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Effect of cataract phacoemulsification on intraocular pressure of patients in the early stages of open-angle glaucoma

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Purpose: *To compare the combination procedure (modified tunnel trabeculopuncture (MTTP) plus phaco with monofocal intraocular lens (IOL) implantation) in the eye with both senile cataract and either advanced or medically uncompensated open-angle glaucoma (OAG) versus phaco with IOL implantation only in the eye with early well-compensated POAG in terms of hypotensive effect and the number of topical glaucoma medications needed.*

Material and Methods: *Totally, 97 patients (194 eyes; age, 60 to 85 years) with bilateral OAG and senile cataract were involved in the study. Groups and time points were compared in terms of IOP and the number of topical glaucoma medications needed.*

Results: *For both groups, there was a significant difference (P <0.05) between baseline and postoperative IOP values over a 6-month period. The hypotensive effect in group 1 (MTTP plus phaco) was greater than in group 2 (phaco only) (10.8 mmHg versus 4.91 mmHg, respectively). After surgery, the mean number of topical glaucoma medications needed reduced by 2.10 in group 1 and 2.19 in group 2, and these reductions were significant (P < 0.05).*

Conclusion: *In the early and late postoperative periods, there were reductions in IOP and the number of topical glaucoma medications needed in patients with OAG that underwent phaco with monofocal IOL implantation, which indicates a beneficial effect of phaco on IOP dynamics in patients with glaucoma.*

Keywords:

intraocular pressure, modified tunnel trabeculopuncture, phacoemulsification, open-angle glaucoma

Introduction

Glaucoma is one of the world's leading causes of blindness. No consensus exists regarding the selection of the best surgical strategy for the disease. Elevated intraocular pressure (IOP) is usually caused by increased resistance to aqueous outflow, but the rate of aqueous production is the same for eyes with open-angle glaucoma (OAG) as it is for eyes without glaucoma. Elevated IOP due to dysfunction of the aqueous outflow system is a major risk factor for developing glaucoma. The question arises whether phacoemulsification with intraocular lens (IOL) implantation has an impact on the hydrodynamic parameters, and consequently, the IOP, in the glaucomatous eye.

In recent years, there have been several publications on the topic. Jimenes-Roman and colleagues (2017) [1] concluded that in both types of glaucoma (primary open-angle glaucoma (POAG) and preusoexfoliation glaucoma), phacoemulsification cataract surgery can result in a significant IOP reduction (20%; with the significance of changes in IOP assessed by the Wilcoxon matched-pairs signed rank test) over a 12-month follow-up period. The number of medications used was also significantly reduced up to 12 months after surgery. The significance of changes in IOP was assessed by the Wilcoxon matched-pairs signed rank test, and the comparison among time intervals was assessed by the Kruskal-Wallis test [1].

In a study by Kaliardas and colleagues (2023) [2], both phacoemulsification cataract surgery alone and that combined with trabeculectomy were found to be effective in the management of POAG with coexisting cataract, presenting a significant decrease in IOP and in the need for glaucoma medications postoperatively at a long-term follow-up period of 24 months. There was a statistically significant decrease in IOP at postoperative day 7 in both groups ($p < 0.001$), which remained until the end of the 24-month follow-up. At month 24, the two groups did not differ significantly in terms of IOP (14.3 ± 1.4 versus 13.1 ± 1.2 for group 1 and group 1m respectively; $p = 0.447$). In addition, there was a statistically significant decrease in the number of glaucoma medications needed at postoperative day 7 in both groups ($p < 0.001$ for both groups compared to baseline). At month 24, patients in both groups needed about one additional glaucoma medication to control their IOP [2].

Pakuliene and colleagues [3] aimed to evaluate IOP pre- and postoperatively, together with anterior chamber angle parameters and biometrical results in cataract patients with or without open angle glaucoma (OAG). Patients with OAG had a larger absolute IOP reduction compared to patients without OAG. If the patients had OAG, they were more likely to have IOP change of ≤ -3.0 mmHg, than if they did not have OAG.

Armstrong and colleagues [4] have undertaken a systematic review and meta-analysis to synthesize evidence quantifying the effect of phacoemulsification on IOP and the required number of topical glaucoma medications in patients with cataract and POAG. They concluded that phacoemulsification as a solo procedure lowered IOP in patients with POAG and reduced dependency on topical glaucoma medications. These effects appeared to last at least 36 years with gradual loss of the initial effect noted after 2 years.

Masis and colleagues [5] performed systemic review and meta-analysis of the clinical data to estimate the net effect of cataract surgery on IOP. For the OAG group, there was an overall IOP change of -2.7 mmHg (95% confidence interval, 3.7 to -1.7) from baseline.

