Rezultati operacije sive mrene na očeh z glavkomom v zadnjem stadiju

The outcome of cataract surgery in eyes with end–stage glaucoma

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Izvleček

Namen: *Ovrednotiti rezultate operacije sive mrene na očeh z glavkomom v zadnjem stadiju.*

Metode: *V to prospektivno klinično raziskavo je bilo vključeno 18 oči osemnajstih bolnikov z glavkomom v zadnjem stadiju, pri katerih je bila narejena fakoemulzifikacija z vstavitvijo mehke intraokularne leče (PHACO IOL). Očesni pritisk (IOP) je bil izmerjen pred posegom in nato 1 teden, 1 mesec ter 3, 6 in 12 mesecev po PHACO IOL. Ovrednoteni so bili najboljša korigirana vidna ostrina (BCVA), število protiglavkomskih zdravil ter vidno polje pred PHACO IOL in na koncu časa opazovanja.*

Rezultati: *Pri vseh očeh je bil čas sledenja po PHACO IOL 12 mesecev. Povprečni IOP pred kirurškim posegom je bil 13,5 mmHg (SD 2,6). V celotnem času sledenja ni bilo razlike med povprečnim IOP pred in po kirurškem posegu (P > 0,05). Povprečna BCVA pred PHACO IOL je bila 0,65 (SD 0,3) logMAR, ki se je izboljšala na pov-*

Abstract

Purpose: *To evaluate the outcome of phacoemulsification and intraocular lens implantation (PHACO IOL) in eyes with end–stage glaucoma.*

Methods: *Eighteen eyes of 18 patients with end–stage glaucoma in which PHACO IOL was performed were included in this prospective clinical study. Intraocular pressure (IOP) was measured before and 1 week, and 1, 3, 6, and 12 months after PHACO IOL. The best corrected visual acuity (BCVA), the number of anti-glaucoma medications and the visual field (VF) test results before PHACO IOL and at the end of follow–up were evaluated.*

Results: *The follow–up period after PHACO IOL was 12 months for all eyes. The mean IOP before surgery was 13.5 mmHg (SD 2.6). There were no differences between the mean IOP measurements before and after surgery during the entire follow–up period (P>0.05). The mean preoperative BCVA was 0.65 (SD*

prečno 0,19 (SD 0,1) logMAR ob koncu časa sledenja po kirurškem posegu (P < 0,0001). Povprečno število protiglavkomskih zdravil pred PHACO IOL je bilo 1,8 (SD 1,4) in 2,0 (SD 1,3) ob koncu časa sledenja po kirurškem posegu (P = 0,104). Pred PHACO IOL je bila pri 7 očeh povprečna vrednost povprečne deviacije na avtomatski perimetriji –23,57 dB (SD 3,9) in –22,87 dB (SD 4,1) ob koncu časa sledenja po kirurškem posegu (P = 0,105). Pred PHACO IOL je bil pri 11 očeh povprečen otok vidnega polja na Goldmannovi perimetriji 17,0° (SD 7,2) in 20,4° (SD 9,0) ob koncu časa sledenja po kirurškem posegu (P = 0,033).

Zaključek: *PHACO IOL na očeh z glavkomom v zadnjem stadiju je rezultirala v značilnem izboljšanju BCVA ob stabilnem IOP brez poslabšanja vidnega polja.*

0.3) logMAR, improving to a mean of 0.19 (SD 0.1) logMAR postoperatively (P<0.0001). The mean number of antiglaucoma medications before surgery was 1.8 (SD 1.4), and it was 2.0 (SD 1.3) postoperatively (P=0.104). The mean value of the mean deviation in 7 eyes on automated perimetry was –23.57 dB (SD 3.9) preoperatively and –22.87 dB (SD 4.1) postoperatively (P=0.105). The mean VF island in 11 eyes on Goldmann perimetry was 17.0° (SD 7.2) preoperatively, improving to 20.4° (SD 9.0) postoperatively (P=0.033).

