



## IMPACT OF PHACOEMULSIFICATION CATARACT SURGERY ON INTRAOCULAR PRESSURE IN EYES WITH OCULAR HYPERTENSION

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## ABSTRACT

**Background:** Cataract surgery has been reported to reduce intraocular pressure (IOP), particularly in patients with ocular hypertension. This study aimed to evaluate the impact of phacoemulsification with posterior chamber intraocular lens (IOL) implantation on IOP in eyes with ocular hypertension. **Methods:** This was a prospective observational study including 30 eyes of patients aged >50 years with senile nuclear cataract and ocular hypertension (IOP 22–24 mmHg, normal optic disc, no antiglaucoma therapy, no prior glaucoma surgery, no complicated cataracts). All patients underwent standard phacoemulsification with posterior chamber IOL implantation by a single surgeon. Oral acetazolamide (500 mg) was administered 30 minutes before surgery. IOP was measured with a non-contact tonometer at baseline, and on postoperative day (POD) 1, 7, 15, 30, and 90. **Results:** Mean preoperative IOP was  $22.7 \pm 0.7$  mmHg. Following cataract surgery, mean IOP significantly decreased to  $17.9 \pm 1.9$  mmHg on POD 1, and remained stable thereafter ( $17.5 \pm 2.1$  mmHg at POD 90). The mean IOP reduction at 3 months was  $-5.3$  mmHg (23%) compared to baseline ( $p < 0.001$ , Cohen's  $d = -2.66$ ). No intraoperative complications or postoperative IOP spikes above baseline were observed. **Conclusion:** Phacoemulsification with posterior chamber IOL implantation results in a significant and sustained reduction in IOP in eyes with ocular hypertension. Cataract surgery may therefore provide dual benefits of visual rehabilitation and IOP control in this patient population.

**KEYWORDS :** Ocular Hypertension, Cataract Extraction, Phacoemulsification, IOP Reduction.

## INTRODUCTION

Ocular hypertension (OHT) is characterized by elevated intraocular pressure (IOP) in the absence of glaucomatous optic nerve damage or visual field loss. It is a well-recognized risk factor for the development of primary open-angle glaucoma (POAG), and careful monitoring and management are essential to prevent progression to optic neuropathy.<sup>[1]</sup> Although topical hypotensive medications remain the first-line treatment for managing elevated IOP, surgical and laser options are considered in selected cases, particularly when medication adherence or tolerance becomes problematic.<sup>[2]</sup>

Cataract and ocular hypertension frequently coexist, particularly in older populations. Phacoemulsification cataract surgery is the standard treatment for visually significant cataracts, and growing evidence suggests that it can also lead to a sustained reduction in IOP, especially in eyes with pre-existing ocular hypertension or glaucoma.<sup>[3,4,5]</sup> The mechanism behind this IOP-lowering effect is thought to involve deepening of the anterior chamber, widening of the iridocorneal angle, and improved aqueous outflow facility following lens extraction.<sup>[6]</sup>

Several studies have evaluated the impact of cataract surgery on IOP in glaucomatous eyes; however, the specific effects in eyes with ocular hypertension without glaucomatous damage remain underexplored.<sup>[7]</sup> Understanding this relationship could inform treatment strategies, possibly delaying or even eliminating the need for glaucoma medications in selected patients.

This study aims to evaluate the effect of uncomplicated phacoemulsification cataract surgery on intraocular pressure in patients with ocular hypertension. By quantifying IOP changes over a defined follow-up period, we seek to clarify whether cataract surgery may have a therapeutic role beyond vision improvement in this patient population.

## MATERIALS AND METHODS

This was a prospective observational study conducted over a period of 3 months. The study adhered to the tenets of the Declaration of Helsinki and written informed consent was obtained from all participants prior to inclusion.

A total of 30 eyes of patients aged  $\geq 50$  years with senile nuclear cataract were enrolled. Only eyes with intraocular pressure (IOP) more than 21 mmHg, normal optic disc appearance, open angles on gonioscopy and no prior history of glaucoma, any laser procedures for glaucoma management or glaucoma surgery were included. Patients on anti-glaucoma medications, with complicated cataracts, or with any ocular/systemic condition that could influence IOP were excluded.

