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FROM CATARACT TO CRISIS: EVALUATING LENS-INDUCED GLAUCOMA IN CLINICAL PRACTICE IN WESTERN GHATS OF INDIA

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ABSTRACT

To determine consequences of duration of symptoms at presentation with post operative visual acuity, IOP, optic disc health & RNFL thickness analysis in LIG patients along with clinical signs for early detection of lens induced glaucoma with help of gonioscopy. This was a longitudinal study case series of 45 patients with LIG who presented to our hospital between February 2024 to July 2024. The purpose of this study was to investigate the age and sex distribution, causes for delayed presentation, immediate post-operative visual outcome with IOP control and the reasons for poor visual outcome. The mean age of the study was 58 ±10 years. 57.8% patients presented after 2 weeks of onset of symptoms and the main reason for late presentation in more than half of the patients (52.5%) was lack of resources and knowledge. Average preoperative intraocular pressure was 40±9 mmHg. After the operation, 40 out of 45 eyes (88.9%) had an intraocular pressure (IOP) of 20 mm Hg or lower. At discharge, 24 of 45 operated eyes (53.3%) had BCVA of 6/12 or better with 6(13.4%) having BCVA less than 6/60. 77.8% patients had 1 or more quadrantal RNFL thinning and all of them presented after 7 days of onset of symptoms. 44.5% had open angles in all 4 quadrants and all belonged to phacolytic type of LIG. Gonioscopy on last follow-up revealed that 91.1% patients had no angle closure in any quadrant indicating that lens extraction subsequently reduces the chances of angle closure in all cases of lens induced glaucoma. Early intervention in LIG patients leads to a better visual prognosis as it causes the least optic disc damage as documented on gonioscopy & OCT-RNFL.

KEYWORDS: Lens Induced Glaucoma, Phacolytic Glaucoma, Phacomorphic Glaucoma, Phacotopic Glaucoma

Lens Induced Glaucoma (LIG), one of commonest cause of secondary glaucoma due to senile cataracts & mandates an early recognition and management to prevent blindness. Lens induced glaucoma (LIG) is common in India. Various forms of lens-induced glaucoma were categorized by their morphological and clinical characteristics. The purpose of this study was to analyze the different traits and manifestations of glaucoma, identify risk factors, and determine how they affect post-operative vision.

Three outstanding features of this group of patients are:

1. The abrupt development of glaucoma in an eye with mature cataract or Hypermature cataract.

2. The advanced age of the patient (above fifties).

3. Continual patient observation for healthy eyesight and regular pressure in the unaffected eye, even if it is aphakic or another condition.

Prognosis for good post-operative visual recovery in these conditions if diagnosed early and managed efficiently is still unsure as optic disc of affected eye cannot be visualized pre-operatively.

Clinical observation is confirmed by the fact that removing the cataractous lens, with or without acetazolamide, reduces eye congestion and results in a smooth recovery with fairly good vision if successive optic disc damage has not already set in.

MATERIALS AND METHODS

This longitudinal study included 45 cases of lens induced glaucoma in the out-patient department of Krishna Institue of Medical Sciences, Karad during the period October 2024 to March 2025 (6 months)

Inclusion criteria:

- All patients diagnosed with LIG
- Patients with written and informed consent for surgery and study

Exclusion criteria:

- Secondary glaucoma other than LIG
- Vision loss due to any other ocular pathology
- Patients who underwent a trabeculectomy with or without cataract surgery
- Patients with poor general condition making them unfit for surgery
- Patients on whom gonioscopy or OCT was not possible

At presentation, duration of onset of symptoms, visual acuity, IOP, inflammation including corneal

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changes were recorded, which were repeated after institution of medical line of treatment (Primary treatment). Post-operatively patients were followed up regularly at 2, 4 and 6 weeks (last follow-up) intervals and the same parameters were evaluated including optic disc changes, gonioscopy and RNFL analysis on last follow-up.

Evaluation of anterior chamber depth was evaluated using slit lamp bio-microscopy with IOP recording done by Goldman's applanation tonometry. Diagnosis of phacomorphic glaucoma was made when patients presented with symptoms of acute onset of pain, redness of involved eye, headache, IOP above 21 mmHg and slit lamp examination showing circumcorneal congestion, corneal edema, shallow anterior chamber (both centrally and peripherally), mid-dilated pupil with an intumescent lens. Diagnosis of phacolytic glaucoma was made in patients presenting with acute onset pain with long standing poor vision, raised IOP of above 21mmHg and slit lamp examination showing circumcorneal congestion, corneal edema, deep anterior chamber with flare/cells/floating lens particles in anterior chamber with hypermature cataract. Diagnosis of phacotopic glaucoma (Dislocated lens induced) was made in patients presenting with acute onset pain and sudden diminution vision in affected eye with raised IOP of above 21mmHg and slit lamp examination showing circumcorneal congestion, corneal edema, shallow anterior chamber with subluxation/dislocation of lens associated with iridodonesis or phacododonesis. Gonioscopy was done with Volk G-3 gonio lens in all patients and quadrantal closure was tabulated based on Schaffer's grading.

