ORIGINAL RESEARCH

Analysis of the factors affecting the post-operative outcome in patients of lens induced glaucoma

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ABSTRACT

Aim and Objectives:

- To evaluate the factor which affect the outcome after surgical management in patient with lens induce glaucoma.
- To study the prevalence of Lens induced glaucoma in eastern Utter Pradesh
- The clinical factors affecting the final outcome of lens include glaucoma patients in respect to type of glaucoma, duration of glaucoma, visual outcome, IOP and corneal clarity.

Material and Methods: 100 patients will be included in the study. All patients with lens induced glaucoma visiting tertiary eye care centre in regional institute of Ophthalmology, Sitapur irrespective of age and sex. A detailed history and a through Ocular examination was done. Patient recruited to the study was operated under local anesthesia after Peri-bulbar block for total lid and globe akinesia, Sics/phacoemulsification with or without IOL implantation with or without trabeculectomy. **Results:** The patients including the demographic and personal relevant details were collected. The chief complaints including ocular pain, headache, blurred vision, perception of coloured halos, nausea and vomiting were recorded. The slit lamp examination was carried out in glaucoma patients and sign of circumcilliary congestion, corneal oedema, shallow anterior chamber according measured by goldmann applanation tonometry, gonioscopy will be done. Fundus evaluation via direct ophthalmoscope and indirect ophthalmoscopy with 90 D/78D lenses. The sample size was calculated based on a previous study that reported that the prevalence of lens induced glaucoma was 7%, 95% level of confidence and Error rate, usually set at 0.05 level is 4. The Intra ocular pressure (IOP) was less than 40 mmHg in most of the patients. The maximum patients have more than 10 mmHg (53.63%) IOP at day 1. Moreover, the IOP was significantly reduced from day 1 to 6 week post-operatively in lens induced glaucoma. **Conclusion:** The females seemed to have an increased risk (female/male ratio 2.03:1) of having Lens-Induced Glaucoma as compared to males.

Key words: Lens, IOP, glaucoma, ophthalmoscopy, trabeculectomy and phacoemulsification

INTRODUCTION

Recently, the cataract and glaucoma rank first and second in terms of causes of blindness. It is not unexpected that these two illnesses co-occur in many people, despite the fact that they are typically not severe enough to result in blindness. One of the most prevalent causes of blindness and visual impairment in India is cataract. The human crystalline lens is a unique transparent, biconvex intraocular structure, which lies in the anterior segment of the eye between the iris and vitreous body are suspended radially at its equator by zonular fibres to the ciliary body, it lies in the patellar fossa and enclosed in capsular bag [1].

In India, 62.6% blindness is due to cataract [2]. Lens-induced glaucoma (LIG) is common in India [3]. It is a common condition seen in patients with senile cataracts and is one of the commonest cause of secondary glaucoma, requiring an immediate attention and management to prevent blindness. These are heterogeneous group of disorders which develop through either open-angle or angle-closure mechanisms [4]. Phacolytic glaucoma (PLG) and lens particle glaucoma are types of secondary open-angle glaucomas. The angle of anterior chamber is open with blockage of the trabecular meshwork by lens proteins. Phacomorphic glaucoma (PMG) and lens displacement glaucoma are types of secondary angle-closure glaucomas. Phacoanaphylactic uveitis, now termed as lens-induced uveitis, is not truly an anaphylactic reaction but is a granulomatous reaction that can cause open-angle or angle-closure glaucoma or combined open-angle and angle-closure glaucoma [5]. Cataract occurs when the crystalline lens loses its transparency normally as a part of the ageing process.

Neglected cataract lens may swell because of the osmotic effect of the degenerated lens proteins [6].

