Effect of phacoemulsification on intraocular pressure in patients with primary open angle glaucoma and pseudoexfoliation glaucoma

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Received: 2017-01-14 Accepted: 2017-04-14

Abstract

• AIM: To compare the effect of phacoemulsification on intraocular pressure (IOP) in patients with primary open angle glaucoma (POAG) and pseudoexfoliation glaucoma (PXG).

• METHODS: A retrospective comparative case series conducted at the Glaucoma Department at the Association to Prevent Blindness in Mexico. The study enrolled consecutive patients having phacoemulsification with intraocular lens (IOL) implantation and a diagnosis of POAG or PXG. Data about IOP values and number of glaucoma medications used was collected at baseline, 1, 3, 6 and 12mo postoperatively.

• RESULTS: The study enrolled 88 patients (88 eyes). After phacoemulsification, there was a statistically significant reduction in IOP values and glaucoma medications use compared to baseline in both POAG and PXG patients (P<0.001). In the POAG group, a 20% decrease in IOP values was evidenced, and a 56.5% reduction in the number of medications used at the one-year follow-up. The PXG group showed a 20.39%, and a 34.46% decrease in IOP and number of medications used, respectively. A significant difference in the mean ΔIOP (postoperative changes in IOP) was evidenced between groups (P=0.005).

• CONCLUSION: In both types of glaucoma, phacoemulsification cataract surgery can result in a significant IOP reduction (20%) over a 12mo follow-up period. The number of medications used is also significantly reduced up to 12mo after surgery, especially in the PXG group.

• KEYWORDS: cataract surgery; pseudoexfoliation glaucoma; secondary glaucoma; primary open angle glaucoma; intraocular pressure

INTRODUCTION

Pseudoexfoliation (PXF) syndrome is a systemic disorder of unknown etiology with the potential for many intraocular complications[1]. PXF is an age-related disorder characterized by the production and accumulation of an abnormal PXF fibrillar material in various ocular tissues[2]. PXF material accumulations mechanically weaken the zonular lamellae and impair zonular anchoring to the ciliary epithelial basement membrane at both its origin and insertion[3]. In addition, previous studies have demonstrated that higher cataract grade and shallower preoperative anterior chamber are key risk factors for endothelial cells reduction after cataract surgery in eyes with PXF[3-7]. Although the prevalence described varies between series in different countries and specific populations[1,8], it has been reported this syndrome affects about 0.2%-30% of people older than 60y worldwide[8]. PXF remains an important risk factor related to ocular complications during cataract surgery due to its association with high intraocular pressure (IOP), reduced pupil dilation and zonular weakness[9-10]. Pseudoexfoliation glaucoma (PXG) is the most common form of secondary open angle glaucoma and develops in the context of PXF[11-12]. Glaucoma
Two IOP measurements were obtained for each eye by the
same ophthalmologist between 9:00 a.m. and 12:00 a.m.
during preoperative and postoperative visits. From the two IOP
measurements, a mean IOP value was derived for statistical
analysis. If the two IOP values differed by more than 2 mm Hg,
the ophthalmologist would perform a third IOP measurement,
and the median value was utilized in the statistical analysis.

Surgical Technique A standard Stop&Chop technique using
topical anesthesia was performed in all cases. Clear
surgical incisions of 2.8 mm were made and manually created
capsulorhexes of 5.0 to 5.5 mm were utilized for all surgeries.
The same ophthalmic viscosurgical device (OVD) Duovisc®
(sodium hyaluronate 3%-chondroitin sulfate 4.0% with sodium
hyaluronate 1.0%; Alcon Laboratories, Inc. Fort Worth, Texas,
USA) was utilized in all surgical procedures. Fluid parameters
were set as follows: vacuum limit 350, aspiration flow rate
40 mL/min. Ultrasound power was set according to the lens
density of each patient. After cataract removal and aspiration
of cortical material, the appropriate IOL was implanted in the
capsular bag, removing the remaining OVD from the anterior
chamber; finalizing the surgical procedure.