Pre-operative medical line of management: Initially, control of IOP was done with acetazolamide sustained release capsule 250 mg orally once a day with topical timolol (0.5%) 12 hourly. Pre-operatively, intravenous mannitol 20% was administered over 30 minutes in indicated cases. Topical Prednisolone (1%) was administered six times a day to patients with phacolytic glaucoma to minimize inflammation. Plain tropicamide (1%) was used to achieve mydriasis before surgery. After obtaining informed consent and explanation of relatively guarded prognosis for surgery, the patients (irrespective of the diagnosis of either phacomorphic or phacolytic glaucoma) were subjected to Small Incision Cataract Surgery (SICS) with standardized equipment which was same for all the surgeries performed. (In cases where IOL could not be implanted in the bag, IOL was inserted in the sulcus)

Post-operative medical line of management: All the patients were examined post operatively on 1st day and discharged on second post operative day. Topical medication comprising of a combination of gatifloxacin (0.3%) and prednisolone (1%) was started six times daily and tapered over six weeks. A cycloplegic- Homatropine 2% eyedrops and topical timolol (0.5%) were given if necessary. Patients with IOP>21mmHg after last follow-up were given topical timolol (0.5%) 12 hourly to control IOP. During the discharge, a complete ophthalmological examination was performed. Follow up was carried out in OPD at 2nd, 4th and 6th week from the day of discharge. At every visit, careful and detailed history with complete ophthalmological examination with gonioscopy was performed in every case. At 6 weeks (last follow-up) OCT-RNFL was done using Topcon OCT-1 3D software providing 4 quadrant thickness of RNFL.

RESULTS

All the patients were unilaterally affected either right (24) or left eye (30). We excluded 9 patients due to incomplete follow-up and data. In our study, phacolytic glaucoma was found to be more common 25(55.6%) than phacomorphic 13(29.6%) (Table 1). The mean age of the study was 58 ±10 years. There was a female preponderance (61.8%) compared to the male (38.2%) with female to male ratio of 1.6:1.

At presentation, 98% patients in the affected eye had best corrected visual acuity (BCVA) <6/60 (Table 3) As many as 57.8% of patients presented after 2 weeks and only 20% presented within a week of their symptoms (Table 1) When asked specifically 52.5% said lack of resources and knowledge as the reason for delay in presentation while other reasons being distance to the hospital, nobody to accompany and financial constraints. All the patients presented with pain and watering of eyes, photophobia and decreased visual acuity but few patients had vomiting (12%). All the cases had ciliary congestion and semi-dilated pupil. Most of the patients (95.4%) had corneal oedema and lens was cataractous (98%).

The initial IOP values at the time of examination varied between 21-58mm Hg, with an average preoperative intraocular pressure of 38±11 mmHg. 42.2% were found to have intraocular pressure exceeding 40 mmHg upon initial examination. After the operation, 40 out of 45 eyes (88.9%) had an intraocular pressure (IOP) of 21 mm Hg or lower upon release with no need for antiglaucoma medication. IOP was reduced dramatically to normal level (<21mmHg) in 89% patients in immediate post-operative period and the average IOP after completing follow up was 15.36 mmHg ± 0.577 and IOP changes were statistically significant ($P < 0.0043$) (Table 2).

At last follow-up, 39 of 45 operated eyes (86.6%) had 6/60 or better and 6(13.4%) had less than 6/60 with 53.3% patients having recovered their visual acuity more than 6/12 after cataract surgery. Leading causes of low vision in these cases were damage to optic disc recorded with help of OCT-RNFL. Best corrected visual acuity (BCVA) changes after cataract surgery were statistically significant (P<0.00001) (Table 3). All patients with BCVA <6/60 at last follow-up (13.4%) had presented >30 days after onset of symptoms. 68.6% patients who presented within 30 days had BCVA of >6/12 indicating that early presentation can lead to a better visual prognosis. Duration of symptoms had a linear relation with visual outcome.