Lens-related elevation in intraocular pressure (IOP) results from a variety of mechanisms such as lens dislocation, lens swelling (intumescent cataract), inflammation due to phacoanaphylaxis and lens particle blocking the trabecular meshwork. Untreated increase in IOP damages the optic nerve mechanically, which inevitably leads to blindness. Elevation in IOP causes compression and backward bowing of lamina cribrosa, leading to obstruction of axoplasmic transport of retinal nerve fibre and ganglion cell death [7].Lens-induced glaucoma (LIG) was first described in the year 1900 by Gifford and von Reussin dependent of each other[8, 9].Lens induced glaucoma is not a single entity but a group of disorders characterized by a secondary glaucoma with acute rise of intraocular pressure (IOP) and a hypermature or rarely an immature senile cataract in one eye and normal IOP in the other eye, with a prompt relief of symptoms after cataract extraction in the affected eye [10-12].

Lens induced glaucoma one of the commonest cause of secondary glaucoma due to senile cortical cataract, it become mandatory to recognise and managed it at it the earliest to prevent blindness. LIG is most common in India and in other developing countries due to delay in cataract removal. Lens induce glaucoma, in general may be secondary angle closure (phacomorphic) or secondary open angle (phacolytic)[12]. In India, a study has shown a prevalence of 3.91% phacomorphic glaucoma cases per operated cases for cataract surgery[1].

In phacomorphic glaucoma, the swollen lens may block the anterior flow of the aqueous humour from the posterior chamber pushing the iris forward. Eventually, the trabecular meshwork gets blocked by the iris and leads to a sudden and extreme rise in IOP. Phacolytic glaucoma is a principal complication of hypermature cataract. Hypermature cataract may cause leakage of lens protein from an intact capsule. The lens protein causes intense inflammation and blockage of trabecular meshwork, subsequently responsible for elevation of IOP [13].

Phacoanaphylactic glaucoma is diagnosed by the manifestation of the ruptured capsule flare in AC and increased IOP. Lens induced glaucoma requires an immediate attention and management to prevent blindness because it is common in India [14].

Extensive search into the literature shows that there is much better visual outcome if patients of LIG are operated on time, otherwise the prognosis stands guarded due to increase in preoperative duration of IOP rise ultimately resulting in glaucomatous optic atrophy [15].

Glaucoma is defined as an optic neuropathy involving a characteristic atrophy of the optic nerve head, often accompanied with typical visual field defects [16]. Examination of a glaucomatous optic nerve reveals “cupping”, which looks like a “hollowing out” of the optic nerve head. Glaucoma is often, though not always, associated with increased intraocular pressure (IOP), as shown in figure 1.

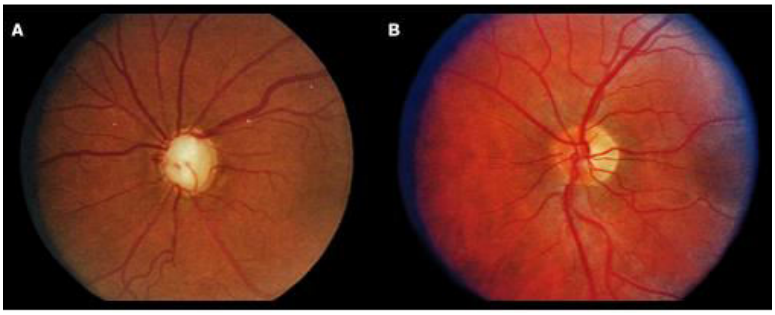

Fig 1: Lens induced glaucoma

It is a diverse group of disorders characterized by a progressive optic neuropathy with visual field loss and characteristic structural changes, including thinning of the retinal nerve fiber layer and excavation of the optic nerve head, and in which IOP is a key modifiable factor.

Intraocular pressure elevation with uveitis may occur subsequent to release of lens material into the AC through a surgically or traumatically created opening in the lens capsule[17]. Because this can occur years after an incomplete extra-capsular cataract extraction, at a time when soluble lens protein has presumably been absorbed, it has been inferred that insoluble lens particles are responsible for outflow obstruction in this entity. The observation that the irrigation of the anterior chamber to remove lens particles helps control the glaucoma adds support to this theory. A cellular role in outflow obstruction is suggested by the report of bloated macrophages in the aqueous humour of a patient who developed this syndrome 67 years after incomplete extra-capsular cataract extraction. In cases in which relatively small amounts of lens material are involved, medical therapy with topical corticosteroids, topical ß-blockers and systemic carbonic anhydrase inhibitors may stabilize the eye long enough for absorption of the lens material to occur. However, if the amount of dispersed lens substance is great (e.g., recent perforating injury to the lens) or the pressure elevation and inflammation are severe or protracted, surgical removal of lens material

by either irrigation/aspiration or extraction, is indicated.

