Evaluation of the Effect of Cataract Surgery on Glaucoma Follow-up and Treatment in Patients with Angle-Closure Glaucoma

Hamdi Sena Uyduran[1], Pınar Eröz[2], Özer Dursun[2], Ayça Yılmaz[2]

ABSTRACT

Objective: This study aims to evaluate changes in the follow-up and treatment of glaucoma after cataract surgery in patients with angle-closure glaucoma and coexisting cataracts.

Materials and Methods: Between January 2018 and December 2023, 70 eyes of 70 patients who met the inclusion criteria were included in the study. The medical records of all patients and retinal nerve fiber layer (RNFL) parameters obtained by optical coherence tomography (OCT) were retrospectively reviewed; examination findings and OCT data were recorded.

Results: The mean intraocular pressure (IOP) of patients under maximum medical treatment before surgery was 27.79 ± 7.29 mmHg, while this value decreased to 14.26 ± 3.53 mmHg six months after surgery. A statistically significant difference was found between IOP values before and after surgery ($p<0.001$). However, no statistically significant difference was found between the mean central RNFL thickness values before and after surgery. The average number of medications used in glaucoma treatment decreased from 3.49 ± 0.88 drops/day before surgery to 2.44 ± 1.15 drops/day six months after surgery. The decrease in the number of medications used was also found to be statistically significant ($p<0.001$).

Conclusion: Cataract surgery is an effective and safe option for controlling IOP in patients with ACG and may be considered as a first-line treatment in suitable patients. Surgery may contribute to structural stability by limiting RNFL thinning; however, patient selection should be based on individual characteristics.

Keywords: Intraocular Pressure, Angle Closure, Glaucoma, Cataract

INTRODUCTION

The World Health Organisation (WHO) describes glaucoma as one of the main causes of blindness worldwide. Although angle-closure glaucoma is less common than open-angle glaucoma, it poses a greater risk of leading to blindness.[1]

Significant advances in cataract surgery techniques in recent years have also contributed to the treatment of angle-closure glaucoma (ACG). Phacoemulsification has emerged as a key alternative in glaucoma treatment, effectively addressing the pathogenesis of ACG by reconstructing the anterior chamber angle and enhancing uveoscleral flow.[2] Removing the lens, which is around 5.5 mm thick, and replacing it with an intraocular lens that is less than 1.0 mm thick significantly increases anterior chamber depth. This enables the anterior chamber angle to reopen.

This procedure may also contribute to correcting pupillary block and improving visual acuity. The high perfusion pressure and viscoelastic use during surgery may widen the anterior chamber angle and reduce adhesions, while the combination of ultrasonic energy and high perfusion pressure may potentially contribute to the dissolution of

1 Erdemli State Hospital, Ophthalmology, Mersin, Türkiye
2 Mersin University Faculty of Medicine , Ophthalmology, Mersin, Türkiye

Received: 10.09.2025
Accepted: 23.02.2026
First Online: 02.03.2026
TJ-CEO 2026;21(1)
DOI: 10.37844/TJ-CEO.2026.21.2

Corresponding author:
Pınar Eröz
Email: p.eroz@hotmail.com

glycosaminoglycans (GAGs) in the trabecular meshwork, thereby enhancing trabecular outflow by increasing permeability and phagocytic activity.[2] During phacoemulsification, removing cellular debris from the trabecular meshwork using irrigation and aspiration can increase the outflow of aqueous humour.[3] In addition, higher levels of inflammatory mediators in the aqueous humour after surgery may facilitate drainage by opening the trabecular meshwork and uveoscleral outflow pathways.

Cataract surgery and intraocular lens implantation using the phacoemulsification technique is a reliable treatment option with proven efficacy in ACG treatment, and this method may help to avoid complications of trabeculectomy or phacotrabeculectomy, which can be quite aggressive.[4,5] It has been reported that cataract surgery in eyes with ACG results in widening of the anterior chamber angle and that no acute angle closure attacks developed in any patient during the three-month follow-up period.[6]

This study aims to evaluate changes to the glaucoma follow-up process and treatment requirements following cataract surgery in patients diagnosed with angle-closure glaucoma.

MATERIALS AND METHODS

This study involved a retrospective review of the medical records of glaucoma patients who attended the Glaucoma Unit at the Department of Ophthalmology, Faculty of Medicine, Mersin University, between January 2018 and December 2023, and who met the specified inclusion criteria. Ethical approval for the study was obtained from the Mersin University Clinical Research Ethics Committee (approval number 07/02/2024-03-129). Written informed consent was obtained from all patients, and the principles of the Helsinki Declaration were adhered to throughout the study. The study was retrospective in design, postoperative follow-up visits at postoperative day 1, week 1, and month 1 were part of the routine clinical practice at our institution. Patients with incomplete follow-up data at these time points were excluded from the final analysis.

