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Original Article

Ophthalmology Section

Clinical Profile, Prognostic Factors and Surgical Outcomes in Lens Induced Glaucoma: A Prospective Study from a Tertiary Care Centre in Western Maharashtra, India

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ABSTRACT

Introduction: Cataracts are a major cause of preventable blindness in India. A considerable number of patients continue to present with advanced cataracts, which can result in complications such as Lens Induced Glaucoma (LIG). LIG is a secondary glaucoma that occurs due to mature or hypermature cataracts, potentially causing significant visual impairment.

Aim: To determine the clinical presentation, prognostic factors, and surgical outcomes in patients with LIG.

Materials and Methods: A prospective study involving 60 patients with LIG was conducted at a tertiary care centre in Western Maharashtra, India from September 2022 to June 2024. All patients underwent Small Incision Cataract Surgery (SICS) and were followed-up postoperatively on day 1, day 7, and week 6.

Results: The mean age of the patients was 69.03 years, with 66.7% being females. Symptoms such as pain, redness, headache and diminished vision were present in all patients. The mean duration of symptoms was 4.08 days. All patients presented with poor visual acuity (<6/60), and the majority had shallow Anterior Chamber (AC) depth (83.3%). The highest number of cases exhibited elevated Intraocular Pressure (IOP), with a range of 41-50 mmHg. Postoperative visual outcomes improved significantly by week 6 in 51.7% of patients.

Conclusion: Early diagnosis and management of cataracts are crucial in preventing LIG and improving visual outcomes. Community outreach programs for early detection and management are essential in a developing country like India.

Keywords: Cataract, Intraocular pressure, Phacolytic, Phacomorphic, Visual acuity

INTRODUCTION

Cataract, a clouding of the eye's natural lens, is the leading cause of blindness worldwide, particularly in low- and middle-income countries. In India, cataracts account for 63.7% of all blindness cases, with an estimated 20 million people being affected, many of whom are over 50 years old [1]. Despite the availability of effective surgical treatments, cataracts remain a significant public health concern, especially in rural areas where access to eye care services is limited [2]. One severe complication of untreated cataracts is LIG, a secondary glaucoma characterised by elevated IOP resulting from lens pathology [3]. LIG is classified into two major types: Phacomorphic glaucoma, caused by a swollen cataractous lens leading to secondary angle-closure, and Phacolytic glaucoma, caused by the leakage of lens proteins through an intact but hypermature cataract, leading to secondary open-angle glaucoma [4].

LIG is relatively rare in developed countries due to the widespread availability of cataract surgery. However, it remains prevalent in regions with limited healthcare resources, such as India, where delayed presentation, poor health-seeking behaviour, and lack of awareness contribute to the burden of disease. The condition predominantly affects elderly individuals, who often present late due to factors such as illiteracy, lack of awareness, socio-economic constraints, and limited access to medical facilities [5]. In rural areas, cultural factors may further delay seeking medical attention, as patients often rely on home remedies or wait for symptoms to become severe before consulting a healthcare professional. The pathophysiology of LIG is complex, involving multiple mechanisms that contribute to increased IOP. Phacomorphic glaucoma occurs due to the anterior displacement of the lens-iris diaphragm, resulting in a pupillary block and shallow AC. This condition may develop rapidly as the cataract progresses to a mature or hypermature state, causing the lens to swell and narrow the AC angle [6]. In contrast, phacolytic glaucoma is caused by the leakage of high-molecular-weight lens proteins into the AC, which obstructs the trabecular meshwork and impairs aqueous humour outflow [6]. Both conditions, if not diagnosed and managed promptly, can lead to irreversible optic nerve damage and permanent vision loss [7].

Previous studies have highlighted the challenges in managing LIG, particularly in low-resource settings where patients often present with advanced disease [8]. In a study by Pradhan D et al., the majority of LIG cases were found to be phacomorphic glaucoma, with a significant proportion of patients presenting with extremely high IOP and corneal oedema [9]. Similarly, Kulkarni VM et al., reported that delayed presentation was a major factor contributing to poor visual outcomes in LIG, as patients often wait until they experience severe pain or loss of vision before seeking treatment [10]. Despite these challenges, early intervention, including cataract extraction and IOP management, has been shown to significantly improve visual outcomes and reduce the risk of permanent blindness.