Increasing lens thickness due to growth of the lens cortex is a well-recognized factor in the development of primary angle closure glaucoma. Other factors, such as short axial length of the globe, pre-existing individual differences in anatomy of the anterior chamber angle (ACA) and zonular relaxation may also contribute to variable extents. When angle-closure glaucoma develops due to an intumescence of the lens that can be distinguished from normal lens growth, the term phacomorphic glaucoma is applied[17,18]. Among the more readily identifiable situations in which angle closure may be attributable to lens swelling are rapidly developing mature cataracts and cataracts caused by trauma or inflammation. The diagnosis of phacomorphic glaucoma should be entertained when unilateral or asymmetrical cataract is associated with shallowing of the ACA not explained by other factors (e.g., miotic therapy, lens subluxation, or uveal effusion). In some cases, the differentiation of phacomorphic glaucoma from primary angle-closure glaucoma may be less clear-cut. Fortunately, both conditions respond to iridectomy (unless extensive peripheral anterior synechiae exist), indicating a common mechanism of pupillary block. The very rare development of phacomorphic glaucoma despite a patent iridectomy suggests that in extreme cases of lens enlargement in very small eyes, the peripheral iris may be directly pushed against the trabecular meshwork without pupillary block[19].

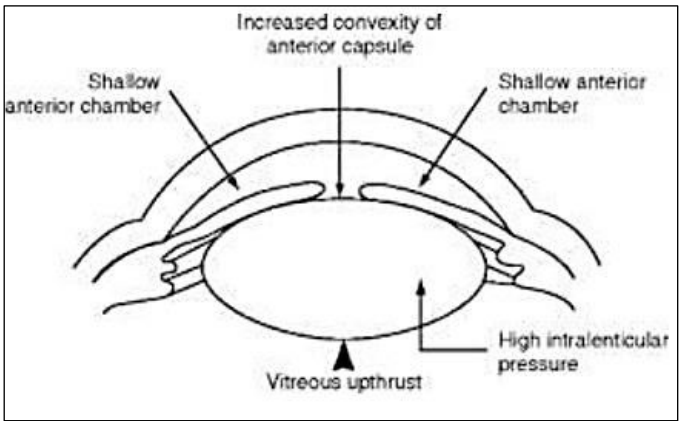

Fig 2: Pathogenesis of phacomorphic glaucoma

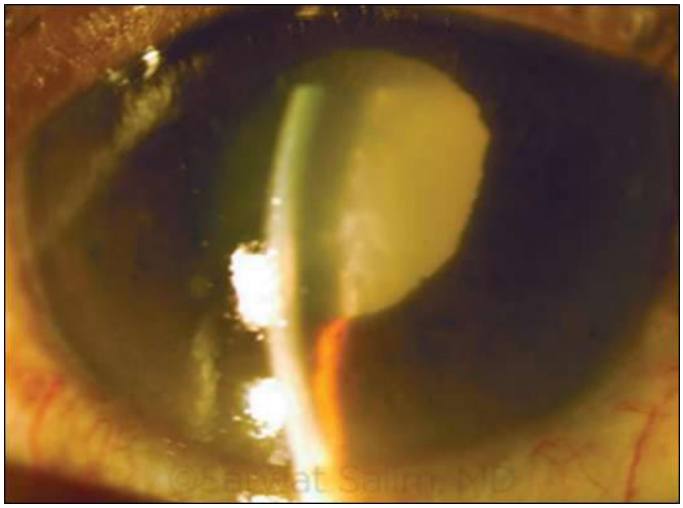

Fig 3: Phacomorphic glaucoma

The definitive treatment of phacomorphic glaucoma in eyes with the potential for visual improvement is cataract surgery. Just as angle closure can result from crowding of the ACA by an enlarged lens, a similar process can occur with an average-sized lens in an extraordinarily small (nanophthalmic) eye.