Conclusion: *PHACO IOL in eyes with end–stage glaucoma resulted in a stable IOP and a significantly improved BCVA without worsening of the VF.*

INTRODUCTION

The prevalence of both cataract and glaucoma increases with age. Improving the functional vision of patients in everyday life is a key goal of cataract surgery. In recent years, there has been controversy surrounding the benefits of cataract surgery for patients with coexisting cataract and end–stage glaucoma (1, 2, 3, 4). Intraocular procedures, especially filtration surgery in patients with end–stage glaucoma, can produce perfusion alterations of the optic nerve head which can result in severe loss of central vision (4, 5). Given the severity of visual field (VF) defects in end–stage glaucoma, the improvement of functional vision after cataract surgery may be questionable. It has been reported that cataract extraction in eyes with end–stage or severe glaucoma can result in improved visual acuity and a decrease of intraocular pressure (IOP), but the improvement in VF is less predictable (1, 3, 6).

In our prospective clinical study we evaluated the outcome of phacoemulsification and intraocular lens implantation (PHACO IOL) in eyes with end–stage glaucoma.

MATERIALS AND METHODS

The patients selected for this prospective clinical study were recruited from the glaucoma unit of the Department of Ophthalmology, University Clinical Centre Maribor, Maribor, Slovenia. In the study we included 18 consecutive patients of either gender, older than 70 years, with coexisting cataract and different forms of end–stage glaucoma, and with a cup–disc ratio (C/D) of 1.0 and severe VF defects with partially preserved central function. Patients were excluded from this study if they demonstrated a history of previous ocular trauma to the study eye, or of uveitis or ocular surgery, with the exception of glaucoma filtration surgery, laser trabeculoplasty or laser iridotomy. The patients were informed of the risks, benefits and alternatives of surgery, and informed consent was obtained.

The data recorded preoperatively included the diagnosis, age, sex, ocular history, number of antiglaucoma medications and the duration of medical treatment for glaucoma. A complete ophthalmological examination was performed, including best corrected visual acuity (BCVA) (decimal equivalents of Snellen's visual acuity were converted to logMAR equivalence for statistical analysis), slit lamp examination, applanation tonometry, gonioscopy, perimetry, fundus evaluation, keratometry and intraocular lens (IOL) power calculation using the SRK/T formula, in all patients before surgery.

End–stage glaucoma was defined on the basis of the VF examination. The VF was examined by either au-

tomated static perimetry (Swedish Interactive Threshold Algorithm [SITA] standard 30–2 program of the Humphrey Field Analyzer) or kinetic perimetry (Goldmann perimetry), depending on the patient's ability to respond in the field examination. All patients had advanced glaucomatous VF loss according to the Hodapp classification on automated perimetry (7), or an extensive ring–shaped or half–ring–shaped absolute defect in the paracentral VF area with a central island, which is defined as stage IV according to the Aulhorn classification, on Goldmann perimetry (8).

In the 4 weeks before the surgical treatment was performed, the IOP was measured with a Goldmann applanation tonometer at least three times, at approximately the same time of day (plus or minus one hour) to minimize diurnal variation of IOP. The average of the preoperative IOPs was used as the baseline IOP.

The indications for PHACO IOL included a BCVA of 0.3 logMAR (0.5 decimal equivalents of Snellen's visual acuity) or worse, with visual disturbance caused by the cataract.

All patients were operated on by an experienced surgeon (T.G.) using local anesthesia after peribulbar injection of mixtures of lidocaine hydrochloride 2% (Xylocaine®) and bupivacaine hydrochloride 0.75% (Marcaine®). The surgical technique was the same in all eyes. The surgery was performed with a temporal clear corneal incision. Subsequently, a standard clear cornea endocapsular phacoemulsification was performed using a corneal tunnel of 3.5 mm. Some patients required intraoperative pupil dilatation with iris hooks or synechiolysis before capsulorrhexis could be performed. An acrylic foldable IOL (Acry–Sof®, Alcon) was implanted into the capsular bag in all cases. Care was taken at the conclusion of surgery to remove as much viscoelastic substance as possible from the eye. At the end of the surgical procedure 4 mg subconjunctival dexamethasone and one drop of a combination of timolol and dorzolamide (Cosopt®) was applied to all eyes. One hour after surgery, all patients received 250 mg of acetazolamide per os, and this was repeated every 8 hours until the evaluation on the first postoperative day. At the first evaluation one day after surgery, 4 mg of dexamethasone was applied subconjunctivally to all eyes. The usual postoperative treatment included a combination of dexamethasone, neomycin and polymyxin B (Maxitrol®) eye drops five or six times a day for 2 weeks, then four times a day for 2 weeks, then three times a day for 3 weeks, then twice a week for 3 weeks, then once a day for 2 weeks, altogether for a duration of 12 weeks. Intraoperative and postoperative complications and their management were noted.