The study included patients aged 40–90 years who had been diagnosed with ACG, had undergone cataract surgery without developing any intraoperative or postoperative complications, and had been followed up for at least three months after surgery. The patients had no additional ocular diseases or medications that could affect intraocular pressure (IOP) values, such as uveitis, steroid use, or retinal detachment. Patients with glaucoma types other than ACG, those with additional ocular pathology or medication use that could affect IOP, those who had undergone any ocular surgery prior to surgery, those with incomplete or inadequate medical records, and patients who were non-compliant with medical treatment were excluded from the study.

Glaucoma was diagnosed if the IOP was 21 mmHg or higher and if there were glaucomatous optic neuropathy findings (such as focal or diffuse neuroretinal rim thinning or localised indentation at the optic nerve head), together with a corresponding visual field defect and/or retinal nerve fibre layer (RNFL) defect. Angle-closure glaucoma was diagnosed if there were narrow-angle findings on gonioscopy (Shaffer grade 1 or 2), elevated IOP, optic nerve damage related to this pressure, RNFL loss and accompanying visual field defects. All patients included in the study met the eligibility criteria for cataract surgery, defined as a visual acuity (VA) of 0.7 or below (logMAR $\geq$0.15) and a nuclear sclerosis (NS) grade of 1 or higher according to the Lens Opacities Classification System III (LOCS III).

All patients underwent a comprehensive ophthalmological evaluation before and after surgery (preoperative; postoperative first day, first week, first month, third month, and sixth month). Visual acuity was measured using the Snellen chart and converted to logMAR equivalents. Anterior and posterior segment examinations were performed using a slit lamp biomicroscope and fundus examinations were conducted with the pupils dilated. Intraocular pressure measurements were taken using a Goldmann applanation tonometer. Angle examinations were evaluated using a three-mirror gonioscope. The antiglaucoma medications used were recorded. For the purposes of this study, maximum medical treatment was defined as the use of two or more topical antiglaucoma agents from different pharmacological classes, including prostaglandin analogues, beta-blockers, alpha-agonists, and/or topical carbonic anhydrase inhibitors. Oral carbonic anhydrase inhibitors used in the preoperative period were not included in postoperative medication counts, and fixed-combination drops were counted according to the number of active components.

All patients underwent cataract surgery and intraocular lens implantation using the phacoemulsification method with no complications through a transparent corneal incision. All surgeries were performed by the same experienced surgeon (AY) under general anesthesia. Postoperatively, topical prednisolone acetate and moxifloxacin eye drops were prescribed four times daily for one month following the loading dose.

Optical coherence tomography (OCT) imaging was performed using a Heidelberg Spectralis OCT device (Heidelberg Engineering Inc., MA, USA). Only high-quality images with a quality score of ≥20 dB were included in the analysis. Retinal nerve fibre layer thickness measurements were recorded in the nasal, temporal, inferior, and superior quadrants, as well as for the average thickness. OCT measurements were repeated before surgery and at three and six months post-surgery.

STATISTICAL ANALYSIS

All statistical analyses were performed using STATISTICA 13.0 software. Mean, standard deviation and frequency (percentage) statistics were used to summarise the data. After performing normality checks on the VA, IOP, RNFL and number of medications variables using the Shapiro–Wilk test, changes according to visits were evaluated using repeated measures analysis of variance and the Friedman test. The statistical significance value was set at $p < 0.05$.

RESULTS

Of the 70 patients included in the study, 27 (38.6%) were male and 43 (61.4%) were female. The mean age of the patients was 66.96 ± 9.82 years. Comorbidities were present in 38 patients (54.3%).

The mean best-corrected visual acuity (BCVA) of patients in the preoperative period was 1.00 ± 0.84 logMAR, in the first month after surgery, this value was measured as 0.43 ± 0.64 logMAR, in the third month as 0.37 ± 0.64 logMAR, and in the sixth month as 0.22 ± 0.37 logMAR (Figure 1). Statistically significant differences in visual acuity levels were detected between the preoperative and postoperative periods ($p < 0.001$) (Table 1).

In the post-hoc analysis, statistically significant differences in visual acuity levels were observed at all time points up to the first week after surgery (i.e. on the first day and during the first week after surgery). However, this difference disappeared in measurements taken one, three, and six months after surgery ($p>0.05$).

During the preoperative period, the average IOP of patients undergoing maximum medical treatment was measured as 27.79 ± 7.29 mmHg, while on the first day after surgery, the average was 17.44 ± 4.01 mmHg, 14.89 ± 3.60 mmHg on the first week, 14.63 ± 3.61 mmHg on the first month, and 14.26 ± 3.53 mmHg on the sixth month (Figure 2). Statistically significant differences were found in terms of IOP values between the pre- and post-surgical periods ($p<0.001$) (Table 1).

