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Review Article

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The Effect of Phacoemulsification Cataract Surgery on Intraocular Pressure Control and Topical Medications use in Glaucoma Patients in Al-zubair Hospital 2023/2024

Dr. Maytham Neamah*

Al-zubayer General Hospital, Iraq

***Corresponding Author:** Dr. Maytham Neamah, Al-zubayer General Hospital, Iraq.

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Background: Glaucoma and cataract established the top two leading causes of blindness all over the world which adversely affect the vision and quality of life. They are often existed as age –related diseases. As both coexist together, their effect on visual function difficult to differentiate. Meantime cataract surgery can have significant effect on the quality of life in glaucoma patients to variable degrees.

Aim: The purpose of this study is to evaluate the changes of intraocular pressure after cataract surgery in glaucomatous patients compared with non-glaucomatous patients and topical medications use.

Material and Methods: Prospective cohort study done for patients with Primary Open Angle Glaucoma (POAG) whom they underwent cataract surgery by phacoemulsification technique done by one surgeon with follow up period of six months in Al-Zubair General Hospital during the period between Dec 2023 to May 2024. The patients were divided in two groups: eyes with glaucoma(G) and eyes without glaucoma(NG). The intraocular pressure (IOP) was measured by Goldman tonometry. The IOP being measured one day preoperatively and postoperatively at one week, one month, 3 months and 6 months consequently .We then compared the preoperative values with postoperative one .

Results: A total 123 eyes of 107 patients were enrolled. The mean age was 64_+12 years with follow up duration of 6 months. We observed decrease in the mean IOP after cataract surgery during all postoperative visits except the 1st week post operatively where not statistically changed (P value 0.987). Furthermore, we noticed increase in the number of eyes free of medications after cataract surgery. The p-value after 6 months (0.04)

Conclusions: In this study, cataract surgery can decrease IOP below the baseline more in glaucomatous than non-glaucomatous patients and we observed decrease in the administration of glaucoma medications after the surgery.

Keywords: *Intraocular pressure; Glaucoma; Cataract surgery; Glaucoma medications*

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Introduction

Glaucoma and cataract are accustomed the headmost two leading causes of blindness all over the world which adversely affect the vision and quality of life. They are oftenly existed as age –related diseases. As both coexist together, their effect on visual function difficult to differentiate. Meantime cataract surgery can have significant effect on the quality of life in glaucoma patients to variable degrees. Cataract is frequently observed in glaucoma patients and treatment of glaucoma speed up the emergence of cataract. [1]. Both have significant impact on vision and cataract surgery does improve vision in glaucoma patients, Also cataract and glaucoma coexist in the same eye when one pathology may lead to the other (resulting in secondary types of cataract or glaucoma) .Conventional treatment of glaucoma is medical, laser and surgical treatment, currently cataract surgery or lens extraction being reviewed as new treatment modality especially those with angle closure variety ,and as a primary wherewithal of reducing intraocular pressure(IOP). There is growing evidence that cataract surgery in glaucoma patients resulted in decreased IOP of 1-2mmHg lasting for at least for 3 years. Cataract surgery exhibits special surgical advantages when done before glaucoma-filtering procedure, early cataract surgery avoids the development of cataract- a common adverse effect of many glaucoma procedures. Within 5 years of trabeculectomy or tube shunt surgery, half of phakic patients develop a visually significant cataract [2]. In addition, trabeculectomy on pseudophakic eyes have less risk of lens-cornea touch .Phacoemulsification surgery on eyes with previous trabeculectomy could impair the functioning bleb through increased the permeability of blood- aqueous barrier, then facilitating the passage of inflammatory mediators that cause bleb fibrosis.

