

# Retrospective Audit of Phacomorphic Glaucoma in Last 12 Years in a Tertiary Eye Care Centre, New Delhi, India

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## ABSTRACT

**Introduction:** Phacomorphic glaucoma is a type of secondary glaucoma caused by lens swelling in eyes with mature or intumescent cataract. It is encountered more commonly in developing countries. Its management includes initial lowering of Intraocular Pressure (IOP) followed by definitive treatment of removal of lens by cataract surgeries. The visual prognosis remains unpredictable due to the irreversible optic nerve damage that may have incurred in a matter of few days. It is equally pertinent to know the postoperative IOP values and whether these patients would require long term Anti-Glaucoma Medications (AGM). The role of Laser Peripheral Iridotomy (LPI) in IOP control preoperatively in such patients also needs to be evaluated.

**Aim:** To assess the visual outcome, IOP control and the requirement of AGM after cataract surgery in phacomorphic glaucoma.

**Materials and Methods:** This was a retrospective, observational study conducted from March 2019 to January 2020 on all patients diagnosed with phacomorphic glaucoma at the tertiary eye care centre. The primary variables were IOP and visual acuity. All patients underwent a complete ophthalmic examination. Cataract surgery was done after instituting treatment for IOP control. Preoperative LPI was done according to consulting doctors' discretion. Trabeculectomy

was combined with cataract surgery based on surgeons' decision. Patients were followed for 6 weeks postoperatively. Fisher-test and paired t-test were used for statistical analysis.

**Results:** A total of 118 patients (25 males and 93 females, mean age  $64.55 \pm 6.35$  years) were recruited in the study and 94 patients followed-up till last visit at 6 weeks. The mean presenting IOP was  $39.55 \pm 12.55$  mmHg. The mean IOP at day 1 postoperatively was  $14.66 \pm 4.55$  mmHg, the difference was statistically significant ( $p$ -value  $< 0.001$ ). There was a significant drop in IOP seen postoperatively at day 1 and 6 weeks ( $p < 0.001$ ). At 6 weeks, the mean IOP was  $13.19 \pm 3.83$  mmHg. A combined cataract extraction and trabeculectomy did not result in statistically significant difference in the final IOP values. At 6 weeks follow-up, 87.23% patients did not require any AGMs; 63.83% patients gained good vision, 26.59% gained borderline vision and 9.58% had poor vision. LPI resulted in a better IOP control preoperatively ( $p = 0.003$ ).

**Conclusion:** Cataract surgery alone results in good IOP control in phacomorphic glaucoma without a need for long term AGMs. However, to prevent permanent angle damage and disc changes an early surgical intervention is required. LPI appears to have a beneficial role in controlling the preoperative IOP in these eyes.

**Keywords:** Cataract surgery, Lens-induced glaucoma, Laser peripheral iridotomy, Optic nerve damage

## INTRODUCTION

Cataract is one of the most important causes of curable blindness globally. It has been estimated that there are about 12.5 million blind people in India, with cataract causing 50 to 80% of this morbidity [1]. Phacomorphic glaucoma is a type of secondary glaucoma caused by lens swelling in eyes with mature or intumescent cataract who otherwise are not predisposed to angle closure [2]. When the lens swells, acute angle closure with pupillary block occurs in the acute phase; in the late phase, it can occur even without pupillary block as a result of forward movement of the peripheral iris [3]. If untreated permanent closure of the angle occurs with irreversible optic nerve damage and visual impairment [4,5].

Phacomorphic glaucoma is encountered more commonly in developing countries, where cataracts tend to get neglected by the patient because of the general belief that cataract surgery is neither indicated nor feasible unless the cataract becomes 'ripe.' Moreover, the limited visual needs of the population do not prompt the patient to seek medical help until late in the disease [6]. One of the studies done in Indian sub-population showed a prevalence of 3.91% phacomorphic glaucoma cases per operated cases of cataract surgery [7]. The incidence appears to be similar in men and women, although precise data are lacking [3].

Management of phacomorphic glaucoma cases include initial lowering of IOP followed by definitive treatment of removal of lens

by cataract surgeries. The initial lowering of IOP is commonly done with medical treatment with combinations of topical AGM, oral acetazolamide, and intravenous mannitol but it has been documented that in 37.5% cases medical treatment had failed to lower IOP [8]. This may be because of the poor corneal drug penetration and relative ischaemia caused by raised IOP leading to the failure of topical therapy. IOP lowering is however desired to prevent the risks of operating on an eye with corneal oedema and high IOP [5].