At last follow-up, 23 cases (51.1%) had a normal optic disc, 14 cases (31.1%) had a Cup-Disc ratio (CDR) of 0.5-0.7 and 8 cases (17.8%) had severe glaucomatous disc damage with CDR >0.8. Correlation between severity of disc damage at presentation and height of IOP was not found to be statistically significant. Gonioscopy on presentation showed that 55.5% (26) patients had at least 1 quadrant angle closure. 20 patients (44.5%) had open angles in all 4 quadrants, and all belonged to phacolytic type of LIG. All cases of phacotopic glaucoma had angle closure in at least 3 quadrants on gonioscopy. Gonioscopy on last follow-up revealed that 91.1% patients had no angle closure in any quadrant. This indicates that lens extraction subsequently reduces the chances of angle closure in all cases of lens induced glaucoma. Of the total patients which presented with IOP >30mmHg, 61.3% (19) of them had closure of angle in more than 1 quadrant indicating that angle closure is a major contributor for raised IOP in lens induced glaucoma especially in phacomorphic and phacotopic glaucoma. Of the total 5 patients with last follow-up IOP >21mmHg 2 patients had angle closure in 2 quadrants while 2 patients had angle closure in 1 quadrant indicating that the raised IOP is because of closed angle of anterior chamber.

Of the total 24 cases with post-op BCVA >6/12, 10 (41.7%) cases had no RNFL thinning while 9(37.5%) cases had 1 quadrant defect and 5 (20.8%) cases had 2 quadrant RNFL thinning. Of 15 cases with post-op BCVA of 6/18 to 6/60, all patients had at least 1 quadrant RNFL thinning with 7 (46.7%) cases having more than 3 quadrant RNFL thinning. All cases 6 (100%) with last follow-up BCVA <6/60 had all 4 quadrant RNFL thinning indicating visual loss is because of optic nerve damage (Table 4). Quadrantal RNFL thinning was first seen in the inferior quadrant followed by superior and nasal quadrant which was in accordance with ISNT rule of optic disc damage.

Table 1: Distribution of cases according to duration of symptoms among lens induced glaucoma subgroups

Types of Lens induced glaucoma	Number of Patients	N (%)	Duration of symptoms (in days)			
			0-7	8-14	15-30	>30
Phacomorphic glaucoma	13	29.6	1	1	6	5
Phacolytic glaucoma	25	55.6	7	3	9	6
Phacotopic glaucoma	7	14.8	2	5	0	0
Total	45	100	10(22.2%)	9(20%)	15(33.3%)	11(24.5%)

Table 2: Distribution of cases according to IOP and duration of symptoms

Intraocular Tension (in mmHg)		Duration of symptoms (in days)				Total
		0-7	8-14	15-30	>30	
At presentation	21-30	8	3	3	0	14(31.1%)
	31-40	1	4	5	2	12(26.7%)
	>40	1	2	7	9	19(42.2%)
After primary treatment	0-20	10	9	10	6	35(77.8)
	21-30	0	0	4	5	9(20%)
	>30	0	0	1	0	1(2.2%)
At last follow-up (Post cataract surgery)	0-20	10	9	12	9	40(88.9%)
	>21	0	0	3	2	5(11.1%)

Table 3: Best Corrected Visual Acuity before and after intervention

Types of LIG	*BCVA at presentation			*BCVA on last follow-up		
	PL+ PR accurate in all quadrants	HMCF	≥6/60	<6/60	6/18 to 6/60	6/6 to 6/12
Phacomorphic	7	6	0	1	5	7
Phacolytic	5	20	0	4	8	13
Phacotopic	3	3	1	1	2	4
Total (Approx %)	15(33.3%)	29(64.5%)	1(2.2%)	6(13.4%)	15(33.3%)	24(53.3%)

*Best Corrected Visual Acuity

Table 4: Distribution of cases according to BCVA at last follow-up and RNFL thinning

*BCVA on last follow-up	#RNFL thinning on OCT at last follow-up					Total
	No defect	1 Quadrant	2 Quadrants	3 Quadrants	4 Quadrants	
6/6- 6/12	10	9	5	0	0	24(53.3%)
6/18- 6/60	0	2	6	3	4	15(33.3%)
<6/60	0	0	0	0	6	6(13.4%)
Total (Approx %)	10(22.2%)	11(24.5%)	11(24.5%)	3(6.6%)	10(22.2%)	45(100%)