Cataract surgery, particularly SICS, has proven to be a cost-effective and highly effective intervention for managing LIG. Studies by Ayub R et al., and Chandrashekharan S et al., have demonstrated that SICS offers excellent postoperative outcomes with minimal complications, even in patients with advanced LIG [11,12]. However, the success of this approach largely depends on early diagnosis and timely surgical intervention. Given the high prevalence of LIG in rural and underserved populations, there is a critical need for community outreach programs and public health initiatives that promote early detection and management of cataracts to prevent complications such as LIG.

Despite the availability of cataract surgery, LIG remains a significant cause of ocular morbidity and vision loss in India, primarily due to late presentation and inadequate access to eye care services. There is also a lack of awareness regarding the importance of regular eye

check-ups and timely cataract surgery, particularly among the elderly and rural populations [5]. The National Programme for Control of Blindness (NPCB) and other initiatives have made significant strides in increasing the availability of cataract surgery. However, more efforts are needed to address the gaps in awareness, accessibility, and affordability of eye care services [13].

The present study aimed to evaluate the clinical profile, prognostic factors, and surgical outcomes in patients with LIG at a tertiary care centre in Western Maharashtra, India. By understanding the clinical characteristics and outcomes associated with LIG, this study seeks to provide insights into optimising management strategies and improving patient outcomes in low-resource settings. Additionally, it emphasises the need for public health interventions to enhance awareness and access to timely eye care, ultimately reducing the burden of blindness due to LIG [14].

MATERIALS AND METHODS

A prospective interventional study was conducted at a tertiary care centre in Western Maharashtra, India from September 2022 to June 2024, involving 60 patients diagnosed with LIG. The study received ethical clearance from the Institutional Ethics Committee (Approval Number: IESC/PGS/2022/110) on September 28, 2022. Informed consent was obtained from all participants after explaining the study aims, procedures, potential risks, and benefits in their native language. All patients attended the outpatient department and were admitted for surgical management.

Inclusion criteria: All cases of LIG were included in the study.

Exclusion criteria: Primary open or closed-angle glaucoma, secondary glaucomas (such as those due to trauma, intraocular inflammation, neovascular glaucoma, pseudo-exfoliation syndrome), corneal dystrophies, degeneration with cataract, and non compliant patients were excluded from the study.

Study Procedure

A detailed history was taken for all patients, including age, sex, and co-morbidities. Clinical features included pain, redness, headache, and diminution of vision. Patients were grouped based on the duration of symptoms: 'early' (those who presented within five days of onset of symptoms) and 'late' (those who presented after five days). The reasons for delayed presentation were categorised as distance to the hospital, lack of an escort, good vision in the fellow eye, fear of surgery, poor health education, and acceptance of poor vision as a natural part of aging. Socio-economic status was classified as either urban or rural. A comprehensive preoperative evaluation was conducted for both the study eye and the fellow eye. This evaluation included assessing visual acuity using a Snellen chart and performing refraction to determine the Best-Corrected Visual Acuity (BCVA) for the fellow eye. Visual acuity of less than 6/60 was categorised as poor vision. Anterior segment examination was performed using slit-lamp biomicroscopy to check for the presence or absence of lid oedema and conjunctival congestion. The cornea was examined for microcystic epithelial oedema, macrocystic bullae, and stromal oedema. AC depth was classified as normal or shallow based on Van Herick grading [Table/Fig-1] [15], and AC reaction was graded according to the Standardisation of Uveitis Nomenclature (SUN) classification [Table/Fig-2] [16]. The lens status was assessed as mature or hypermature.

Posterior segment evaluation was conducted using direct and indirect ophthalmoscopy. The condition of the optic disc, including its size, shape, colour, margins, blood vessels, and cup-to-disc ratio, was noted. A B-scan was performed on all study eyes. IOP was measured using a non contact applanation tonometer. Phacomorphic glaucoma was diagnosed based on the presence of acute pain, corneal oedema, conjunctival congestion, a fixed dilated pupil, and an intumescent cataract with a shallow AC. Phacolytic glaucoma was diagnosed in cases presenting with pain, corneal oedema (with or without AC flare), normal AC depth, and floating lens particles in the AC.

Width of the empty space (LACD) as compared to the corneal thickness	van Herick grade	Angle status
No black space observed	0	Closed
<1/4 corneal thickness	1	Extremely narrow
1/4 of corneal thickness	2	Narrow
>1/4 to 1/2 of corneal thickness	3	Open
≥1 of corneal thickness	4	Wide open

[Table/Fig-1]: Van Herick grading [15].
LACD: Limbal anterior chamber depth

Grade	Number of cells (High-intensity 1×1-mm slit beam)	Flare
0	<1	None
0.5+	1-5	Not applicable
1+	6-15	Faint
2+	16-25	Moderate (clear iris details)
3+	26-50	Marked (hazy iris details)
4+	>50	Intense (fibrin or plasmoid aqueous)

[Table/Fig-2]: Standardisation of Uveitis Nomenclature (SUN) [16].