Statistical Analysis Given an α of 0.05, a β of 0.20, a standard
deviation of 1.00, and a power of 0.80, the estimated study
sample size was 43.5 per group. The statistical significance
of changes in IOP was determined by a Wilcoxon match-
pairs signed rank test. The comparison among time intervals
was assessed by the Kruskal-Wallis test. In addition, a Dunn
multiple comparison test was used to compare the preoperative
IOP measurements with postoperative time intervals. A P value
less than 0.05 was considered statistically significant. Normal
and non-normal distributions were determined by Shapiro-
Wilk tests for all variables. Statistical analyses were performed
using the Statistical Package for Social Sciences (SPSS)
software (version 20, SPSS, Inc., Chicago, IL, USA). Graphs
and layouts depicted in Figures were elaborated using the 2015
GraphPad software Inc. Prism version 6.0.

RESULTS A total of 88 patients were enrolled in the study, 44 per group.
Clinical and demographic data are summarized on Table 1.
Figure 1 depicts the effect of phacoemulsification cataract
surgery on the mean IOP at each time interval. There was
a statistically significant reduction in IOP compared to
preoperative values at all time intervals from 1 to 12mo
postoperatively. In the POAG group, IOP diminished compared
to baseline at all time points (Table 2).
The decrease was significantly greater than in the PXG group at 3, 6 and 12 mo postoperatively. A significant difference in the mean ΔIOP was evidenced between groups as shown in Table 3. In the PXG group the mean IOP before surgery was 17.9 mm Hg with a mean of 2.06 medications used, which decreased to a mean of 14.25 mm Hg postoperatively with a mean of 1.35 medications used after 12 mo of follow-up, which represents a 20.3%, and a 34.46% decrease in IOP and number of medications used, respectively.

The mean IOP before surgery in the POAG group was 15.9 mm Hg with a mean of 2.3 medications used, which decreased to 13.1 mm Hg with a mean of 1.1 medications used during the 12 mo follow-up. This represents a 20.0% decrease in IOP, and a 56.5% reduction in the number of medications used.

Preoperatively, 34 patients in the PXG group required glaucoma medications. During the 12 mo follow-up, the number of medications used diminished in all patients and also 10 patients discontinued medication use due to IOP decrease. No patient required additional glaucoma medications postoperatively.

**DISCUSSION**

In our study, the mean postoperative IOP at 12 mo was significantly lower than the respective preoperative values. Moreover, the mean ΔIOP difference was also statistically significant between groups \( (P<0.0001) \). This difference suggests that despite the reduction of the postsurgical IOP mean values in both groups, the POAG group showed a greater reduction in IOP values compared to the PXG group.

Our findings agree with previous studies that documented an improvement in glaucoma control after phacoemulsification. Mierzewski et al.\(^{[19]}\), reported in PXG patients, a decrease in IOP from 20.6 to 15.1 mm Hg (a 27% reduction; \( P<0.00001 \)). In addition, the number of medications used decreased from 1.7 to 1.2, similar to our results\(^{[12]}\). Also reported a 5% increase in postoperative IOP, but the glaucoma severity was not reported and therefore poorly controlled patients may have minor improvements postoperatively.

Other series have demonstrated a greater IOP reduction postoperatively in elderly patients, females, eyes with an axial length ≤21 mm, and PXF patients\(^{[17-18,20]}\). However, it has been described that in patients with certain types of glaucoma, mean IOP may be reduced up to 5.5 mm Hg\(^{[16,18]}\). A recent Meta-analysis evaluated the impact of phacoemulsification on IOP in glaucoma patients, which reported that in POAG patients who are controlled with 1 or 2 medications, phacoemulsification alone results in a modest decrease in IOP (13%) as well as in medication use (12%)\(^{[17]}\). Furthermore, this analysis reported that incisional glaucoma surgery would be rarely necessary for IOP control within 1y\(^{[17-18]}\). In patients with mild to moderate PXG controlled with 1 or 2 medications, phacoemulsification results in a moderate decrease in IOP (20%) and in the number of medications required after surgery (35%)\(^{[18]}\).

Shingleton et al.\(^{[21]}\) studied 240 eyes, also with medically controlled PXG, in patients who underwent uncomplicated phacoemulsification. The extent of glaucoma damage was not reported. Among 51 eyes with a follow-up of 60 mo, the IOP decreased from 18.0 to 16.9 mm Hg (6%; \( P<0.030 \)), and the number of medications used decreased from a mean of 1.6 to 1.0 (38%), similar to the reduction obtained in the PXG group in our study.