Therefore, it is advisable that cataract surgery offered in glaucoma patients with uncontrollable IOP. This IOP lowering effect of cataract surgery may reduce the applications of Anti-glaucoma medications or even stop them especially in glaucoma with mild elevation of IOP, and even for severe and end stage glaucoma cataract surgery is still advocated at least to improve the quality of life [3,4]. With the advent of advanced phacoemulsification, nowadays cataract extraction has become more safer procedure, Hence, it is applied widely in management of glaucoma for better control of IOP. In addition to its main indication to improve vision, cataract surgery can lower IOP and reduce the need to IOP lowering medications on a variety of primary glaucoma has been documented, particularly those with narrow angle. As compared to combined phaco trabeculectomy, phaco cataract surgery alone is simple and not needs complex post-operative managements and not associated with higher rate of complications [5,6]. It is well known that cataract may progress rapidly after glaucoma filtering surgery regardless the control of IOP, later on cataract surgery could affect the function of the filtering bleb [7]. In addition to improvement in vision, cataract surgery can also improve visualization of optic disc and diagnostic tools results of the optic disc such as OCT scanning of the optic nerve and monitoring the progression in visual field loss. It is reported that cataract surgery can reduce IOP in both glaucoma and non-glaucoma patients and more profound effect on glaucoma patients and this effect vary greatly among those patients. It is unclear which patients and /or ocular characteristics that predict the IOP –lowering effect after cataract surgery, However, its suggested that angle configuration ,aqueous humor dynamics, existing ocular diseases, most important preoperative IOP. Intrinsic glaucoma anatomical and physiological factors may play a role in this context where lensectomy could have effect on IOP control. After cataract surgery even eyes without glaucoma exhibit anatomical changes in the anterior chamber and other biometrical factors, for example, increase in the anterior chamber depth (ACD), angle opening distance and anterior chamber area. Although, these changes more evident in angle closure glaucoma, still it might occur in open angle glaucoma [8]. Another suggested mechanism for the IOP lowering effect of cataract surgery in patient with open angle glaucoma is the remodeling of the trabecular endothelium in response to stress of the ultrasonic vibrations during phacoemulsification. However, this hypothesis is inadequate for overall explanation, since the initial studies to report IOP-lowering after cataract surgery were on patients undergoing ICCE or ECCE rather than phacoemulsification. A complex relationship appeared between cataract surgery and IOP when the preoperative IOP is in the statistically normal range [9]. There is postulated mechanism of increased uveoscleral outflow due to the release of prostaglandin F-2, hyposecretion of aqueous humor caused by traction on the ciliary body due to fibrosis and contraction of the posterior lens capsule after cataract surgery. Sometimes, lens extraction in cataract surgery done not to improve visual acuity as primary goal, but, rather to lower intraocular pressure. The clear lens extraction doesn't accepted by many ophthalmologist as mean to control intraocular pressure while it is done, somewhat, on wider scale by refractive surgeons [10]. It seems that changes in IOP after cataract surgery in glaucoma patients depend on the type of glaucoma and baseline IOP. Eyes with angle closure glaucoma reveal greater postoperative IOP reduction as compared to the primary open-angle glaucoma(POAG) which

show mild reduction. Although it is variant of POAG, pseudoexfoliation glaucoma is associated marked IOP reduction, It is well-known that deposition of exfoliative material on the trabecular meshwork imped aqueous drainage through this meshwork, it is suggested that during phaco emulsification or generally in cataract surgery these material would be washed out thus ,no more obstacle to the aqueous drainage facility [11,12].

This study was designed to evaluate how much does cataract surgery change IOP in both glaucomatous and control group, and whether glaucomatous patients stop or decrease Antiglaucoma medications after cataract surgery.

Methods

In this prospective cohort study, we studied the change in IOP in glaucomatous patients whom they underwent cataract surgery by modern phacoemulsification and control group without glaucoma. All patients were assessed by the same ophthalmologist, who was masked to patients' identity. The study protocol gained approval by the Local Ethics Committee of The AL _Zubayer hospital administration and The Scientific Committee for Research and Development in the Basra Health Directorate, and all participants signed an informed consent. The study was conducted according to the principles of Declaration of Helsinki. A 123 eyes of 107 patients whom they have cataract (59 males, 64 females) were operated on during the period between Dec 2022 to March 2023 and followed for 6 months postoperatively.

Full ophthalmological examination was done in the ophthalmic outpatient consultation room, the IOP measured twice by Goldman Applanation Tonometer attached to slit lamp and the mean was recorded (Haag- Streit tonometer,Haag Streit company,Switzerland) and central corneal thickness(CCT) measured by Ultrasonic Pachymeter (Nidek, Japan).

All patients with POAG with age between 45 to 95 years on Antiglaucoma medications with visually significant cataract operated on by one professional surgeon and followed up for 6 months were included in this study, phaco surgery done with clear corneal incision with White Star Signiture Pro phaco machine from (Johnson and Johnson Company, USA) and all with foldable IOL implantation (Rayner monofocal IOL, Rayner Company, ENGLAND and Senser monofocal IOL, Johnson and Johnson Company, USA), glaucoma patients criteria included uncontrollable IOP (22-35mmHg), cup-disc ratio of more 0.6, documented visual field defect on Perimetry (Humphery perimetry) and documented RNFL damage by OCT(Carle Ziess).