Cataract surgery in phacomorphic glaucoma poses several challenges: the high IOP increases the risk of dreaded intraoperative complications like Posterior Capsule Rupture (PCR) and expulsive haemorrhage [1]. Further frequent complications like repeated iris prolapse, anterior chamber collapse, zonular dialysis, vitreous loss, corneal endothelial injury, and increased postoperative inflammation make the surgery technically more difficult [2].

Preoperative LPI may offer multiple benefits in such patients. LPI helps in lowering IOP by releasing the pupillary block and may facilitate surgery by increasing the peripheral Anterior Chamber (AC) depth. Moreover, by equalising the pressures in anterior and posterior chambers, the effect of relative ischaemia is negated allowing the topical medications to work. But doing a LPI in such patients may be challenging. Corneal oedema due to raised IOP may hamper visibility. As the lens is positioned in close proximity to

iris, there is a risk of lens capsule rupture with subsequent leakage of lenticular material into the AC.

Although these patients present early to the hospitals because of the acute symptoms, the visual prognosis remain unpredictable due to the irreversible optic nerve damage that may have incurred in a matter of few days. So, it is critical to know the proportion of these cases attaining a good postoperative visual acuity. It is equally pertinent to know the postoperative IOP values and whether these patients would require long term AGM. The primary outcome of the study was assessment of Best Corrected Visual Acuity (BCVA), IOP and the requirement of AGMs at 6 weeks postoperatively. The secondary outcome was to evaluate the role of laser peripheral iridotomy in preoperative IOP control.

## MATERIALS AND METHODS

It was a retrospective, observational study done at a tertiary eye care center in North India from March 2019 to January 2020. The study was approved by the Institutional Review Board (IRB/2019/AUG/29) and it followed the tenants of declaration of Helsinki.

**Inclusion criteria:** All patients data diagnosed with phacomorphic glaucoma by subjective complaints of acute pain and redness associated with presence of corneal oedema, shallow anterior chamber, an intumescent total cataractous lens and IOP above 21 mmHg [9] between June 2006 to September 2018 were included in the study.

**Exclusion criteria:** Gonioscopy of other eye was done to rule out primary angle closure disease and fellow eyes which had narrow angle and raised IOP were excluded from the study.

The preoperative assessment included Best Corrected Visual Acuity (BCVA), slit-lamp examination, applanation tonometry, gonioscopy, axial length measurement, anterior chamber depth by A scan and B-scan ultrasonography for posterior segment status. Gonioscopy was also performed for the subjects. All patients were treated medically to lower the IOP. Nd:YAG LPI was done in patients according to consulting doctors' discretion as there is ambiguity regarding the role of LPI in these eyes and few surgeons were not comfortable doing LPI due to the risk of lens capsule perforation. All LPI's were done after instituting medical treatment. Pilocarpine 2% eye drop was instilled 3 times before the procedure to achieve any degree of pupillary constriction. If the cornea was oedematous even after intravenous mannitol, topical glycerin 10% was instilled onto the cornea under topical pro-paracaine to cause corneal deturgescence and clearing. LPI was done with an Abraham lens with a power of 4-5 mJ with a minimum iridotomy size of 200 microns with 2-4 shots at a visibly thinned portion of the iris or at a site of crypt, if present. Following LPI, steroid drops were intensified and cataract surgery was done within 3 days.

Written informed consent was taken from all patients prior to the surgery. The surgeries were performed under peribulbar anaesthesia. Cataract surgery was done by Extra Capsular Cataract Extraction (ECCE), Small Incision Cataract Surgery (SICS) or phacoemulsification according to surgeons' discretion. In early part of the 21<sup>st</sup> century, a surgeon usually preferred SICS/ECCE as a surgical technique in phacomorphic glaucoma based on their expertise and experience. But later on, phacoemulsification was also performed in these cases. Surgeons chose to do trabeculectomy with cataract surgery if B scan showed cupping of the optic disc. Postoperatively, patients were treated with topical antibiotic (moxifloxacin) and steroid (prednisolone) eye drops. Patients were followed-up for 6 weeks postoperatively and a detailed examination including BCVA, IOP, slit-lamp examination and fundus examination was done at every follow-up visit. Visual outcome was categorised using the World Health Organisation (WHO) standard where good vision is 6/6 to 6/18, borderline vision is less than 6/18 to 6/60 and poor vision is less than 6/60 [10].

## STATISTICAL ANALYSIS

Statistical analysis was performed using Statistical Package for the Social Science (SPSS) version 24. Continuous data were presented as mean with confidence interval set to 95%. Fischer-exact test was used to compare the results of categorical variable. To compare the means of different groups, t-test (two-tailed) was used and  $p < 0.05$  was considered significant.