In addition, among studies including PXG and non-PXG patients, Peräsalo\(^{[22]}\), retrospectively studied 182 Finnish patients (226 eyes) with medically controlled PXG (\( n=124 \)) and POAG (\( n=102 \)) who underwent phacoemulsification cataract surgery. The IOP decreased from 17.1 to 15.3 mm Hg (\( P<0.001 \)) at 12 mo of follow-up. The number of medications used decreased from a mean of 1.5 to 0.9 (40%); but 37% of the patients in the study required an increase in medications\(^{[22]}\). This study included PXG and POAG patients, and reported similar reductions both in IOP and in postoperative medication use; however, no significant differences were evidenced between groups. Similarly, Elguin et al.\(^{[23]}\) reported no significant differences in postoperative IOP measurements between PXG and POAG patients undergoing uneventful cataract surgery.

Several studies have shown that the decrease in IOP after phacoemulsification is more pronounced in eyes with a
higher preoperative IOP\textsuperscript{[16]}\textsuperscript{1}. However, few studies have evaluated the postoperative IOP response in patients with PXG compared to those with POAG. It has been suggested that phacoemulsification removes a source of PXF material (the anterior lens capsule) and results in or stimulates clearance of PXF and pigment debris from the anterior segment, in particular the trabecular meshwork\textsuperscript{[11]}\textsuperscript{2}. Various IOP reduction mechanisms after phacoemulsification have been proposed, however, the key mechanism may vary across different types of glaucoma\textsuperscript{[23]}\textsuperscript{3}. IOP drop following phacoemulsification has been shown to be greater in patients with PXF\textsuperscript{[17]}\textsuperscript{4}. In addition, it has been described that IOP response after phacoemulsification surgery in patients with PXF correlated with the volume of irrigation fluid used intraoperatively, thus reinforcing the idea that the procedure may remove exfoliation material from the outflow system\textsuperscript{[17,24]}\textsuperscript{5}. This study has some limitations that should be noted, one of the main weaknesses of this study is its retrospective nature with the inherent limitations of data extrapolation, and therefore subject to the selection bias of such a study. In addition, this study examined IOP alone and did not evaluate the status of the optic nerve head, nerve fiber layer, or visual fields in the disease population.

In summary, our findings suggest that inpatients diagnosed with PXG or POAG, controlled with 1 or 2 medications and IOP >25 mm Hg, cataract phacoemulsification surgery results in a significant decrease in IOP, as well as in the number of medications required after surgery. Therefore, early cataract surgery may be considered for the treatment of patients with a visually significant cataract and glaucoma as a reasonable surgical option in patients with coexisting cataract and relatively well-controlled glaucoma.

**ACKNOWLEDGEMENTS**

We wish to acknowledge the Association to Prevent Blindness in Mexico for the facilities to carry out this study.

**Conflicts of Interest:** Jimenez-Roman J, None; Lazcano-Gomez G, None; Martinez-Baez K, None; Turati M, None; Gulías-Cañizo R, None; Hernández-Zimbrón LF, None; Ochoa-De la Paz L, None; Zamora R, None; Gonzalez-Salinas R, None.

**REFERENCES**


### Table 3 Impact of postoperative IOP on IOP reduction evidenced by ΔIOP for each group postoperative change in IOP mm Hg

<table>
<thead>
<tr>
<th>Postop. interval</th>
<th>POAG</th>
<th>PXG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eyes (n)</td>
<td>Mean±SD</td>
<td>Mean ΔIOP (%)</td>
</tr>
<tr>
<td>1mo</td>
<td>44</td>
<td>13.36±2.21</td>
</tr>
<tr>
<td>3mo</td>
<td>43</td>
<td>13.26±2.93</td>
</tr>
<tr>
<td>6mo</td>
<td>38</td>
<td>13.26±2.16</td>
</tr>
<tr>
<td>12mo</td>
<td>38</td>
<td>13.19±2.2</td>
</tr>
</tbody>
</table>

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