Eyes with trauma or with previous ocular surgery, other types of glaucoma like Pseudoexfoliative glaucoma, angle closure glaucoma, pigmentary glaucoma, eyes with intraoperative and/or postoperative complications, and those who are not completed the follow-up visits were excluded. Also patients who needed another non-glaucoma related surgical or laser procedure such as YAG laser capsulatomy within the 6 months of the surgery excluded.

We recorded the number of Antiglaucoma medications before surgery (whether monotherapy or dual therapy and more) and compare it with postoperative status of using these drugs. Data were analyzed by software package (SPSS version 24 program) and differences between preoperative and postoperative mean IOP were assessed by Chi square. A P value of less than 0.05 considered statistically significant.

Results

One hundred twenty three eyes of 107 patients (59 males, 64 females) were enrolled in this study. The mean surgical age was 64+_12 years old. Preoperative mean IOP value was 27.81+-3 .49(SD) (range, 22-30)mmHg. The mean IOP at 1st week ,1st month, 3rd month and 6th postoperative months were 25.9 +-3.4,18.05 +-2.6,18.6+-3.04 and 19.38+-2.49 mmHg, respectively. The follow up visits where IOP checked at 1st week, 1st month, 3rd month and 6th months. The mean number of preoperative Antiglaucoma medications were 1.35+-0.8(range, 0-3) reduced postoperatively to 0.3-+0.45 (range, 0-2). About 36 (60%) of the operated eyes become drug free after cataract surgery, 18 (30%) of the operated eyes has reduced medications used after surgery, 6 (10%) of the operated eyes remain on the same medications. There was decrease in the IOP values in the 1st, the 3rd and 6th months postoperatively with no significant change in the 1st postoperative week. Preoperative mean CCT value 557+-22.09(SD) (520-595)um. There was no significant increase in the CCT value in the postoperative visits.

Table 1: Summarized the baseline characteristics of the patient involved in this study, where number of females more than males and majority of patients (60.2%) in the age group between 56 to 75 years old.

Variable	No.	%	Mean + SD
Age			64+_12
45-55	32	26.0	
56-65	38	30.9	
66-75	36	29.3	
76-85	13	10.6	
86-95	4	3.3	
Total	123	100.0	
SEX			
Male	59	48.0	
Female	64	52.0	
Total	123	100.0	
Chronic disease			
No	72	58.5	
Yes	51	41.5	
Total	123	100.0	

Table 1: *Population Characteristics for both patients with glaucoma and healthy individuals who underwent phacoemulsification cataract surgery.*

N.B: Chronic diseases includes HT(Hypertension), IHD (Ischemic heart diseases), DM (Diabetes mellitus) and COAD (Chronic obstructive airway diseases).

The preoperative IOP was high in the glaucoma patient, being between (23-35 mmHg), whereas in non-glaucoma patients is quite within normal range (12-22 mmHg), most glaucoma patients have IOP values between 20 to 30 mmHg, while the healthy patients their IOP values between 12-20mmHg, as illustrated in table (2).

Preoperative IOP	Glaucoma patients(G)	Non-glaucoma patients(NG)
10-15	0 (0%)	13 (20.6%)
16-20	0 (0%)	38 (60.3%)
21-25	27 (45%)	12 (19%)
26-30	28 (46.6%)	0 (0%)
31-35	5 (8.3%)	0 (0%)
Total	60	63
Central corneal thickness (CCT)	557um	552um

Table 2: *Show the comparism of preoperative IOP and CCT between glaucoma patients(G) and Non glaucoma(NG).*

In the above table, it's clear that most of the glaucoma patients(G) operated on for cataract surgery have uncontrolled IOP as compared to the non-glaucoma patients (NG). However, there was no significant differences between the two groups regarding central corneal thickness(CCT).