All patients were treated preoperatively with oral carbonic anhydrase inhibitors, topical beta-blockers, and intravenous mannitol (20% solution at 1 g/kg body weight over 30-40 minutes) to reduce IOP. The patients were informed about the guarded visual prognosis, and informed consent was obtained. Surgery was performed after conducting the necessary basic investigations for fitness and achieving control of LIG through medical management. Manual SICS was performed on all patients under local anaesthesia using a peribulbar block. An IOL was implanted in the capsular bag. In complicated cases, such as those with Posterior Capsular Rupture (PCR) or zonular dialysis, an iris claw lens was implanted. Postoperative examinations were conducted on day 1, day 7, and at week 6. During each follow-up, visual acuity was evaluated by checking vision with a pinhole on postoperative day 1 and day 7, while BCVA was measured at the 6th week follow-up. Slit-lamp examinations were performed to assess the presence of corneal oedema and AC reaction, with AC reaction grading done according to the Standardisation of SUN classification.

STATISTICAL ANALYSIS

All collected data were tabulated in a Microsoft Excel spreadsheet and analysed using Statistical Package for the Social Sciences (SPSS) software version 26.0. Quantitative data were summarised using mean (SD) or median (IQR), while qualitative data were presented as proportions. Statistical tests were applied as appropriate to determine the significance of the findings.

RESULTS

A total of 60 patients with LIG were included in the study, mean age of the patients was 69.03±3.79 years, with a median age of 69 years (IQR: 66.72). Most patients were female (66.7%), while 33.3% were male. [Table/Fig-3] shows the prevalence of hypertension and diabetes mellitus among the patients.

Parameters	n (%)
Prevalence of hypertension	
Present	31 (51.7)
Absent	29 (48.3)
Prevalence of diabetes mellitus	
Present	29 (48.3)
Absent	31 (51.7)

[Table/Fig-3]: Prevalence of hypertension and diabetes mellitus among the LIG patients.

The majority of patients were from rural areas (70%), while 30% were from urban areas. All patients presented with symptoms such as diminished vision, redness, watering, eye pain, and headache (100%). The mean duration of the symptoms was 4.08±2.28 days, with a median of 4.00 days and an Interquartile Range (IQR) of 3 to 4 days. The majority of the patients, 46 (76.7%), presented early (<5 days), while 14 (23.3) presented late (>5 days).

Ocular examination findings: Visual acuity was poor (<6/60) among all patients. Lid oedema and conjunctival congestion were observed in all cases. The corneal examination revealed microcystic epithelial oedema in 95% of patients, and microcystic epithelial oedema with macrocystic bullae in 5%. The AC depth was shallow in 50 (83.3%) of patients, as assessed by Van Herick grading, while 10 (16.7%) had a normal depth. Regarding lens status, 52 (86.7%) cases had mature cataracts, and 8 (13.3%) had hypermature cataracts. Most patients, 47 (78.3%), had an IOP of 41-50 mmHg, while 13 (21.7%) had an IOP of 31-40 mmHg. Phacomorphic glaucoma was diagnosed in 50 (83.3%) of cases, while phacolytic glaucoma was diagnosed in 10 (16.7%). Manual SICS with Posterior Chamber Intraocular Lens (PCIOL) implantation was performed in 51 (85%) cases. In 9 (15%) of complicated cases (e.g., those with PCR or zonular dialysis), an iris claw lens was implanted. Out of the 60 patients, 11 experienced intraoperative complications: nine had PCR, and two had zonular dialysis.

Postoperative outcomes: On postoperative day 1, 90% of patients had poor vision (<6/60), while 10% had moderate vision (6/18-6/60). By day 7, 26.7% had good vision (6/6-6/12), and 73.3% had moderate vision. At six weeks, 51.7% of patients achieved good vision (6/6-6/12), while 48.3% had moderate vision [Table/Fig-4].