Postoperative evaluation included slit lamp examination, applanation tonometry, and fundus evaluation. Patients were evaluated at 1 and 7 days, and at 1, 3, 6, and 12 months after the PHACO IOL procedure. At all follow–up examinations the IOP was measured at approximately the same time of day (plus or minus one hour) to minimize diurnal variation of IOP. The BCVA, the number of antiglaucoma medications, and the VF examination 12 months after PHACO IOL were also evaluated at the end of follow–up.

Student's t–test for paired data and the chi–squared test were used for statistical analysis of the results. P values of less than 0.05 were considered significant.

RESULTS

Eighteen eyes of 18 patients were included in this prospective clinical study. There were 12 women (66.7%) and 6 men (33.3%) and the mean age was 76.3 years (SD 3.5), with a range of 70–82 years. The most frequent diagnosis was primary open–angle glaucoma, found in 10 eyes (55.6%), 5 eyes (27.7%) had pseudoexfoliation glaucoma, and chronic angle–closure glaucoma was found in 3 eyes (16.7%). The baseline characteristics are listed in Table 1.

Prior to PHACO IOL, goniotrephination with a scleral flap, without intraoperative antimetabolites, was performed in 11 eyes (61.1%). The mean time elapsing between glaucoma filtration surgery and PHACO IOL was 4.3 years (SD 3.3), with a range of 1–10 years. In 5 eyes (27.7%), a selective laser trabeculoplasty was carried out prior to PHACO IOL. The mean time elapsing between selective laser trabeculoplasty and PHACO IOL was 4.6 years (SD 2.6), with a range of 1–8 years. In 3 eyes (16.7%), a peripheral laser iridotomy was performed prior to PHACO IOL. The mean time elapsing between peripheral laser iridotomy and PHACO IOL was 6 years (SD 2.0).

Table 1: *Baseline characteristics*

Patient	Gender	Age (years)	Glaucoma Type	Previous surgical procedures
1	F	82	POAG	/
2	M	74	POAG	FS
3	F	81	POAG	SLT
4	F	81	POAG	SLT
5	M	73	PEX	FS
6	F	80	PEX	FS
7	F	77	POAG	FS
8	F	77	POAG	FS
9	F	74	CAG	LI
10	F	73	POAG	/
11	M	73	PEX	SLT
12	M	78	PEX	FS
13	M	76	PEX	FS
14	F	76	CAG	LI
15	F	77	POAG	FS
16	F	70	POAG	FS, SLT
17	F	72	POAG	FS, SLT
18	M	79	CAG	FS, LI

PEX – Pseudoexfoliation glaucoma; POAG – Primary open–angle glaucoma; CAG – Chronic angle closure glaucoma; FS – Filtration surgey; SLT – Selective laser trabeculoplasty; LI – Laser iridothomy; M – Man; F – Female;

The mean duration of medical treatment for glaucoma before PHACO IOL was 7.1 years (SD 3.0), with a range of 2–12 years. The mean number of antiglaucoma medications used before PHACO IOL was 1.8 (SD 1.4), with a range of 0–4. The mean preoperative BCVA was 0.65 (SD 0.3) logMAR (0.25 with a range of 0.05–0.5 decimal equivalents of Snellen's visual acuity).

In 7 eyes (39%) the VF was examined by threshold automated perimetry and in 11 eyes (61%) by Goldmann perimetry. Preoperatively the mean value of the mean deviation (MD) was –23.57 dB (SD 3.9) and the mean value of the pattern standard deviation (PSD) was 9.75 dB (SD 1.7) on automated perimetry. Preoperatively the mean VF island was 17.0° (SD 7.2) on Goldmann perimetry.

The mean IOP before PHACO IOL was 13.5 mmHg (SD 2.6), with a range of 10–19 mmHg.