MATERIAL AND METHODS

Study was done on all patients with lens induced glaucoma visiting tertiary eye care centre in Regional institute of Ophthalmology, Sitapur irrespective of age and sex after getting ethical approval from institutional Review Board. Informed written consent was taken in each case regarding the purpose of the study and also for publication of data thereafter confirming to Helisinki declaration.

STUDY DURATION
The study was conducted for the duration of 1year from Feb. 2021 to Jan. 2022.

SAMPLE SIZE (N)
The sample size was calculated based on a previous study that reported that the prevalence of lens induced glaucoma was 7%, 95% level of confidence and Error rate, usually set at 0.05 level is 4. Total 100 patients will be included in this study.

$$n=Z^2 P(1-P)/d^2$$

Where,

- n = sample size,
- Z = Z statistic for a level of confidence, for the level of confidence of 95%, which is conventional, Z value is 1.96.
- P = expected prevalence or proportion (in proportion of one; if 7%, P = 0.07),
- d = precision (in proportion of one; if 5%, d = 0.05).

$$n=1.96x1.96x0.07x0.93/0.05^2$$
$$n=100.04$$

Total 100 Patients Were Enrolled In the Study on the Basis of Well Define Inclusion and Exclusion Criteria.

INCLUSION CRITERIA

- All patient who will be operated for lens induced glaucoma.
- Patient willing to sign the consent form and comply with the post-operative follow up schedule.
- All patient of lens induced glaucoma who will be subjected to sics/phaco with or without PCIOL implantation with or without trabeculectomy.

EXCLUSION CRITERIA

- Patient having other co morbid condition associated with poor visual outcome.

PREOPERATIVE EVALUATION
Pre-operative work up of the patients including the demographic and personal relevant details were collected. The chief complaints including ocular pain, headache, blurred vision, perception of coloured halos, nausea and vomiting were recorded. The slit lamp examination was carried out in glaucoma patients and sign of circumcilliary congestion, corneal oedema, shallow anterior chamber according measured by goldmann applanation tonometry, gonioscopy will be done. Fundus evaluation via direct ophthalmoscope and indirect ophthalmoscopy with 90 D/78D lenses. The Keratometry of effected eye and fellow eye was done. The B-scan was done when media is not clear.

SURGICAL PROCEDURE

- Patient were divided into two groups first group will include less than two week of symptoms , second group will include patients with more than two weeks of symptoms.
- Patient recruited to the study was operated under local anaesthesia after peri-bulbar block for total lid and globe akinesia.
- sics/phacoemulsification with or without IOL implantation [foldable or non-foldable] with or without trabeculectomy.

POST-OPERATIVE EVALUATION
The patients were subjected to routine follow up at post-operative day 1,1 week, 2 weeks and 6 weeks.The factors that were assessed post operatively are

- Visual outcome
- Intraocular Pressure
- Corneal clarity
- Duration of post-operative hyperaemia and also asses the correlation between final visual outcome preoperatively and postoperatively along with type of glaucoma, duration of glaucoma and IOP.

STATISTICAL ANALYSIS
SPSS version 21.0 was used for statistical analysis. Data was presented as mean (standard deviation) and percentage (%). The Chi-square test was used to compare the categorical variables and independent t test was used to compare discrete variables between groups. The p value 0.05 was considered significant.

Results and Discussion
Table 1 and Figure 4 show the distribution of patients according to age group (years). The percentage of 41-50, 51-60, 61-70 and >70 years age group were 15.00%, 31.00%, 38.00%, and 15.00%, respectively. The mean age was 61.43±9.45 years.