Preoperative IOP Mean +-SD	IOP 1 week after surgery				
	10-15	16-20	21-25	Mean ± SD	p-value
21-25	2	20	5		
26-30	2	18	8		
31-35	0	2	3		
Total 27.81 ± 3.49	4	40	16	25.90 ± 4.8	0.99

Table 3: *Shows the comparison between the preoperative IOP and 1 week postoperative IOP.*

The mean IOP decreased in 1st postoperative week, but, this is statistically not significant (p value 0.987) as described in the table [3]. This probably not represent the real measurement, furthermore, in the early postoperative days IOP could be elevated rather decreased due to inflammation and/or retained viscoelastic material while there is decrese in mean value 0f IOP from (27.81 ± 3.49) pre. op to (25.90 ± 4.8) post. op.

In the table [4], it's clear that mean IOP decreased significantly after 1st month postoperative period (P value 0.03). Majority of patients whom their preoperative IOP between 22 to 30 mmHg have decreased IOP between 12 to 20 mmHg.

Preoperative IOP	IOP 1 month after surgery				
	10-15	16-20	21-25	Mean ± SD	P value
21-25	4	21	2		
26-30	3	20	5		
31-35	0	5	0		
total	7	46	7	18.05+-2.65	0.03

Table 4: *Demonstrate the comparison between the preoperative IOP and the 1st postoperative month.*

Similarly, in table [4 ,5], the mean IOP after 3rd and 6th postoperative month decreased significantly as compared to that of the preoperative values (P value 0.01 and 0.04, respectively).

	IOP 3 Months after surgery				
	10-15	16-20	21-25	Mean ± SD	p-value
21-25	4	22	1		
26-30	1	21	6		
31-35	0	3	2		
Total	5	46	9	18.0 ± 2.6	0.01

Table 5: *Elucidate how much the mean IOP decreased after 3 months from the cataract surgery.*

Preoperative IOP	IOP 6 m0nth after surgery				
	10-15	16-20	21-25	Mean ± SD	p-value
21-25	2	24	1		
26-30	0	17	11		
31-35	0	2	3		
Total	2	43	15	19.38 ± 2.491	0.04

Table 6: *Reveals the mean IOP 6 months after the surgery as compared to the mean preoperative value.*

In table (7), we describe the preoperative and postoperative mean IOP, CCT. The mean IOP decrease in value at the 1st month, 3rd month and 6th month and was statistically significant, but that the 1st week was not significant. The mean preoperative CCT was 557.68+-20 .2(SD). The increased in CCT in the 1st postoperative week statistically significant (P value 0.1), but those of the 1st, 3rd and 6th were not significant.

IOP	Mean ± SD	P value	CCT Mean ± SD
Pre op	27.81 ± 3.49	10.04	557.68+-20.2(SD)um
Post op 1 week	25.90 ± 37.9	0.987	615.47+-28.7(SD) um
Post op. 1 month	18.05 ± 2.65	0.03	574.64+-15.4(SD)um
Post op 3 month	18.61 ± 3.04	0.01	550.75+-16.83(SD)um
Post op. 6 month	19.38+-2.49	0.04	551.57+-17.89(SD)um

Table 7: *Summarize the preoperative and postoperative mean IOP (Mean+-SD), P value, Mean CCT (Mean+-SD).*

United Arab Emirates DirhamThe paragraph show that there is descending in p-value of IOP from pre-operative which was 10.4 to post-operative value which become significant after one month post operation p-value is 0.03 18 and the mean value of IOP decrease from 25.8 preoperative to 18.05 after one month from operation which mean there is significant difference in IOP Preoperative and post-operative

	Pre –op. IOP	Eyes (n, %)	IOP Pre op. (mmHg)	IOP changes 6 mo. (mmHg)
Glaucoma group (N=60)	10-14	0(0%)	0	0
	15-20	0(0%)	0	0
	21-25	27(45%)	21.3+-0.4	-4.8+-2.3
	26-30	28(46.6)	28.0+-2.3	-6.7+-3.1
	31-35	5(8.3%)	31.4+-0.8	-9+-1.9
Non glaucoma group (N=63)	10-14	13(20.63%)	10.7+-0.5	-0.4+-1.4
	15-20	38(60.3)	16.3+-0.9	-1.8+-2.7
	21-25	12(19%)	21.6+-0.5	2.6+-1.3
	26-30	0(0%)	0	0
	31-35	0(0%)	0	0

Table 8: *Overview the number of eyes, preoperative mean IOP and mean IOP at the final visit (6th postoperative month) in both glaucomatous eyes and healthy eyes.*

In our study we noticed that 36 (60%) of the operated glaucoma eyes became medications free, so the total number of medication significantly stopped (P value<0.05) and the final visit 35 eyes of the 36 have good IOP control, IOP being below 20 mmHg (table 9). All glaucomatous eyes that become drug free after cataract surgery, they were on mono or dual therapy preoperatively.