In the course of cataract surgery in 7 eyes (39%), a synechiolysis and then a pupil dilatation with iris hooks was performed. No intraoperative complications such as posterior capsular or zonular rupture, anterior chamber hyphema or others were noted. On the first postoperative day no complications such as IOP spikes or anterior chamber exudation were noted. In addition, no postoperative complications were observed on other follow–up visits.

The follow–up period after PHACO IOL was 12 months in all eyes. The mean IOP 1 week after PHACO IOL was 14.8 mmHg (SD 2.5); at 1 month postoperatively it was 14.2 mmHg (SD 2.6), at 3 months 13.7 mmHg (SD 2.4), at 6 months 13.9 mmHg (SD 2.6) and at the end of 12 months of follow–up it was 13.1 mmHg (SD 1.5). No differences were established between the mean IOP measurements before and after PHACO IOL during the entire follow–up period ($P>0.05$).

At the last postoperative follow–up visit, the mean number of antiglaucoma medications was 2.0 (SD 1.3), with a range of 0–4. The difference between the mean number of antiglaucoma medications before

PHACO IOL and the mean number of antiglaucoma medications after PHACO IOL at the end of follow–up was statistically nonsignificant (P =0.104). During the follow–up period after PHACO IOL, antiglaucoma medications had to be added for three eyes (16.7%), owing to insufficient reduction of IOP (in one eye one antiglaucoma medication after 3 months and another after 6 months; in one eye one antiglaucoma medication 1 month after surgery; in one eye one antiglaucoma medication 3 months after surgery). At the last postoperative follow–up visit, the mean BCVA was 0.19 (SD 0.1) logMar (0.67 with a range of 0.3–1.0 decimal equivalents of Snellen's visual acuity). The difference between the mean preoperative BCVA and the mean BCVA after PHACO IOL at the end of follow–up was statistically significant (P <0.0001). At the last postoperative follow–up visit, the mean value of the MD was –22.87 dB (SD 4.1) on automated perimetry. The difference between the mean preoperative MD and the mean MD after PHACO IOL at the end of follow–up was statistically nonsignificant (P =0.105). At the last postoperative follow–up visit, the PSD was 10.00 dB (SD 1.5) on automated perimetry. The difference between the mean preoperative PSD and the mean PSD after PHACO IOL at the end of follow–up was statistically nonsignificant (P =0.305). At the last postoperative follow–up visit, the mean VF island was 20.4° (SD 9.0) on Goldmann perimetry. The difference between the mean preoperative VF island and the mean VF island after PHACO IOL at the end of follow–up was statistically significant (P =0.033).

The IOP, BCVA, number of antiglaucoma medications and VF test results before and after PHACO IOL in the cohort of 18 patients with end–stage glaucoma are listed in Table 2.

***Table 2**: Intraocular pressure, best corrected visual acuity, number of antiglaucoma medications and visual field test results before and after cataract surgery in the cohort of 18 patients with end–stage glaucoma*

Patient	IOP (mmHg) Entry	IOP (mmHg) Exit	BCVA Entry	BCVA Exit	No.GM Entry	No.GM Exit	AP (MD) Entry	AP (MD) Exit	GP (°) Entry	GP (°) Exit
1	15	15	0.3	1.0	3	3	/	/	20	30
2	11	11	0.05	0.5	0	2	/	/	10	10
3	14	12	0.3	0.5	3	3	/	/	20	20
4	14	12	0.4	0.6	3	3	/	/	20	20
5	16	12	0.4	0.8	3	3	–25.41	–25.28	/	/
6	10	10	0.3	0.7	0	0	–23.37	–22.38	/	/
7	10	14	0.3	0.8	0	0	/	/	7	10
8	10	14	0.3	0.8	0	0	/	/	15	20
9	19	14	0.1	0.9	2	2	/	/	20	30
10	14	12	0.4	0.5	3	3	–28.62	–28.52	/	/
11	18	14	0.3	1.0	3	3	–24.60	–21.88	/	/
12	12	12	0.3	0.8	0	0	–26.50	–26.25	/	/
13	12	14	0.2	0.6	2	2	–18.31	–17.56	/	/
14	13	14	0.1	0.5	4	4	/	/	5	5
15	13	16	0.05	0.6	2	3	/	/	30	30
16	12	12	0.2	0.3	0	1	/	/	20	30
17	14	14	0.5	0.8	2	2	–18.20	–18.25	/	/
18	17	13	0.16	0.3	3	3	/	/	20	20