All patients underwent standard phacoemulsification with posterior

chamber intraocular lens (IOL) implantation performed by the same surgeon. There were no intraoperative complications. On the day of surgery, all patients received a single oral dose of acetazolamide 500 mg prior to the surgery to prevent intraoperative and immediate postoperative IOP spikes.

The primary outcome was the change in IOP following cataract surgery. IOP was measured using a non-contact tonometer at baseline (preoperative) and postoperatively at Day 1, Day 7, Day 15, Day 30 and Day 90.

All statistical analyses were performed using standard statistical software (Python-based environment). Descriptive statistics were calculated for all timepoints (mean  $\pm$  SD, median, range, and 95% confidence intervals). The distribution of paired differences (postoperative – preoperative) was assessed using the Shapiro–Wilk test. Depending on normality, comparisons were performed using the paired t-test and confirmed with the Wilcoxon signed-rank test. Cohen's  $d$  was calculated as a measure of effect size. A  $p$ -value  $< 0.05$  was considered statistically significant.

## RESULTS

## Study Population

A total of 30 eyes of 30 patients were included. All surgeries were uneventful, and no intraoperative or postoperative complications were noted.

## Intraocular Pressure Trends

The mean preoperative IOP was  $22.7 \pm 0.5$  mmHg. Postoperatively, there was a consistent and sustained reduction in IOP at all follow-up visits (Table 1, Fig. 1).

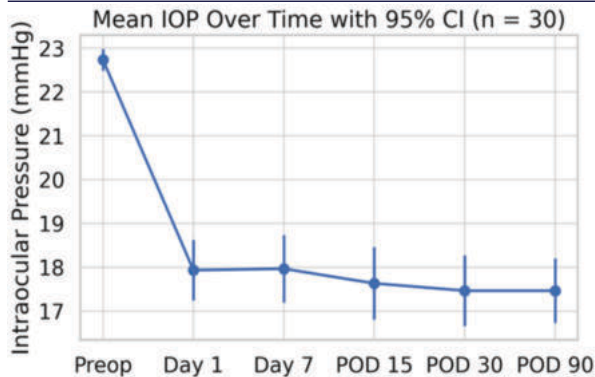
- Day 1:  $17.9 \pm 1.2$  mmHg
- Day 7:  $18.0 \pm 1.3$  mmHg
- POD 15:  $17.6 \pm 1.2$  mmHg
- POD 30:  $17.5 \pm 1.1$  mmHg
- POD 90:  $17.5 \pm 1.2$  mmHg

## Comparisons with Baseline

At each follow-up timepoint, IOP was significantly lower compared to baseline (paired t-test and Wilcoxon signed-rank test,  $p < 0.001$  for all).

**Table 1: Descriptive Statistics of Intraocular Pressure (IOP)**

| Timepoint | Mean IOP (mmHg) | SD   | Median | Min | Max |
|-----------|-----------------|------|--------|-----|-----|
| Preop     | 22.73           | 0.69 | 23     | 22  | 24  |
| Day 1     | 17.93           | 1.93 | 18     | 14  | 22  |
| Day 7     | 17.97           | 2.16 | 18     | 14  | 22  |
| POD 15    | 17.63           | 2.31 | 18     | 12  | 22  |
| POD 30    | 17.47           | 2.26 | 18     | 12  | 21  |
| POD 90    | 17.47           | 2.06 | 18     | 13  | 21  |



**Figure 1: Mean Intraocular Pressure Over Time Measured During the Study**

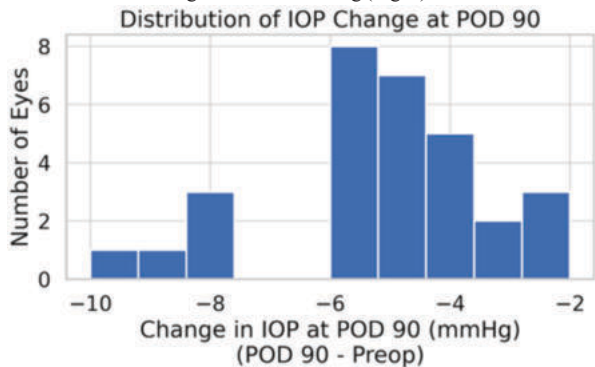
At Day 90, the mean paired reduction in IOP was  $-5.2$  mmHg, representing an approximate 23% decrease from baseline. This reduction was highly significant (paired t-test,  $p < 0.001$ ; Wilcoxon signed-rank test,  $p < 0.001$ ). The effect size (Cohen's d) for the Day 90 reduction was  $-1.0$ , indicating a large effect. (Table 2)

