraocular lens was implanted in three cases with PEX and in one case without it. Wong et al. [14] reported similar experience in senile cataract eyes with true exfoliative syndrome.

Zonular weakness or laxity is one of important features in patients with PEX, requiring extreme caution and precision during the procedure. In our group of patients with pseudoexfoliation and cataract, there were no cases of zonular dialysis preoperatively, while three patients manifested zonular weakness during the surgery. All the patients underwent “burst” technique for phacoemulsification, our preferred technique over the “pulse” mode, which means less ultrasound energy use. It is recommended to use adjunctive pupil and zonule support devices [15]. Anterior capsular snap over the capsulorhexis edge has been described as a sign of zonular dehiscence and instability [16].

It is of extreme importance to minimize the risk of zonular dialysis occurrence during emulsification of the lens nucleus, which can be characterized by a greater degree of hardness in some cases. On most of the patients we used the “Phaco quick” technique (85%), “stop and chop” technique in 15%, and “divide and conquer” technique in 5% of cases. The preference was given to the technique that enables faster and more effective nuclear fragmentation, but, ultimately, the recommended technique is the one the surgeon is most comfortable with.

In the phase of viscoelastic aspiration it is extremely important to completely remove viscoelastic substance used in the previous phase of lens implantation since even small residue may result in transitory elevation of IOP.

Early postoperative complications most commonly include postoperative corneal edema and transitory ocular inflammation signs. Zhang and Saheb [17] reported that endothelial cell density is lower in cataract patients with PEX preoperatively, and corneal cell loss is greater postoperatively. They also reported that there is a transient increase in central corneal thickness after cataract surgery in eyes with PEX, as opposed to eyes without PEX.

Lens dislocation and anterior capsular constriction more commonly occur in patients with pseudoexfoliation mostly as the consequence of frequent postoperative inflammation and a smaller capsulorhexis resulting from the narrow pupil.

IOP control in the early postoperative period seems to be important in patients with PEX who underwent cataract surgery [18]. It was shown that a long-term reduction in mean IOP occurred in PEX eyes with and without glaucoma preoperatively, suggesting a protective effect of phacoemulsification on IOP in these eyes [19]. Also, preoperative diagnosis of glaucoma seems to be the only factor to affect the higher postoperative IOP [20]. There were no differences in complications between eyes with PEX and eyes without PEX [21].

CONCLUSION

In our experience, phacoemulsification method can be safely performed in cataract patients with PEX. It is a challenging surgery, but careful preoperative planning and intraoperative care can ensure a successful outcome and safe procedure. Concerning the numerous complications that may occur in these patients, we did not face severe intraoperative complications apart from certain problems in performing capsulorhexis.

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Оперативне и постоперативне компликације факоемулзификације код пацијената са катарактом и псеудоексфолијационим синдромом

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САЖЕТАК

Увод/Циљ Псеудоексфолијациони синдром (ПЕС) представља системски поремећај који се јавља у старијем животном добу а карактерише се наслагама љуспастог материјала на предњој капсули сочива, ендотелу рожњаче, дужици, зонулама, цилијарном телу, ирису и пупиларном рубу. Прогресивна слабост зонула заједно са већом тврдоћом очног сочива, старост и присуство глаукома су чешћи код пацијената са ПЕС-ом.

Циљ рада је упоредити оперативне и постоперативне компликације факоемулзификације код пацијената са катарактом који имају ПЕС у односу на оне који немају ПЕС.

Методe Студија је обухватила 300 узастопно оперисаних очију са сенилном катарактом и ПЕС-ом и 300 узастопно оперисаних очију са сенилном катарактом без ПЕС-а који су оперисали катаракту факоемулзификацијом од стране једног хирурга. Свим пацијентима је рађен комплетан офталмолошки преглед преоперативно, првог, седмог и 180. дана после операције.

Резултати Значајна статистичка разлика између посматраних група преоперативно је постојала у следећем: болес-

ници са ПЕС-ом су били старији ($74,2 \pm 8,0$, распон 56–82 година; тј. $68,1 \pm 9,6$, распон 56–79 година), имали су мањи дијаметар пупиле и виши интраокуларни притисак (ИОП, $16,1 \pm 4,1$ тј. $13,8 \pm 3,7$ mmHg). У току операције није било значајних разлика у врсти компликација. Ране постоперативне компликације су биле: значајан раст ИОП-а (33 тј. шест болесника; $p < 0,001$), чешћи налаз корнеалног едема (36 тј. 21 болесник; $p < 0,036$), инфламације у предњој очној комори (17 тј. седам болесника; $p < 0,037$). У касном постоперативном периоду значајно је чешћи био налаз пораста ИОП-а у групи са ПХФ (24 тј. пет болесника; $p < 0,0002$).

Закључак У рукама искусног и пажљивог хирурга факоемулзификација је безбедна и корисна хируршка метода код пацијената са сенилном катарактом и ПЕС-ом. Највећи проблем представља уска зеница, зонуларна нестабилност и правовремено препознавање факодонезе и глаукома код пацијената са ПЕС-ом.

Кључне речи: факоемулзификација; псеудоексфолијациони синдром; сенилна катаракта