Brizido and colleagues [6] performed a review to determine the real effect of cataract surgery on IOP change in patients with OAG, focusing on data retrieved from randomized clinical trials (RCTs). Included studies retrieved a consistent reduction in IOP occurring after surgery, varying between 4.1 and 8.5 mmHg depending on the RCT. There was also a decrease in the number of glaucoma medications, with a mean reduction of 0.2-1.0 agents postoperatively.

A question arises whether phacoemulsification with IOL implantation can impact hydrodynamics and, correspondingly, IOP, in the glaucomatous eye.

The purpose of the study was twofold: (a) to compare modified tunnel trabeculopuncture (MTTP) plus phaco with IOL implantation in the eye with both senile cataract and either advanced or medically uncompensated OAG versus phaco with IOL implantation only in the eye with early well-compensated OAG in terms of hypotensive effect and (b) to compare the two groups in terms of the number of hypotensive medications needed.

Material and Methods

This was a retrospective cohort study. Totally, 97 patients (194 eyes) with bilateral OAG and senile cataract were involved in the study. A combination surgery (MTTP plus phaco with IOL implantation) was conducted in the eye with both senile cataract and either grade 3 to 4 or medically uncompensated OAG. A phaco with IOL implantation only was conducted in the eye with both senile cataract and either grade 1 to 2 or medically compensated OAG.

Automated static perimetry, optical coherence tomography (OCT) of the optic nerve and ganglion cell complex and gonioscopy were performed to assess the severity of glaucomatous process. In addition, patients underwent optic biometry with corneal pachymetry.

Informed consent was obtained from all study patients.

IOP was measured with the ICare tonometer at baseline and at week 1, month 1, month 3, and month 6 postoperatively.

We compared groups and time points in terms of average IOP.

Patients of group 1 underwent an MTTP plus divide and conquer phaco with IOL implantation. Patients of group 2 underwent divide and conquer phaco with IOL implantation only.

Student t-test and Mann-Whitney U test were used for statistical analysis.

Results

In group 1, the mean IOP was 27.05 ± 3.75 mmHg at baseline ($P < 0.05$), 18.96 ± 1.98 mmHg at week 1, 14.94 ± 1.92 mmHg at month 1, 15.35 ± 1.75 mmHg at month 3, and 16.25 ± 1.36 mmHg at month 6 (Table 1). In group 2, the mean IOP was 22.5 ± 2.14 mmHg at baseline ($P<0.05$), 17.02 ± 1.25 mmHg at week 1, 16.89 ± 1.35 mmHg at month 1, 17.41 ± 1.45 mmHg at month 3, and 17.59 ± 1.15 mmHg at month 6 (Table 1). There was a significant difference ($P<0.05$) between preoperative and postoperative IOP values for both groups.

The mean number of topical glaucoma medications at baseline was 3.02 ± 1.0 for group 1 and 2.78 ± 1.0 for group 2 (Table 2). In group 1, the mean number of glaucoma eyes drops was 0.39 ± 0.75 at week 1, 0.63 ± 0.55 at month 1, 0.61 ± 0.54 mmHg at month 3, and 0.9 ± 0.46 mmHg at month 6. In group 2, the mean number of glaucoma eyes drops was 0.39 ± 0.45 at week 1, 0.62 ± 0.54 at month 1, 0.66 ± 0.49 mmHg at month 3, and 0.59 ± 0.50 mmHg at month 6. There was a significant difference ($P < 0.05$) between preoperative and postoperative mean numbers of topical glaucoma medications for both groups.

Therefore, at month 6, a reduction in mean IOP (compared to baseline) was of 10.8 mmHg for group 1 ($P<0.05$), and 4.91 mmHg for group 2 ($P<0.05$). In addition, at month 6, a reduction in mean number of topical glaucoma medications (compared to baseline) was of 2.1 for group 1 ($P<0.05$), and 2.19 for group 2 ($P<0.05$).

The results obtained indicate that phaco with IOL implantation is beneficial in patients with well-compensated non-advanced POAG, and is characterized by a 20.2% reduction in mean IOP (a hypotensive effect) and a 78.8% reduction in mean number of topical glaucoma medications at month 6.

Discussion

The results of the current study demonstrated the beneficial role of phacoemulsification in the IOP dynamics (with facilitation to changes in aqueous circulation) in patients with glaucoma: there were statistically significant reductions in IOP over 6 months after surgery (with a 20.2% reduction in mean IOP at month 6) and a 78.8% re-

Table 1. Mean intraocular pressure (IOP) values before and after surgery in group 1 and group 2

Group	IOP at baseline	IOP at day 7 after surgery	IOP at month 1 after surgery	IOP at month 3 after surgery	IOP at month 6 after surgery
Group 1	27.05 ± 3.75	18.96 ± 1.98	14.94 ± 1.92	15.35 ± 1.75	16.25 ± 1.36
t-test value		1.908	2.875	2.827	2.708
	P < 0.05	P < 0.05	P < 0.05	P < 0.05	P < 0.05
Group 2	22.5 ± 2.14	17.02 ± 1.25	16.89 ± 1.35	17.41 ± 1.45	17.59 ± 1.15
t-test value		2.211	2.217	1.969	2.021
	P < 0.05	P < 0.05	P < 0.05	P < 0.05	P < 0.05