Table 1: Distribution of patients according to age group (years)

Age group (years)	n	%
41-50	15	15.00
51-60	31	31.00
61-70	38	38.00
>70	16	15.00
Mean±SD	61.43±9.45	

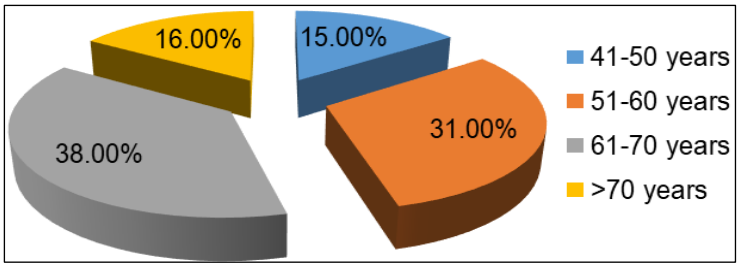

Fig 4: The distribution of patients according to age group (years)

Table 2 and Figure 5 show the distribution of patients according to types of glaucoma. The percentage of Lens-Induced Glaucoma LIG, Phacomorphic glaucoma, Phacolytic glaucoma, Lens particle glaucoma and Phacoantigenic glaucoma were 7.0%, 67.0%, 26.0%, 0.0%, and 0.0%, respectively.

Table 2: Distribution of patients according to Types of Glaucoma

	n	%
Lens-Induced Glaucoma LIG	7	7.0
Phacomorphic glaucoma	67	67.0
Phacolytic glaucoma	26	26.0
Lens particle glaucoma	0	0.0
Phacoantigenic glaucoma	0	0.0

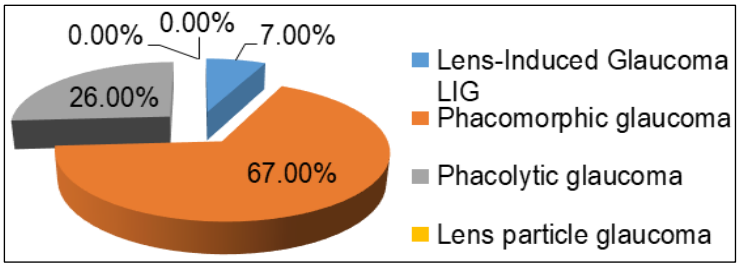

Figure 5: Distribution of patients according to types of glaucoma.

Table 3 and Figure 6 show the distribution of patients according to Intraocular pressure (IOP). The 0-10, 11-20, 21-30, 31-40, 41-50 and >50 IOP were 48.0% 7.0% 13.0% 21.0% 9.0% and 2.0% in right eye and 39.0%, 17.0%, 18.0%, 10.0%, 12.0%, and 4.0%, respectively.

Table 3:Distribution of patients according to Intraocular pressure (IOP)

IOP (mmHg)	OD		OS	
	n	%	n	%
0-10	48	48.0	39	39.0
11-20	7	7.0	17	17.0
21-30	13	13.0	18	18.0
31-40	21	21.0	10	10.0
41-50	9	9.0	12	12.0
>50	2	2.0	4	4.0

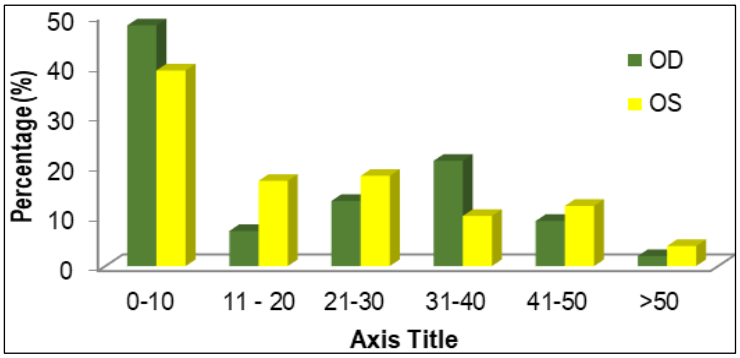

Fig 6: Distribution of patients according to Intraocular pressure (IOP)

Table 4 and Figure 7 show the distribution patients according to type of surgery. The percentage of SICS+PCIOL, PHACO+PCIOL, SICS+TRAB, phaco+ TRAB, SICS+/- PCIOL, PHACO+/-PCIOL, Lens Extraction and Lens Extraction+/- PCIOL types of surgery were 53.00%, 5.00%, 3.00%, 0.00%, 26.00%, 0.00%, 2.00% and 1.00%, respectively.