*Best Corrected Visual Acuity #Retinal nerve fiber layer

DISCUSSION

According to my research, lens-induced glaucoma (LIG) primarily affects elderly people (mean age 58 ± 10 years), with a significant female preponderance. Numerous studies have observed similar demographic features. According to Kulkarni *et al.* (2023) and Jarwal P.N. (2019) the majority of patients who arrive with LIG are older, especially those who are older than 60. In line with your study, additional investigations by Singh *et al.* (2020) highlight the role that low awareness and socioeconomic constraints play in delayed presentation in this age range. Additionally, research on risk factor evaluation, as that done by Sreenivasulu and Prasad (2015) confirms that older patients who receive delayed medical care are more likely to suffer from severe optic nerve damage. Phacomorphic and phacolytic glaucoma are the two primary clinical manifestations that are seen while phacolytic glaucoma is more prevalent in my study. (Table 1) While Jarwal (2019) and Pandey *et al.* (2023) have described similar heterogeneity in LIG types, Kulkarni *et al.* (2023) noted a preponderance of phacolytic cases in their tertiary care analysis. They emphasize that an intumescent lens often predisposes to an acute angle-closure mechanism (phacomorphic), while phacolytic presentations are caused by leakage of lens protein in hypermature cataracts. These studies' comparable clinical range highlights the common pathogenic mechanisms underlying LIG in environments with low resources. The significant relationship between the duration of symptoms and the ultimate visual result is a crucial component of this study. Two weeks had passed since around 57.8% of the patients showed up, and the visual recovery was worse for those who did so later. There are several research that support this opinion. For instance, Cornelius *et al.* (2016) and Sastry *et al.* (2017) found that optic nerve injury and noticeably greater intraocular pressure (IOP) upon presentation were associated to treatment failures. Early presentation (within 7 days) was also associated with improved post-operative best-corrected visual acuity (BCVA), according to Pandey *et al.* (2023), highlighting the need of prompt surgical intervention in reducing permanent damage.

According to this study, most patients saw significant visual improvement and a dramatic drop in intraocular pressure (IOP), with the average post-operative IOP being about 15.36 mmHg, when small incision cataract surgery (SICS) was paired with proper pre- and post-operative treatment. (Table 2) This result is in line with the prospective analysis by Mangane and Vidyashri (2021) and the research by Anitha and Baliga (2017), which both demonstrate that early cataract extraction successfully reduces intraocular pressure and maintains or recovers vision. Similarly, Ushalatha *et al.* (2016) clinical study demonstrated that achieving inflammation control and IOP reduction prior to surgery

can result in positive results for LIG patients, even when severe cataracts are present.

This study's use of OCT-derived retinal nerve fiber layer (RNFL) analysis to record optic nerve damage served as a crucial diagnostic component. (Table 4) The significance of RNFL measurement in assessing structural damage in LIG has gained recognition, despite its primary usage in the early diagnosis of primary open-angle glaucoma. While Vazquez and Huang (2016) point out that even mild optic nerve abnormalities may be identified early by OCT, Laurenti and Salim (2016) explain how lens material leaking can indirectly cause RNFL thinning. Therefore, the predictive significance of advanced imaging in averting blindness is reinforced when RNFL analysis is incorporated into the follow-up protocol of LIG patients, as is done here. In addition to being a clinical problem, the delayed presentation identified also represents more general social and economic challenges. Limited financial resources, low health literacy, and insufficient access to eye care are major factors contributing to the decreasing prognosis in LIG, according to studies by Singh *et al.* (2020) and Anand *et al.* (2020). These results underline the critical need for better screening systems, patient education, and community engagement in order to guarantee appropriate cataract removal and to prevent further glaucoma.

CONCLUSION

The aim of the present study was to evaluate the effect of cataract leading to lens induced glaucoma and to find out the prognosis and visual outcome after medical and surgical management. The primary clinical manifestations of LIG are the triad of sudden decreased vision, ocular discomfort, and redness. We conclude that due to large number of cataract cases in our country, cases of lens induced glaucoma are quite prevalent. Cataract extraction is the cure in all cases of lens induced glaucoma with negligible residual complications so far as the control of intra-ocular pressure and restoration of visual acuity is concerned. In majority of failed cases, patients presented late, and optic disc damage had already set in which was confirmed with help of OCT-RNFL. Good visual acuity can be achieved in LIG patients presenting within 2 weeks of onset of symptoms with meticulous control of IOP and inflammation with pre-operative medications. Delay in presentation of more than 2 weeks and IOP>35mmHg reselts in damage to optic nerve which ultimately causes potentially blinding LIG's. This study further emphasizes how critical it is to inform the public about the risks of lens-induced glaucoma and the necessity of prompt cataract surgery. People in the community would therefore abandon the widely held notion that cataracts shouldn't be operated on until they are fully developed. When patients are being discharged from the first eye surgery, it is best to advise them about prompt surgery for the second eye.

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