Table 2. Mean number of topical glaucoma medications needed before and after surgery in group 1 and group 2

Group	Mean number of glaucoma medications needed before surgery	Mean number of glaucoma medications needed after surgery			
		Week 1	Month 1	Month 3	Month 6
Group 1	3.02 ± 1.0	0.39 ± 0.75	0.63 ± 0.55	0.61 ± 0.54	0.92 ± 0.46
t-test value		2.105	2.094	2.121	1.909
P	<0.05	<0.05	<0.05	<0.05	<0.05
Group 2	2.78±1.0	0.39 ± 0.45	0.62 ± 0.54	0.66 ± 0.49	0.59 ± 0.50
t-test value		2.18	1.901	1.904	1.958
P	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

duction in mean number of topical glaucoma medications at month 6 compared to baseline ($P < 0.05$).

Given the above and based on the information provided in the reviewed literature, it can be concluded that, in patients with early, well-compensated OAG, phacoemulsification facilitates a reduction in IOP and medication use in the postoperative period. Therefore, phacoemulsification with IOL implantation can be considered as an alternative to medication treatment and the first surgical option for early, well-compensated OAG.

In patients with early glaucoma, phacoemulsification with IOL implantation only is advantageous to the combined surgical procedure in terms of the rate and severity of surgical trauma and invasiveness, as well as easiness of postoperative rehabilitation. The combined surgical procedure, however, should be considered in patients with advanced medically uncompensated or compensated glaucoma.

Conclusion

First, phacoemulsification with IOL implantation only may be a procedure of choice in patients with senile cataract and early, well-compensated OAG, aiming to reduce IOP or the number of medications used to control IOP.

Second, phacoemulsification with IOL implantation only has a statistically significant hypotensive effect in patients with both senile cataract and early, well-compensated OAG, with reductions in IOP over 6 months after surgery (particularly, a 20.2% reduction in mean IOP at month 6).

Third, there were statistically significant reductions over 6 months (particularly, a 78.8% reduction at month 6) in mean number of topical glaucoma medications compared to baseline in eyes with both senile cataract and early compensated OAG which underwent phacoemulsification with IOL implantation only.

Finally, the combination procedure (MTTP plus phaco) resulted in a greater hypotensive effect (with a 39.93% IOP reduction) than phaco only, and should be a method of choice in eyes with both senile cataract and either medically uncompensated or late OAG.

References

1. **Jimenez-Roman J, Lazcano-Gomez G, Martínez-Baez K, Turati M, Gulías-Cañizo R, Hernández-Zimbrón LF, et al.** Effect of phacoemulsification on intraocular pressure in patients with primary open angle glaucoma and pseudoexfoliation glaucoma. Int J Ophthalmol. 2017;10(9):1374–8. doi: 10.18240/ijo.2017.09.07.
2. **Kaliardas A , Chatziralli I, Katsanos A, Kitsos G.** Phacoemulsification versus Phacoemulsification/Trabeculectomy for the Treatment of Primary Open-Angle Glaucoma Coexis-

tent with Cataract: A Comparative Study. Medicina (Kaunas). 2023 Feb 27;59(3):470. doi: 10.3390/medicina59030470.
3. **Pakuliene G, Kuzmiene L, Siesky B, Harris A, Januleviciene I.** Changes in ocular morphology after cataract surgery in open angle glaucoma patients. Sci Rep. 2021 Jun 9;11(1):12203. doi: 10.1038/s41598-021-91740-z.
4. **Armstrong JJ, Wasiuta T, Kiatos E, Malvankar-Mehta M, Hutnik CML.** The Effects of Phacoemulsification on Intraocular Pressure and Topical Medication Use in Patients With Glaucoma: A Systematic Review and Meta-analysis of 3-Year Data. J Glaucoma. 2017 Jun;26(6):511-22. doi: 10.1097/IJG.0000000000000643.
5. **Masis M, Mineault PJ, Phan E, Lin SC.** The role of phacoemulsification in glaucoma therapy: A systematic review and meta-analysis. Surv Ophthalmol. 2018 Sep-Oct;63(5):700-10. doi: 10.1016/j.survophthal.2017.08.006.
6. **Brízido M, Rodrigues PF, Almeida AC, Abegão Pinto L.** Cataract surgery and IOP: a systematic review of randomised controlled trials. Graefes Arch Clin Exp Ophthalmol. 2023 May;261(5):1257-66. doi: 10.1007/s00417-022-05911-3..

Disclosures

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Abbreviations: *IOL, intraocular lens; IOP, intraocular pressure; MTTP plus phaco, modified tunnel trabeculopuncture plus phacoemulsification; OAG, open-angle glaucoma*