Table 4: Distribution patients according to type of surgery

Type of surgery	n	%
SICS+PCIOL	53	53.00
PHACO+PCIOL	15	15.00
SICS+TRAB	3	3.00
phaco+ TRAB	0	0.00
SICS+/- PCIOL	26	26.00
PHACO+/-PCIOL	0	0.00
Lens Extraction	2	2.00
Lens Extraction+/- PCIOL	1	1.00

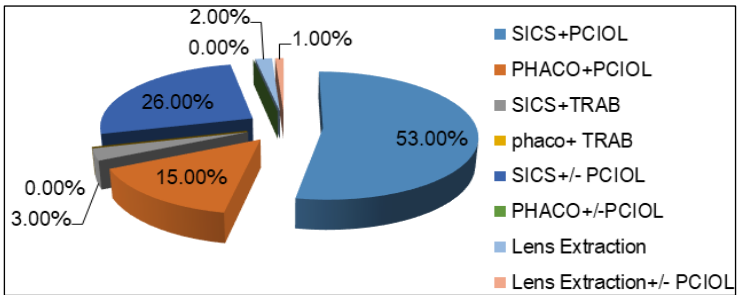

Fig 7: Distribution patients according to type of surgery

Table 5 and Figure 8 show the changes in cornea clarity from post-operative day 1 to post-operative 6 weeks in involved eye. The percentage of Clear cornea, striated keratopathy, Corneal edema were 85.53%, 14.47%, and 0.00% at pre-operative, 63.16%, 22.37%, and 14.47% at day 1, 95.77%, 1.41%, 2.82% at 1 week, 92.59%, 0.00% and 7.41% at 2 week and 97.83%, 2.17% and 0.00% at 6 week. The change in cornea clarity from post-operative day 1 to post-operative 6 weeks in involved eye was significantly different.

Table 5: Changes in cornea clarity from post-operative day 1 to post-operative6 weeks in involved eye

	Pre-Operative (n=76)		Post-Operative Day 1 (n=76)		Post-Operative 1 Week (n=71)		Post-Operative 2 Weeks(n=52)		Post-Operative 6 Weeks (n=46)		p-Value
	n	%	n	%	n	%	n	%	n	%	
Clear	65	85.53	48	63.16	68	95.77	50	92.59	45	97.83	<0.001*
Striated keratopathy	11	14.47	17	22.37	1	1.41	0	0.00	1	2.17	
Corneal edema	0	0.00	11	14.47	2	2.82	4	7.41	0	0.00	

*=Significant (p<0.05)

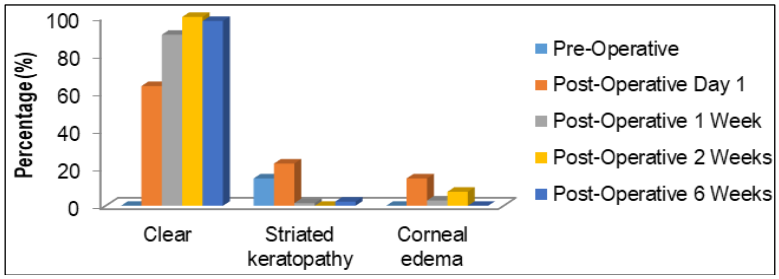

Fig 8: Changes in cornea clarity from post-operative day 1 to post-operative 6 weeks in involved eye

Table 6 and Figure 9 show the changes in duration of hyperemia from post-operative day 1 to post-operative 6 weeks in involved eye. The percentage of clear, ≤ 1 week and > 1 week duration of hyperemia were 0.0%, 30.26%, and 0.00% at day 1, 63.38%, 2.82% and 5.63% at 1 week, 90.57%, 2.17% and 0.0% at 2 week and 100%, 0.0% and 0.0% at 6 week. The change in duration of hyperemia was significantly different from post-operative day 1 to week 6.