IOP – Intraocular pressure; BCVA – Best corrected visual acuity (decimal equivalents of Snellens visual acuity); No.GM – Number of antiglaucoma medications; AP – Automated perimetry; MD – Mean deviation (dB - Decibel); GP – Goldmann perimetry; ° – Degrees

DISCUSSION

The combined presence of a visually significant cataract and glaucoma in the elderly population is a frequent condition, because the prevalence of both increases with age and also because a cataract can present as a long–term complication of glaucoma filtering surgery (9, 10). It has been reported that an uneventful PHACO IOL is associated with a long–term reduction in IOP or a reduction in the number of antiglaucoma medications in patients with glaucoma (11, 12, 13). The presence of cataract also affects the sensitivity and reliability of the VF test in a glaucoma patient, which improves after PHACO IOL (14, 15, 16). On the other hand coexistence of a visually significant cataract and end–stage glaucoma is not a frequent condition. It has been reported that intraocular procedures, especially filtration surgery for end–stage glaucoma, may be associated with a risk of immediate unexplained postoperative VF loss, which includes fixation with an accompanying change in central visual acuity, termed the "wipe–out" phenomenon (4, 5). The mechanism behind this problem and the means to prevent it are unknown, although it has been suggested that a hypotonic condition or perfusion alterations of the optic nerve head may be risk factors for fixation and central visual acuity loss in these patients with advanced glaucoma (2, 4). It has been reported that patients with late–stage glaucoma and open–angle glaucoma can experience considerable early IOP spikes following uneventful PHACO IOL, which could alter the perfusion of the optic nerve head (2, 17). That is why surgeons may be hesitant about recommending PHACO IOL for patients with end–stage glaucoma, because of concerns regarding the possibility of the occurrence of the "wipe–out" phenomenon and the questionable improvement of functional vision. Therefore, only few reports are available dealing with the outcome of PHACO IOL in eyes with end–stage glaucoma (1, 3, 6).

In their prospective study, which included 12 eyes with advanced cataract and end–stage glaucoma, Altmeyer et al. evaluated the benefit of cataract surgery (1). Ten eyes were treated with PHACO IOL alone, whereas two patients underwent combined cataract–glaucoma surgery (PHACO IOL and trabeculectomy). After 6 months of postoperative follow–up the authors reported a significant improvement in the mean visual acuity and a significant reduction in IOP and the number of antiglaucoma medications. The VF was examined by automated static perimetry, so postoperatively they found a significant improvement of the mean MD and no difference in the mean PSD. They concluded that patients with progressive cataract and end–stage glaucoma can benefit from cataract surgery, because an increase in visual acuity as well as a decrease in IOP without worsening of the VF may be achieved (1).

Chen et al. conducted a retrospective review of 41 eyes with visually significant cataract and open–angle glaucoma that underwent automated static perimetry before and after PHACO IOL (3). Seven eyes were treated with PHACO IOL alone, whereas 34 patients underwent combined cataract–glaucoma surgery (PHACO IOL and trabeculectomy). After 6 months of postoperative follow–up the authors reported a significant improvement of visual acuity and a significant reduction in IOP. Fourteen eyes had mild, 13 had moderate, 11 eyes had severe and 3 eyes had end–stage VF defects. In eyes with mild or moderate glaucoma–related damage, the MD often improved significantly after cataract extraction, but improvement was less predictable in eyes with severe or end–stage damage (3).

Stewart et al., in a prospective study which included 24 eyes with cataract and advanced glaucoma damage, evaluated the impact of combined cataract–glaucoma surgery (PHACO IOL and trabeculectomy) on the results of VF testing (6). The VF was examined by automated perimetry within 6 months before and after surgery. The authors found no appreciable change in either the average MD or PSD after cataract extraction (6).

In our prospective study, which included 18 eyes with advanced cataract and end–stage glaucoma, we evaluated the outcome of PHACO IOL. The VF was examined by either automated static or Goldmann perimetry. During the follow–up period of 12 months after PHACO IOL, the IOP and the number of antiglaucoma medications were stable but a significantly improved BCVA without worsening of the VF could be noted.