Visual acuity	n (%)
Postoperative day 1	
6/6-6/12 (Good)	0
6/18-6/60 (Moderate)	6 (10)
<6/60 (Poor)	54 (90)
Postoperative day 7	
6/6-6/12 (Good)	16 (26.7)
6/18-6/60 (Moderate)	44 (73.3)
<6/60 (Poor)	0
Postoperative week 6	
6/6-6/12 (Good)	31 (51.7)
6/18-6/60 (Moderate)	29 (48.3)
<6/60 (Poor)	0

[Table/Fig-4]: Visual acuity on postoperative day 1, 7 and week 6.

On day 1, microcystic epithelial oedema was present in all patients. By day 7, the cornea was clear in 65% of patients, while 35% showed microcystic epithelial oedema. By the 6th week, the cornea was clear in all patients. The AC reaction, graded according to the SUN classification, on day 1, 1.7% of patients had grade 1+ AC reaction, 63.3% had grade 2+ AC reaction, and 35% had grade 3+ AC reaction. However, by day 7, 91.7% of patients showed no reaction, while 8.3% exhibited mild to moderate reactions [Table/Fig-5]. The AC was quiet by the 6th week postoperatively.

The mean IOP decreased from 21.15 mmHg on Day 1 to 18.9 mmHg by Day 7, and further to 17.7 mmHg by the 6th week [Table/Fig-6].

There was no statistically significant association between the duration of symptoms (early vs. late presentation) and visual outcomes at Day 7 (p-value=0.059) or at Week 6 (p-value=0.640) [Table/Fig-7].

AC reaction (SUN's classification)	n (%)
Postoperative day 1	
Grade 1+	1 (1.7)
Grade 2+	28 (63.3)
Grade 3+	21 (35)
Postoperative day 7	
None	55 (91.7)
Grade 1+	3 (5)
Grade 2+	2 (3.3)

[Table/Fig-5]: AC reaction on postoperative day 1 and 7.

Postoperative day	Mean±SD	Median	IQR
Day 1 IOP	21.15±2.01	20.00	20-22
Day 7 IOP	18.90±2.00	18.00	18-20
At 6th week IOP	17.70±1.60	18.00	16-18

[Table/Fig-6]: IOP on postoperative day 1, 7 and at 6th week.

Duration of symptoms	Good n (%)	Moderate n (%)	p-value
Visual acuity at postoperative day 7			
Early (<5 days)	15 (32.6)	31 (67.4)	0.059
Late (>5 days)	1 (7.1)	13 (92.9)	
Total	16 (26.7)	44 (73.3)	
Visual acuity at postoperative 6th week			
Early (<5 days)	23 (50)	23 (50)	0.640
Late (>5 days)	8 (57.1)	6 (42.9)	
Total	31 (51.7)	29 (48.3)	

[Table/Fig-7]: Table showing visual acuity in relation to duration of symptoms.

DISCUSSION

This study aimed to evaluate the clinical profile, prognostic factors, and surgical outcomes of patients with LIG at a tertiary care centre in Western Maharashtra, India. Present findings indicate that LIG remains a significant cause of ocular morbidity, particularly among elderly and rural populations, primarily due to delayed presentation and limited access to timely eye care services. The mean age of patients in this study was 69.03 years, with a predominance of females (66.7%). These demographic findings align with those reported by Pradhan D et al., who found that LIG was more frequent in females, potentially due to socio-economic and cultural factors that delay their access to healthcare services [9]. The higher prevalence of LIG among elderly patients reflects the natural progression of cataracts in this age group, as untreated cataracts continue to mature, leading to complications such as LIG. Similar age distributions were observed in studies by Kulkarni VM et al., and Rijal AP and Karki DB, emphasising that the risk of LIG increases with age due to poor cataract management practices, particularly in rural areas where eye care services are less accessible [10,17].

Present study identified phacomorphic glaucoma as the most common type of LIG (83.3%), followed by phacolytic glaucoma (16.7%). These findings are consistent with those reported by Kulkarni VM et al., who also found a higher prevalence of phacomorphic glaucoma in their study [10]. However, the proportion of phacomorphic glaucoma cases in present study was higher than that reported by Pradhan D et al., who found 72% of cases to be phacomorphic and 28% phacolytic [9]. This discrepancy could be attributed to differences in the demographic characteristics of the study populations and variations in health-seeking behaviour between regions. The predominance of phacomorphic glaucoma in present study may also suggest that patients in present setting tend to present with more advanced disease, likely due to delayed diagnosis and treatment.