Table 6: Changes in duration of hyperemia from post-operative day 1 to post-operative 6 weeks in involved eye

	Post-Operative Day 1 (n=76)		Post-Operative 1 Week (n=71)		Post-Operative 2 Weeks (n=53)		Post-Operative 6 Weeks (n=46)		p-Value
	n	%	n	%	n	%	n	%	
Clear	0	0.0	45	63.38	48	90.57	46	100	<0.001*
≤ 2 week	23	30.26	2	2.82	1	2.17	0	0.00	
> 2 week	0	0.00	4	5.63	0	0.00	0	0.00	

*=Significant (p<0.05)

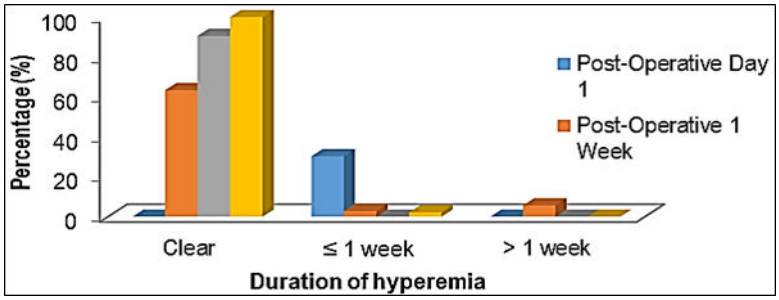

Fig 9: Changes in duration of hyperemia from post-operative day 1 to post-operative 6 weeks in involved eye

It is the main cause of preventable blindness [20]. Cataracts are among the most frequent conditions that the ophthalmology team is asked to treat surgically. Age is the most frequent cause, despite the fact that there are numerous others. This progressive, painless opacification of the crystalline lens may be treated surgically (lens extraction)[21].Untreated cataracts have the potential to become intumescent or hypermature and result in lens-induced glaucoma.

In our study, the Uncorrected Visual Acuity (UCVA) vision was significantly improved from post-operative day 1 to post-operative 6 weeks in involved eye. The Best Corrected Visual Acuity (BCVA) vision was significantly improved from post-operative day 1 to post-operative 6 weeks in involved eye. Rao *et al*. (2018)[22] reported that the other 22 cases (22%) presented with visual acuity between Count finger close to face to count finger 2 metres and a total of 36 cases (46.15%) improved to BCVA of 6/6 -6/18 postoperatively.

In our study the percentage of clear conjunctiva, ≤ 1 week and > 1 week duration of hyperemia were 0.0%, 30.26%, and 0.00% at day 1, 63.38%, 2.82% and 5.63% at 1 week, 90.57%, 2.17% and 0.0% at 2 week and 100%, 0.0% and 0.0% at 6 week. So that, frequencies of clear conjunctiva was significantly increased from post-operative day 1 (0.00%) to post-operative 6 weeks (100%). The percentage of ≤ 1 week and > 1 week duration of hyperemia in cases was significantly reduced from post-operative day 1 to week 6.

CONCLUSION

This prospective study was carried out that included a total 100 patient with lens induce glaucoma were enrolled during study period. Data was collected at pre-operative, post-operative day 1, week 1, week 2 and at week 6 follow-up. The visual acuity from 6/6 - 6/60 was considered as good visual acuity and visual acuity less than 6/60 poor visual outcome. Out of 54 cases having perception of light with projection of rays preoperatively, 51 cases (94.44%) improved. The Intra ocular pressure (IOP) was less than 40 mmHg in most of the patients. The maximum patients have more than 10 mmHg (53.63%) IOP at day 1. Moreover, the IOP was significantly reduced from day 1 to 6 week post-operatively in lens induced glaucoma.