**Table 2: Changes in Intraocular Pressure (IOP) Compared to Preoperative Values**

| Timepoint | Mean Change (mmHg) | SD Change | Shapiro p | Paired t-test p | Wilcoxon p | Cohen's d |
|-----------|--------------------|-----------|-----------|-----------------|------------|-----------|
| Day 1     | -4.8               | 1.85      | 0.1684    | <0.001          | <0.001     | -2.6      |
| Day 7     | -4.77              | 1.99      | 0.2488    | <0.001          | <0.001     | -2.39     |
| POD 15    | -5.1               | 2.2       | 0.0283    | <0.001          | <0.001     | -2.32     |
| POD 30    | -5.27              | 2.13      | 0.0245    | <0.001          | <0.001     | -2.47     |
| POD 90    | -5.27              | 1.98      | 0.1204    | <0.001          | <0.001     | -2.66     |

#### Distribution of IOP Change

The distribution of paired IOP changes at Day 90 showed that the majority of eyes achieved a clinically meaningful reduction, with no cases of IOP increase greater than 1 mmHg (Fig. 2).



**Figure 2: Distribution of Intraocular Pressure Change at Day 90**

At 3 months postoperatively, 22 of 30 eyes (73.3%) achieved a  $\geq 20\%$  reduction in IOP compared to baseline. A chi-square test of independence was conducted to examine the relationship between preoperative IOP category (22, 23, 24 mmHg) and the likelihood of achieving this threshold reduction. The association was not statistically significant,  $\chi^2(2, N = 30) = 2.52$ ,  $p = 0.284$ , indicating that the probability of achieving a clinically meaningful IOP reduction did not depend on baseline IOP within the studied range.

#### DISCUSSION

In this prospective observational study, we demonstrated that phacoemulsification with posterior chamber IOL implantation in patients with ocular hypertension led to a significant and sustained reduction in intraocular pressure over a 3-month follow-up period. The mean IOP reduction at 90 days was approximately 5 mmHg (23%), with the majority of eyes maintaining stable, lowered IOP levels throughout follow-up. Importantly, no patient experienced a postoperative IOP rise beyond baseline, and the procedure was free of intraoperative complications.

Our findings are consistent with prior reports that cataract surgery

exerts a lowering effect on IOP, particularly in eyes with ocular hypertension or early glaucoma.<sup>[3,4,5,7]</sup> Several mechanisms have been proposed, including improved aqueous humor outflow through widening of the anterior chamber angle, deepening of the anterior chamber, and increased trabecular outflow facility after lens extraction.<sup>[6]</sup> The magnitude of IOP reduction in our cohort ( $\sim 5$  mmHg) is comparable to results from earlier studies reporting reductions in the range of 2–6 mmHg at 1–3 months postoperatively.<sup>[3,4,7]</sup>

Clinically, the observed IOP reduction is meaningful. A 20–25% decrease in IOP is often targeted in the management of ocular hypertension to reduce the risk of conversion to glaucoma.<sup>[1,2]</sup> Thus, cataract surgery in this patient group may not only restore vision but also provide ancillary IOP control, potentially delaying or reducing the need for topical glaucoma therapy.<sup>[7]</sup>

A notable strength of our study is the uniformity of surgical technique: all procedures were performed by a single experienced surgeon, thereby minimizing variability. Moreover, our sample consisted exclusively of ocular hypertensive patients without optic nerve damage, ensuring homogeneity. The use of prophylactic oral acetazolamide minimized the risk of intraoperative and early postoperative IOP spikes, which were not observed in this cohort. Overall, our results support the growing body of evidence that cataract surgery alone can serve as an effective IOP-lowering intervention in patients with ocular hypertension.<sup>[3–7]</sup>

#### CONCLUSION

Phacoemulsification with posterior chamber IOL implantation produced a significant and sustained reduction in intraocular pressure in eyes with ocular hypertension. At 3 months postoperatively, mean IOP decreased by approximately 23% from baseline. These findings suggest that cataract surgery not only restores visual function but may also offer therapeutic benefit in IOP control for ocular hypertensive patients.

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