Post-hoc analysis revealed a significant difference in IOP values between pre-operative and post-operative measurements taken on the first day after surgery. However, no significant difference was found in measurements taken at one, three and six months post-surgery ($p>0.05$).

On average, patients used 3.49 ± 0.88 drops of antiglaucoma eye drops per day before surgery. This decreased to 3.14 ± 0.94 drops per day on the first day after surgery, to 2.83 ± 1.06 drops per day in the first week, to 2.61 ± 1.15 drops per day in the first month, and to 2.44 ± 1.15 drops per day in the sixth month (Figure 3). A statistically significant difference was found in the number of medications used between the pre- and post-surgical periods ($p<0.001$) (Table 1).

In the post-hoc analysis, it was observed that the number of drugs used decreased significantly at all time points after surgery compared to the pre-surgery period. However, there was no significant difference between the measurements taken on the first day and during the first week after surgery, or between the first, third and sixth months ($p>0.05$).

The thickness of the RNFL was 70.63 ± 22.64 μm on average before surgery, 71.15 ± 22.90 μm at three months post-surgery, and 69.37 ± 22.76 μm at six months post-surgery. No statistically significant difference was found between the pre- and post-operative periods in terms of RNFL thickness ($p=0.622$) (Table 1).

Table 1. *Clinical Findings Before and After Surgery*				
Time	IOP(mmHg)	BCVA(logMAR)	Number of antiglaucoma medications (drops/day)	RNFL (µm)
Pre-op	27.79 ± 7.29	1.00 ± 0.84	3.49 ± 0.88	70.63 ± 22.64
Day 1	17.44 ± 4.01	0.78 ± 0.70	3.14 ± 0.94	NA
Week 1	14.89 ± 3.60	0.58 ± 0.70	2.83 ± 1.06	NA
1st month	14.63 ± 3.61	0.43 ± 0.64	2.61 ± 1.15	NA
3rd month	14.44 ± 3.30	0.37 ± 0.64	2.49 ± 1.16	71.15 ± 22.90
6th month	14.26 ± 3.53	0.22 ± 0.37	2.44 ± 1.15	69.37 ± 22.76
p value	<0.001	<0.001	<0.001	0.622

BCVA: Best Corrected Visual Acuity, IOP: Intraocular Pressure, RNFL: Central retinal nerve fiber layer thickness, NA: not available