IOP Range	No. of Glaucoma eyes with drug free		
	1 Week postop	1 Month postop	3 Moths postop
10-15	3 (8.3%)	4 (11.11%)	3 (8.3%)
16-20	24(66.6%)	30 (83.3%)	31(86%)
21-25	9 (25%)	2 (5.5%)	2 (5.5%)
Total	36	36	36
P value	0.003	0.005	0.005

Table 9: *Number of glaucoma eyes with medications free at the 4 postoperative visits.*

The total number of eyes that gained sustained IOP control with decreased number of medications after surgery was 18 (30%) as described in table 10.In the 1st postoperative week the topical

Antiglaucoma medications reductions doesn't' significantly reduce the IOP (pvalue 0.4), while it's significant in the 1st, 3rd and 6th post-operative months, while 6 eyes (10%) obtained IOP control with the same preoperative medications ,that's' more than one medication during the whole postoperative visits, and 2 eyes were not obtained sustained IOP value below (21mmHg) despite the use of topical mediations, their IOP were (24 and 25 mmHg)n.

IOP	No. of Glaucoma eyes with reduced medications		
	1 Week postop	1 Month postop	3 Months postop
10-15	1 (5.5%)	2 (11%)	1 (5.55%)
16-20	12 (66.66%)	13 (72.2%)	12 (66.66%)
21-25	5 (27.77%)	3 (16.66%)	5(27.77%)
Total	18	18	18
P value	0.4	0.03	0.04

Table 10: *Number of eyes with reduced topical medication during the postoperative visits.*

Discussion

Several studies had shown that IOP decreased after cataract surgery in patients with glaucoma and Non-glaucoma (healthy individuals). The preoperative baseline IOP is the strongest predictor of the amount of decrease in IOP after cataract surgery [13]. In addition to improvement in vision, our findings in this study provide beneficial effect of cataract surgery in minimizing IOP in patients with POAG, also there is significant decrease in the number of glaucoma medications. Clinically, IOP control is always the first priority in the management of glaucoma while VA is seldom engaged as assessment index of glaucoma treatment outcome .Nevertheless ,VA is high predictor of quality of life in those patients [14]. Cataract surgery unlikely to be performed solely to improve vision In severe and end stage glaucoma patients with controlled IOP due to the risk of "wipe out " which is the sudden loss of vision without apparent causes especially in advanced glaucoma after filtering surgery [15]. Some studies have shown that the reduction in IOP was statistically significant for glaucomatous patients and normal patients 6 months after cataract surgery and IOL implantation [16]. Others had demonstrated that phacoemulsification and IOL implantation allow for reduction in the use of postoperative glaucoma medications in POAG patients [17]. It's wise to investigate how much reduction of these medications influence the quality of life of the patients, finance and drug side effects. Chang et al. [18] Demonstrated that, in ocular hypertensive and glaucoma patients, uncomplicated phacoemulsification had no significant IOP-lowering effect compared with their phakic fellow eyes for up to 3 years postoperatively and there was no difference between the mean number of postoperative IOP-lowering medications used in the operated and fellow eyes.

The proposed mechanisms that have been explain the IOP reduction after cataract surgery include: amelioration of aqueous outflow facility by drainage angle widening and/or fibrosis and contraction of the posterior capsule causing traction on the ciliary body, thus decreasing the aqueous humor and increase facility outflow [19]. After cataract surgery IOP reduction more evident in patients with pseudoexfoliative glaucoma where intra operative aspiration of pseudoexfoliative particles deposited on the trabecular meshwork leading to increased outflow facility, there is also increased blood-aqueous barrier permeability which impaired in those patients [20]. In our study, the reduction in the mean IOP were comparable to that observed in Sophia at el (2020) in USA who studied the results of 7574 eyes underwent cataract surgery, the preoperative mean IOP was 15.2mmHg +-3.4(SD) decreased to 14.2mmHg +-3(SD) at 12 months of surgery. It is also comparable to another study in our country done in Ibn Al-Haytham Eye Teaching hospital [21] where they evaluated the changes of IOP after uneventful phacoemulsification and reported reduction in mean IOP from preoperative of (18.68+-2.84 mmHg) to postoperative (14.11+-2.61mmHg). Overall, our results are consistent with the findings in previous studies that demonstrate improvement of glaucoma control after phacoemulsification and reported a mean reduction in IOP of 2.2mmHg 1 year after cataract surgery [22]. In this respect, for patients with cataract, but mild, well-controlled glaucoma requiring few medications, phacoemulsification alone is probably reliable option.