## RESULTS

A total of 118 eyes of 118 patients of phacomorphic glaucoma were recruited in the study and 94 patients followed-up till 6 weeks postoperatively. There was a 20% dropout and data of these patients were not included in the final assessment. The mean age of the patients was  $64.55 \pm 6.35$  years. There were 25 (21.19%) males and 93 (78.81%) females. The patients had glaucoma-related symptoms (sudden onset ocular pain, headache, red eye, nausea, vomiting) for 1 to 90 days before presentation (mean,  $22.08 \pm 11.21$  days). All cataracts were of mature grade. Preoperative gonioscopy revealed closed angles in all involved eyes with no significant findings in the fellow eyes. Peripheral Anterior Synechiae (PAS) could not be commented on as indentation gonioscopy was difficult due to high IOP and very shallow AC. Extracapsular Cataract Extraction (ECCE), SICS and phacoemulsification were done in 64, 39 and 15 patients respectively. Additionally, trabeculectomy was done in 28 patients (23.72%) in the same sitting as cataract extraction. The mean presenting IOP was  $39.55 \pm 12.55$  mm Hg. The mean IOP at day 1 postoperatively was  $14.66 \pm 4.55$  mm Hg [Table/Fig-1] and this decrease from presentation to postoperative day 1 was statistically significant ( $p < 0.001$ ). At 6 weeks, the mean IOP was  $13.19 \pm 3.83$  mmHg [Table/Fig-1] and this difference was also significant ( $p < 0.001$ ). A combined cataract extraction and trabeculectomy did not result in any further statistically significant difference in the final IOP [Table/Fig-2]. The difference in final IOP between these two groups was not significant.

| Variables                              | Values            |
|--|-------------------|
| Mean age (years)                       | $64.55 \pm 6.35$  |
| Number of males                        | 25 (21.19%)       |
| Number of females                      | 93 (78.81%)       |
| Mean duration of symptoms (days)       | $22.08 \pm 11.21$ |
| Mean IOP at presentation (mm Hg)       | $39.55 \pm 12.55$ |
| Mean BCVA at presentation              | $4.05 \pm 1.10$   |
| Mean IOP day 1 postoperative (mm Hg)   | $14.66 \pm 4.55$  |
| Mean IOP 6 weeks postoperative (mm Hg) | $13.19 \pm 3.83$  |

[Table/Fig-1]: Demographic detail.

IOP: Intraocular pressure; BCVA: Best corrected visual acuity

| Type of surgery         | Number | Mean drop in IOP | Standard deviation | p-value |
|-------------------------|--------|------------------|--------------------|---------|
| Cataract only           | 72     | 25.71            | 3.81               | 0.419   |
| Cataract+Trabeculectomy | 22     | 28.64            | 3.87               |         |

[Table/Fig-2]: IOP control-cataract versus combined Surgery at 6 weeks; Statistical test used- two-tailed t-test.

Of 94 patients who followed till 6 weeks, 82 patients (87.23%) did not require AGMs and showed normal IOP ranges, and 12 patients had to be put on long term AGMs [Table/Fig-3]. The two surgical groups viz., cataract and combined surgery did not show any significant difference in long term AGMs requirement. Postoperative optic nerve examination showed permanent glaucomatous changes in 26 patients (28%) at 6 weeks' follow-up. When optic nerve changes were analysed with the duration of symptom onset, the relation came out to be significant ( $p = 0.002$ ). The mean logMAR Visual Acuity (VA) preoperatively was  $4.05 \pm 1.10$ . The final VA at 6 weeks was  $0.66 \pm 0.24$  ( $p < 0.001$ ). There were 60 patients (63.83%) who gained good vision, 25 (26.59%) gained borderline vision and 9 (9.58%) had poor vision

at the final visit. Phacoemulsification gave the best visual outcomes followed by SICS and then conventional ECCE, the difference being statistically significant ( $p$ -value=0.023), [Table/Fig-4]. IOL was placed in all patients. In this cohort, no posterior capsular rent occurred.

| Number of AGM medicines given  | Number of patients | Percentage | 95% CI Lower limit | 95% CI Upper limit |
|--|--------------------|------------|--------------------|--------------------|
| Total patients with AGM (1 AGM-8 patients, 2 AGMs-4 patients, 3 AGMs-None) | 12                 | 12.77%     | 6.02%              | 19.51%             |
| Patients with no AGMs  | 82                 | 87.23%     | 80.49%             | 93.98%             |