Present study demonstrated a significant improvement in visual outcomes following surgical management, with 51.7% of patients achieving good vision (6/6-6/12) by the sixth week postoperatively. This was comparable to the outcomes reported by Kumar VS et al., where 38% of patients had a BCVA of 6/9, and 28% had 6/12 vision

after six weeks [18]. The improvement in visual acuity in present study underscores the effectiveness of early surgical intervention in managing LIG. However, it also highlights the importance of reducing delays in presentation, as prolonged IOP elevation can lead to irreversible optic nerve damage, reducing the chances of visual recovery [17].

Present findings showed that 90% of patients had poor vision (<6/60) on postoperative day 1, with 63.3% of patients presenting with grade 2+ AC reaction according to the SUN classification [16], and 35% with grade 3+ AC reaction. These results were consistent with previous studies that also observed a high prevalence of AC inflammation and poor vision immediately after surgery in cases of LIG [19,20]. The presence of microcystic epithelial oedema in all patients on day 1 further supports the finding that LIG can cause significant intraocular inflammation and corneal oedema, which can temporarily affect postoperative visual outcomes.

By day 7, there was substantial improvement, with 65% of patients showing a clear cornea and 91.7% having no AC reaction. This rapid resolution of inflammation suggests that the surgical management of LIG, particularly using manual SICS, effectively mitigates the acute inflammatory response and stabilises the anterior segment. Previous studies, including those by Chandrashekharan S et al., and Venkatesh R et al., have similarly reported favourable outcomes with SICS in patients with LIG, highlighting its safety and efficacy in resource-limited settings [12,19,21].

Interestingly, present study found no statistically significant association between the duration of symptom presentation (early vs. late) and visual outcomes at day 7 (p-value=0.059) and at Week 6 (p-value=0.640). This differs from findings by Pandey AN et al., who noted a higher chance of delayed visual recovery in patients with late presentation [22]. The lack of a significant association in present study may be due to the relatively small sample size or the specific characteristics of the population. It may also suggest that, even in cases of delayed presentation, appropriate surgical intervention can lead to comparable visual outcomes, as long as optic nerve damage has not progressed irreversibly.

The intraoperative complications observed in present study were relatively low, with 11 patients (18.3%) experiencing complications, including PCR in nine cases and zonular dialysis in two cases. These rates are comparable to those reported in the study by Trikha S et al., who found that the overall incidence of zonular dialysis during cataract surgery was low (0.50%) among 22,312 consecutive eyes, with a small proportion experiencing complications such as PCR and zonular dialysis [23]. The low complication rates in present study may be attributed to the proficiency of the surgical team and the use of standardised surgical protocols, such as SICS, which have been shown to minimise complications in complex cases of LIG.

Present study underscores the importance of early diagnosis and management of cataracts to prevent complications like LIG, which can lead to significant vision loss if not treated promptly. The results demonstrate that timely surgical intervention, even in cases presenting with advanced LIG, can result in favourable visual outcomes. This highlights the critical role of community outreach programs and public health initiatives in promoting early detection and management of cataracts, particularly in rural and underserved populations. Health education campaigns should be tailoured to raise awareness about the importance of regular eye check-ups, especially for elderly individuals who are at a higher risk of developing cataracts and subsequent complications like LIG.

The strengths of present study include its prospective design and comprehensive evaluation of patients with LIG, which provide valuable insights into the clinical characteristics and outcomes associated with this condition in a resource-limited setting. Additionally, the use of standardised surgical techniques and postoperative assessments allows for reliable comparisons with other studies.

Further research should explore strategies to enhance early detection and timely intervention for cataracts, particularly in rural and underserved communities where the burden of LIG is highest. Additionally, studies evaluating the cost-effectiveness of various surgical approaches in different settings would help optimise resource allocation for cataract management in low- and middle-income countries. Investigating novel techniques to reduce intraoperative complications and improve postoperative recovery rates in LIG patients may also contribute to better clinical outcomes.

Limitation(s)

The relatively small sample size may limit the generalisability of present study findings. Moreover, the study's follow-up period was limited to six weeks, which may not capture long-term visual outcomes and potential late-onset complications. Future studies with larger sample sizes and longer follow-up durations are needed to confirm our findings and assess the sustainability of visual recovery following the surgical management of LIG.

CONCLUSION(S)

LIG is a preventable complication of untreated cataracts that can lead to significant vision loss. Early diagnosis and surgical management are crucial for improving visual outcomes and reducing IOP. Public health initiatives, including community outreach programs, are essential for promoting early cataract detection and management, particularly in rural and underserved populations in India.

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