As a result of differences in glaucoma form, age, sex, previous ocular history, duration of medical treatment for glaucoma, type of antiglaucoma medication, type of cataract, amount of glaucomatous optic neuropathy, grade of visual disturbance caused by the cataract, operative technique, type of implanted IOL, number of eyes included, follow–up time, evaluation of IOP reduction, type of VF examination and statistical analysis of the results from included patients, a comparison of the reported studies is very difficult.

The results of our study, which showed a significantly improved BCVA without worsening of the VF after PHACO IOL, are similar to those previously reported (1, 3, 6). The IOP and the number of antiglaucoma medications after PHACO IOL in our study were stable. In 3 eyes in which prior to PHACO IOL glaucoma filtration surgery had been perfomed, antiglaucoma medications had to be added during the follow–up after PHACO IOL because of insufficient reduction of IOP. In the studies of Altmeyer et al. and Chen et al., the IOP and the number of antiglaucoma medications after surgery were significantly reduced (1, 3). This may be because, in those two studies, combined cataract–glaucoma surgery (PHACO IOL and trabeculectomy) was done in some of the eyes, and therefore an additional IOP–lowering effect was achieved.

Antiinflammatory treatment after PHACO IOL in eyes with end–stage glaucoma may also influence the results. It can be shown that, when compared with trabeculectomy, an uncomplicated PHACO IOL results in a significantly longer lasting (up to 3 months) breakdown of the blood–aqueous barrier (18). We know that the glaucomatous eye has more tissue fragility and more inflammatory capacity than a non–glaucomatous eye. Thus one of the factors indicating successful PHACO IOL in eyes with end–stage glaucoma is the control of the inflammatory response caused by surgery. The best postoperative antiinflammatory schedule for these eyes has not been determined, and data regarding this regimen are lacking. Therefore we recommend subconjunctival antiinflammatory treatment (dexamethasone) at the end of surgery and on the first day after surgery, close follow–up in the first week after surgery to assess the possibility of fibrinous exudation in the anterior chamber, and certainly aggressive local and also – when needed – subconjunctival corticosteroid therapy. The local antiinflammatory therapy should be continued for at least 12 weeks after surgery. Patients should be evaluated at 1 and 7 days, and at 1, 3, 6, and 12 months after PHACO IOL, and the postoperative evaluation should include slit lamp examination, applanation tonometry, and fundus evaluation. In this way, the possible IOP rise due to corticosteroid treatment can also be detected. We believe that a stable IOP and a stable number of antiglaucoma medications after the surgical procedures in our study were also the result of aggressive, consequent and long–standing antiinflammatory therapy.

The need for prevention of early IOP spikes foll-owing uneventful PHACO IOL in patients with late–stage glaucoma and open–angle glaucoma has already been pointed out (2, 17). Therefore we recommend one drop of a combination of timolol and dorzolamide (Cosopt®) at the end of surgery, together with 250 mg of Acetazolamide per os 1 hour after surgery and then every 8 hours until the evaluation on the first postoperative day. We believe that, in our study, the significantly improved BCVA without worsening of the VF after surgery was also a result of the immediate postoperative IOP control, which prevented alteration of the perfusion of the optic nerve head.

There are limitations to the interpretation of the results from outcome studies. For instance, there are no control groups in such studies. Surgical outcome studies allow the comparison of individual or group practitioner results with other published historical surgical reports or with selected subpopulations within the same outcome study. However, despite the limitations, meaningful information can be derived from outcome studies. The results of our study provide information about the effect of PHACO IOL in eyes with end–stage glaucoma: it resulted in a stable IOP, a stable number of antiglaucoma medications and a significantly improved BCVA, without worsening of the VF. Information from this report can be used for patient education regarding the potential risks and benefits of PHACO IOL, and the rate of visual improvement, postoperative IOP control and glaucoma progression in eyes with end–stage glaucoma. Multiphysician and multicenter outcome studies can fur-

ther increase the value of this information, which can be used to evaluate operative outcomes, and intraoperative and postoperative events.

In view of the results of our study we can conclude that PHACO IOL improves the functional vision in everyday life and also increases the quality of life of patients with end-stage glaucoma.

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