**[Table/Fig-3]:** Number of patients with AGMs at 6 weeks postoperative. AGMs: Anti-glaucoma medications; N=94

| Cataract surgery category      | ECCE | SICS | PHACO | Total | p-value |
|--------------------------------|------|------|-------|-------|---------|
| A (6/6-18 or 0-0.5 logMAR)     | 25   | 22   | 13    | 60    | 0.023   |
| B (6/24 -6/60 or 0.6-1 logMAR) | 18   | 6    | 1     | 25    |         |
| C (<6/60 or >1 logMAR)         | 8    | 1    | 0     | 9     |         |
| Total patients                 | 51   | 29   | 14    | 94    |         |

**[Table/Fig-4]:** Type of cataract surgery and final visual outcome; Statistical test used- Fisher-exact test.

ECCE: Extra capsular cataract extraction; SICS: Small incision cataract surgery; PHACO: Phacoemulsification

Preoperative LPI was done in 22 patients. The mean difference in IOP from the first presentation to preoperatively after instituting of treatment was  $31.71 \pm 10.36$  mm Hg in LPI group while in non-LPI group it was  $22.81 \pm 13.50$  mm Hg ( $p=0.003$ ) [Table/Fig-5].

| Peripheral iridotomy | Mean drop in IOP | Number | SD    | p-value |
|----------------------|------------------|--------|-------|---------|
| Yes                  | 31.71            | 22     | 10.36 | 0.003   |
| No                   | 22.81            | 96     | 13.50 |         |

**[Table/Fig-5]:** Drop in IOP in LPI and non-PI group; Statistical test used- two-tailed t-test.

LPI: Laser peripheral iridotomy; PI: Peripheral iridotomy

## DISCUSSION

Phacomorphic angle closure commonly occurs in the setting of an intumescent total cataractous lens leading to sudden total angle closure that result in an acute elevation of IOP. Because of the acuteness of the condition, patient usually seeks medical attention. It is a type of ophthalmic emergency and requires immediate medical and surgical attention. Removing the cataractous lens as soon as possible is desirable as delayed surgical management may lead to permanent closure of the angle with long term visual morbidity due to progressive optic nerve damage.

In this retrospective study, out of 118 patients 94 patients completed the 6 weeks follow-up for the final assessment. There were 21.19% males and 78.81% females in the study. A higher incidence in females have similarly been reported by other studies [1,7]. This may be a chance finding but may also reflect a social issue especially in developing nations where females are dependent on others for medical care and do not get medical attention until the disease is advanced. This may also be the reason for not following -in the postoperative period.

In this study, at 6 weeks follow-up, 87.23% patients had a well-controlled IOP without the requirement of AGM. This success rate was found to be similar to previous studies in which it was reported to vary from 80-95%. This reflects that removal of the primary inciting cause that is, lens removal, may restore the function of the trabecular meshwork. Unlike in primary angle closure, where the angles are occluded for a long time, the changes incurred are also more permanent. In phacomorphic angle closure however the angles were not occluded earlier so a timely removal of the lens helps in normalising the IOP postoperatively. However, if the closed angle stage persists for longer time glaucoma can ensue with high IOP due to permanent closure of the angle or resultant dysfunctional trabecular meshwork.

A combined cataract extraction and trabeculectomy did not prove beneficial and the final IOP were similar in both the groups even in patients who presented after two weeks of developing acute symptoms. In this study, 12 patients had to be placed on AGMs for IOP control postoperatively. Surprisingly, the need for long term AGMs was not related to the duration of the disease in the study. Hence, there may be factors other than duration of symptoms which affect IOP control like previous angle status. Similarly, Senthil S et al., found that cataract surgery alone and combined surgery yielded comparable IOP control [11]. Other studies done by Ramakrishnan R et al., and Prajna NV et al., found cataract surgery effective in long term control of IOP [1,9]. However, Angra SK et al., reported inadequate control of IOP in patients with attack persisting more than 7 days in his group of patients [8]. Hence, the need for simultaneous filtration surgery and the cut-off duration needs further investigation.

Fundus changes that can occur in these cases are related to the acute elevation of IOP and pre-existing status of the optic nerve. In this study, 28% of the patients had glaucomatous changes at 6 weeks follow-up and was found to be statistically significant when correlated with disease duration. The literature reports this percentage to be 10%-34% [11]. So, the timing of surgical intervention may not have been significant as per requirement of AGM postoperatively but for vision preservation and preventing damage to the optic nerve, an early surgical intervention is highly desirable. In the setting of resumption of normal aqueous outflow but with some degree of glaucomatous damage, these patients need to have a baseline visual field and quarterly follow-up for the initial 2-3 years to pick-up glaucomatous progression and timely institution of medical treatment.