Cataract surgery in patients with glaucoma could be associated with transient increase in the IOP in the early postoperative period which might endanger optic nerve in patients with advanced glaucoma [23], In this study, there is decrease in the mean IOP in the 1st postoperative week, but statistically not significant (P value 0.987) and this is probably overestimated due to corneal oedema altering the biomechanics of the cornea. Hence, the actual IOP value may be lower.

Cataract surgery alone is as effective as combined procedure in reducing IOP at sustainable level in pseudoexfoliative glaucoma [24]. This raise the role of cataract surgery as a way to control IOP in patients with POAG. Intraocular pressure reduction after cataract

surgery may be attributed partly to changes in the angle and anterior chamber configuration. [25].

The major limitation of this study is the short follow up period ,limited sample size ,lack of diurnal IOP measurements, we measured the IOP at usual office time from 9 am to 3pm and that the IOP did not measured at the same for all patients or consistently the same patient, this represent inter visit variation ,lack of corneal hysteresis measurements, we do not measure the rate of progression of glaucoma before and after the cataract surgery because this is another issue and need further study .Complicated cataract surgery were associated with increased IOP and therefore not included in the database .Anterior chamber biometric factors were not included in this model like anterior chamber angle width ,anterior chamber depth.

It's mentioned in some studies that the IOP lowering effect of cataract persist for at least 12 months [26]. Therefore, it's not unusual for glaucomatous patients with controlled IOP after cataract surgery for 12 months to have elevated IOP after this period. In this study, we can't precisely predict which glaucoma patients are likely to have the benefits of IOP lowering nor reduced medications use after cataract surgery.

Conclusions

Our results suggest that patients with primary open angle glaucoma(POAG) were more likely to achieve sustained IOP reduction after cataract surgery. Patients with higher baseline IOP had increased probability of achieving reduction in IOP. This evidence elucidates the significant benefit of cataract surgery in patients with POAG.

We also observed an average decline in the postoperative dependence on topical glaucoma medications with some patients became medications free. Hence, cataract surgery is particularly appealing option for long-term glaucoma management in minimally served areas where access to glaucoma subspeciality care limited.

Further studies are needed to evaluate the effect phacoemulsification on different types of glaucoma as this study focused on POAG.

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Conflicts of Interest

No potential conflict of interest relevant to this article was reported.

References

1. Kirti Singh', Sonal Dangda. (2016). Role of cataract extraction in glaucoma. Del J Ophthalmol. 26: 235-239.
2. Jennifer S. Kung,Daniel Y.Choi, Anjum S.Cheema, and Kuldev Singh. (2015). Middle East Afr J Ophthalmol. 22: 10-17.
3. Lin Fu,Yau Kei Chan,Junhua Li, Li Nie, and Weihua Pan. (2020). Long term outcomes of cataract surgery in severe and end stage primary angle closure glaucoma with controlled IO.BMC Ophthalmol. 20: 160.
4. Yu-Chun Cheng, Ming-Hui Sun, Wei-Chi Wu, and Wei-Wen Su. (2021). Cataract extraction slowed the visual field progression rate in patients with angle closure glaucoma. Taiwan J Ophthalmol. 11(4): 386-388.
5. Jolly L. Tsui, Noel C. Chan, and Clement C. Them. (2020). The role of lens extraction in glaucoma management. Ann Transl Med. 8(22): 1550.
6. Surinder Singh Pandav, Natasha Gautam Seth, Atul Arora, Faisal Thattaruthody, Ajay Jurangal, Sushmita Kaushik, and Srishti Raj. (2019). Intraocular pressure reduction in a spectrum of angle closure disease following cataract extraction. Indian J Ophthalmol. 67(9): 1433-1438.
7. Woo Jin Kim, Ju Mi Kim, Kyoung Nam Kim, and Chang Sik Kim. (2019). Effect of preoperative factor on intraocular pressure after phaco emulsification in primary open angle glaucoma and primary angle closure glaucoma. Korean J Ophthalmol. 33(4): 303-314.
8. Diana Melancia Luis Abegao Pinto Carlos Marques Neves. (2015). Cataract Surgery and Intraocular Pressure. Ophthalmic Res. 53:141-148.
9. Mark A. Slabaugh and Philip P, Chen. (2014). The effect of cataract extraction on intraocular pressure. Curr Opin Ophthalmol. 25: 122-126.
10. Tarek M. Eid, MD. (2011). Primary lens extraction for glaucoma management. Saudi Journal of Ophthalmology. 25: 337-345.
11. Maria Picoto, Jose Galveia , Ana Almeida , Sara Patricio , Helena Spohr , Paulo Vieira , Fernanda Vaz. (2014). Intraocular pressure after cataract surgery. Rev Bras oftalmol 73(4): 230-236.
12. Tao V. Tran, Kaweh Mansouri , and Andre Mermoud. (2021). Goniowash: a new surgical approach combined with cataract surgery to lower intraocular pressure in pseudoexfoliation syndrome. Int Ophthalmol. 41(5): 1563-1571.