REFERENCES

1. Jain IS, Gupta A, Dogra MR. *et al*. Phacomorphic glaucoma Management and visual prognosis. Ind J Ophthalmol. 1983;31:648–53
2. Kanagarajan P, Nandi P, Lokeshmaran A. Prevalence of cataract blindness in a rural Puducherry. Indian Medical Gazette; 2011 Sep
3. Sharma RG, Verma GL, Singhal B. A direct evaluation of Scheie's operation with sclerectomy along with lens extraction in lens induced glaucoma. Ind J Ophthalmol. 1983;31:639–641.
4. Duane TD, Jaeger EA. Duane's ophthalmology. CD ROM. ed. Philadelphia (PA): Corporate Technology Ventures; 1999.
5. Albert DM, Jakobiec FA. Principles and practice of ophthalmology on CD ROM. Philadelphia (PA): Media Solutions Corporation; 1995.
6. Pant Sitoula, Sarkar I, Nayak D, Singh SK. Lens induced glaucoma in eastern Nepal. Nepal J Ophthalmol 2016;8(16): 161-166.
7. Jonathan PE, Obstbaum SA. Lens induced glaucoma. Documenta Ophthalmia 1992;81(3): 317-338.

8. Gifford H. The dangers of the spontaneous cure of senile cataract. American Journal of Ophthalmology. 1900;17:289–293.
9. von Reuss. Centralblatt für Praktische Augenheilkunde. 1900;24:p. 33.
10. Irvine SR, Irvine AR., Jr. Lens-induced uveitis and glaucoma. Part III."Phacogenetic glaucoma": lens-induced glaucoma; mature or hypermature cataract; open iridocorneal angle. American Journal of Ophthalmology. 1952;35(4):489–499.
11. Flocks M, Littwin CS, Zimmerman LE. Phacolytic glaucoma; a clinicopathologic study of one hundred thirty-eight cases of glaucoma associated with hypermature cataract. Archives of Ophthalmology. 1955;54(1):37–45.
12. Chandler PA. Problems in the diagnosis and treatment of lens-induced uveitis and glaucoma. Archives of Ophthalmology. 1958;60(5):828–841.
13. Duke-Elder S. System of ophthalmology.London: Henry Kimpton; 1969;11: 662-663
14. Papaconstantinou D, Georgalas I, Kourtis N, Krassas A, Diagourtas A, Koutsandrea C, Georgopoulos G. Lens-induced glaucoma in the elderly. Clin Interv Aging. 2009;4:331-6.
15. Tyagi R, Tarannum S, Dhawan A, Mishra S. Clinical profile of lens induced glaucoma at a tertiary centre in north India. Indian J Clin Exp Ophthalmol 2019;5(2):169-75.
16. Prum BE Jr, Rosenberg LF, Gedde SJ, Mansberger SL, Stein JD, Moroi SE, Herndon LW Jr, Lim MC, Williams RD. Primary Open-Angle Glaucoma Preferred Practice Pattern(®) Guidelines. Ophthalmology. 2016 Jan;123(1):P41-P111.
17. Nche EN, Amer R. Lens-induced uveitis: an update. Graefes Arch Clin Exp Ophthalmol. 2020 Jul;258(7):1359-1365.
18. Markowitz SN, Morin JD. Angle-closure glaucoma: relation between lens thickness, anterior chamber depth and age. Can J Ophthalmol. 1984 Dec;19(7):300-2.
19. Areiter E, Neale M, Johnson SM. Spectrum of Angle Closure, Uveal Effusion Syndrome, and Nanophthalmos. J Curr Glaucoma Pract. 2016 Sep-Dec;10(3):113-117.
20. GBD 2019 Blindness and Vision Impairment Collaborators; Vision Loss Expert Group of the Global Burden of Disease Study. Causes of blindness and vision impairment in 2020 and trends over 30 years, and prevalence of avoidable blindness in relation to VISION 2020: the Right to Sight: an analysis for the Global Burden of Disease Study. Lancet Glob Health. 2021 Feb;9(2):e144-e160.
21. Allen D, Vasavada A. Cataract and surgery for cataract. BMJ. 2006 Jul 15;333(7559):128-32.
22. Battula Yallamanda Babu Rao, Rajender Gupta, Bhukya Harish. Assessment of intraocular pressure and visual acuity in patients of lens induced glaucoma before and after manual cataract surgery. International Journal of Contemporary Medical Research 2018;5(12):L6-L9.