BCVA attained at the end of 6 weeks was variable with 63.83% gaining good vision, 26.59% borderline vision and 9.58% had poor vision as per World Health Organisation (WHO) guidelines (mentioned previously) [10]. The patients who did not gain favourable vision had pallor of the neuro-retinal rim due to the persistent acute IOP elevation before the surgical intervention. So, duration of the disease is an important determinant of visual recovery. Lee SJ et al., found poor postoperative visual recovery when surgery was performed more than five days after onset of the initial glaucoma symptoms [3]. Similarly, Ramakrishnan R et al., found a significant correlation between better postoperative visual recovery and shorter duration of symptom onset [1]. Visual recovery also depended on the type of surgery used for cataract extraction. Patients who had undergone phacoemulsification gained good visual outcomes followed by SICS and then conventional ECCE. Preoperative visual acuity was similar in all 3 groups. The decision for the type of cataract surgery was based on surgeon's expertise and discretion. The recent improvement in technique, instrumentation and expertise of surgeons along with availability of highly dispersive and cohesive Ocular Viscoelastic Devices (OVDs) makes phacoemulsification safer and easier now-a-days. ECCE technically speaking may have more risks of dreaded complications of PCR and expulsive haemorrhage when operated on a high pressured eye. In this study, it is possible that surgeons' chose cases with a relatively clear cornea and softer cataracts for phacoemulsification and hence the better result. A randomised controlled trial would be able to determine the best surgical practices in this scenario, along with risks and benefits of a particular type of surgery.

In this study, 22 patients underwent preoperative laser PI along with starting of AGMs for the high IOP. Laser PI is not done commonly by clinicians due to the technical challenges encountered. The presence of corneal oedema, shallow AC coupled with a total intumescent lens risks injuring either the cornea anteriorly or the lens behind. There can be accidental lenticular rupture with risk of egress of liquefied lens matter into the AC which may aggravate the inflammation. However, the literature reports that the irides in



phacomorphic glaucoma are thinner than in Acute Primary Angle Closure (APAC) eyes, so LPI can be completed with few shots [12]. Also, in case of accidental injury to the lens which happened in one of the patients, it is usually a micro-perforation which may cause a micro leak of lens matter but without any further consequence. On the other hand, there are multiple benefits of a LPI. It releases the pupillary block and thus brings equilibrium to the pressure differential between the anterior and the posterior chambers. It is postulated that there is an inherent pressure differential between the anterior and posterior chambers as proposed by Silver DM and Quigley HA by about 1-8 mm Hg which increases manifold in the presence of an acute total angle closure associated with a pupillary block [13]. It also creates a state of ischaemia which does not let the medications act. Negating this relative differential IOP effect by doing a PI reduces the ischaemia state and allows the medications to work efficiently. Also, the eye becomes quiet suitable making it easier and safer for surgery. There is definitely a paucity of literature regarding the role of LPI in phacomorphic glaucoma and need further trials.

However, this study showed significant lowering of IOP in LPI group in comparison to non-LPI group. Some of these patients even had IOPs recorded in single digits after LPI. Similarly, Tomey KF and Al-Rajhi AA in 1992 studied the role of laser iridotomy in the initial management of phacomorphic glaucoma and brought out the essence of PI in these cases [6].

### Limitation(s)

The study is limited by its retrospective nature. The patients could only be followed for 6 weeks postoperatively. A longer follow-up is desired to know how these eyes behave in the longer period in terms of visual benefit, IOP control and AGM requirement. Another limitation was the multiple observers managing the cases. So, postoperative gonioscopy was not performed in all these patients and presence of PAS could not be determined.

### CONCLUSION(S)

Phacomorphic glaucoma is an end stage consequence of a mature cataract and is a real problem in developing nations. A timely intervention can provide good visual recovery without the need for long term AGM. So, it is important to create awareness amongst the rural civilisation to get timely help and not to keep their cataracts to ripe and rupture. Role of LPI is beneficial but should be carefully done to avoid accidental injury to cornea or lens. A properly designed future

study considering much longer follow-ups in terms of visual benefit, IOP control and AGM requirement, under single observer would give much more information. However, considering the limited number of studies present, an audit in a tertiary eye care center highlighted few observations to help design future studies henceforth.

A randomised trial however is needed to find out the best possible surgery and the role of preoperative LPI in these cases.

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