13. Sabyasachi Sengupta, Rengaraj Venkatesh, Palaniswamy Krishnamurthy et al. (2016). Intraocular pressure reduction after phacoemulsification versus manual small –incision cataract surgery. a report by the American Academy of Ophthalmology; 123: 1695-1702.
14. Yang HS, Lee j, choi S. (2013). Ocular biometric parameters associated with intraocular pressure reduction after cataract surgery in normal eyes. Am J Ophthalmol 156: 89-94.
15. Lichter PR, Ravin JG. (1974). Risk of sudden visual loss after glaucoma surgery. Am J Op hthalmol. 78(6): 1009-1013.
16. Kim DD, Doyle JW, Smith MF. (1999). Intaocular pressure reduction following phacoemulsification cataract extraction with posterior chamber lens implantation in glaucoma patients. Ophthalmic Surg Lasers; 30: 37-40.
17. Steven LM, Stuart KG, Mae G, Michael K, Pradeep R. (2022). Cataract surgery lowers intraocular pressure and medication use in the medication group of the Ocular Hypertension Treatment Study. Am J Ophthalmol. 236: 53-62.
18. Chang TC, Budenz DL, Lui A, Kim WI, Dang T, et al. (2012). Long term effect of phacoemulsification on intraocular pressure using phakic fellow eye as control. J Cataract Refract Surg. 38: 866-70.
19. Servet C, Zeynep D, Halil IY, Nursen OA, Yasmin FC and Faik S. (2015). The effect of phacoemulsification surgery on intraocular pressure and anterior chamber anatomy of the patients with cataract and ocular hypertension. Indian J Ophthalmol. 63(9): 743-745.
20. Tran VT. (2015). Washout of pseudoexfoliative material combined with cataract extraction: a new surgical approach to lower intraocular pressure in pseudoexfoliation syndrome. Int Ophthalmol. 35: 209-214.
21. Zainab B. Abood, Alyaa A. Kareem. (2023). Changes of anterior chamber biometry and relationship to intraocular pressure changes after phacoemulsification surgery in non-glaucomatous eyes. IPMJ. 22(2): 192-196.
22. Pohjalainen T, Vesti E, U usitalo RJ, Loatikain L. (2001). Intraocular pressure after phacoemulsification and intraocular lens implantation in non-glaucomatous eyes with and without exfoliation. J Cataract Refract Surg. 27(3): 426-431.
23. Topouzis F, Tranos P, Koskosas A, Pappas T, Anastasopoulos E, Dimitrakos S, Wilson MR. (2005). Risk of sudden visual loss following filtration surgery in end stage glaucoma. Am J Ophthalmol. 140(4): 661-666.
24. Apama Rao and Rakhi D. (2023). Cataract versus combined surgery in pseudo exfoliation glaucoma. Indian J Ophthalmol. 73(3): 797-802.
25. Bilak S, Simisek A, Capkin M, et al. (2015). Biometric and intraocular pressure change after cataract surgery. Optom Vis Sci 92: 464-70.
26. Tong JT, Miller KM. (1998). Intraocular pressure reduction following phacoemulsification and foldable posterior chamber lens implantation. J Cataract Refract Surg 24: 256-262.