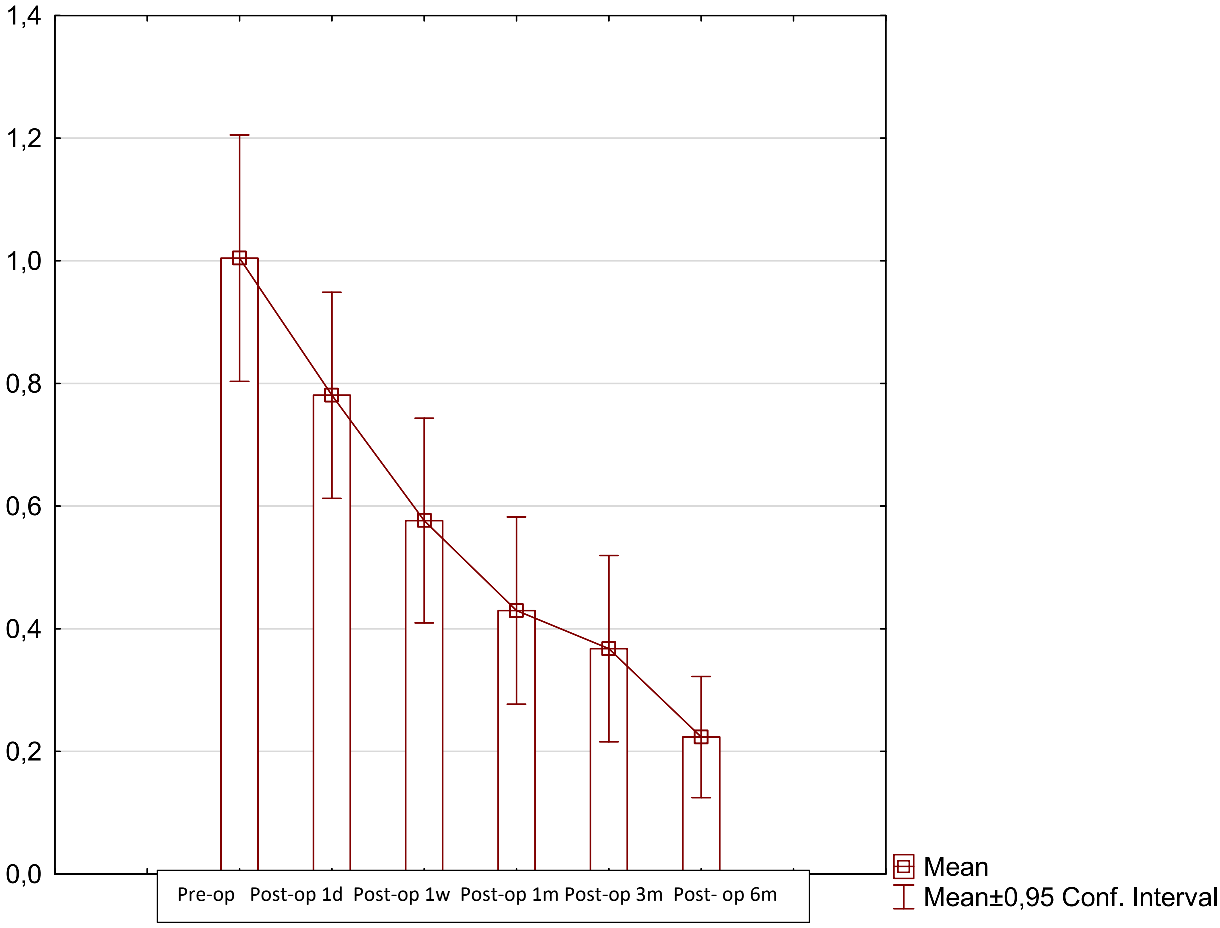

Figure 2. *Average change in best-corrected visual acuity (BCVA, logMAR)*

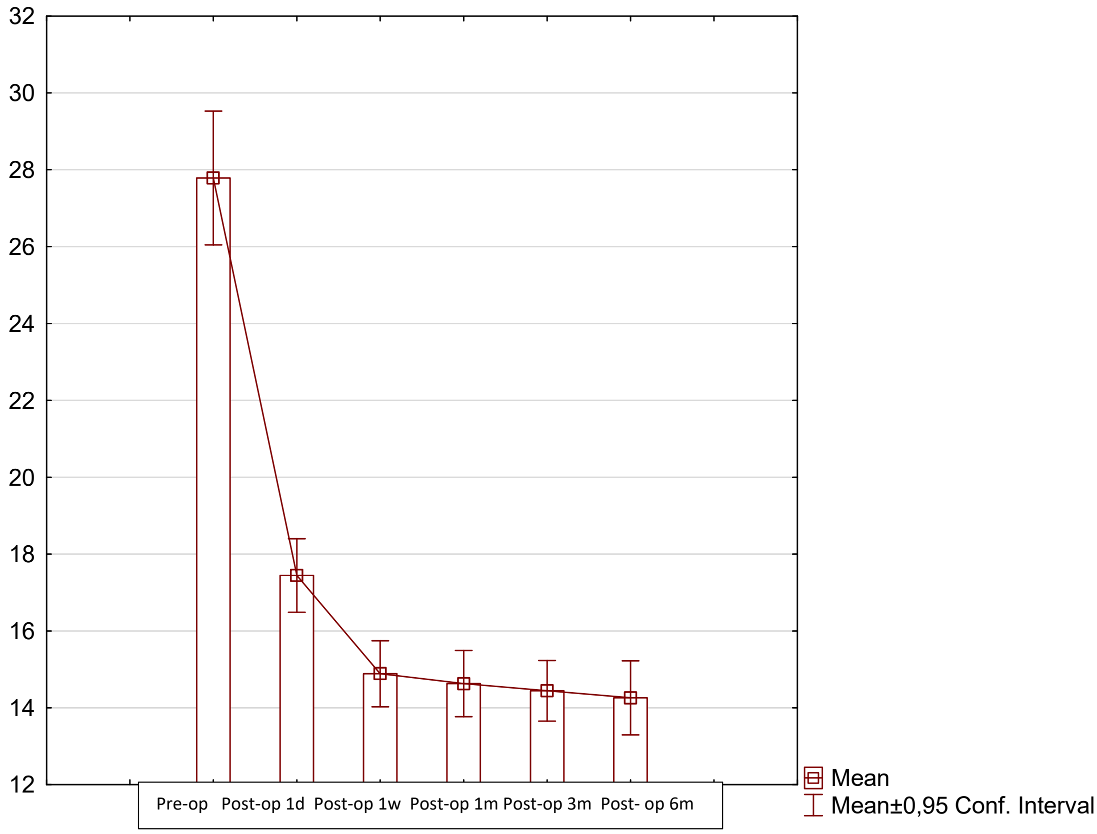

Figure 2. *Average change in intraocular pressure (IOP).*

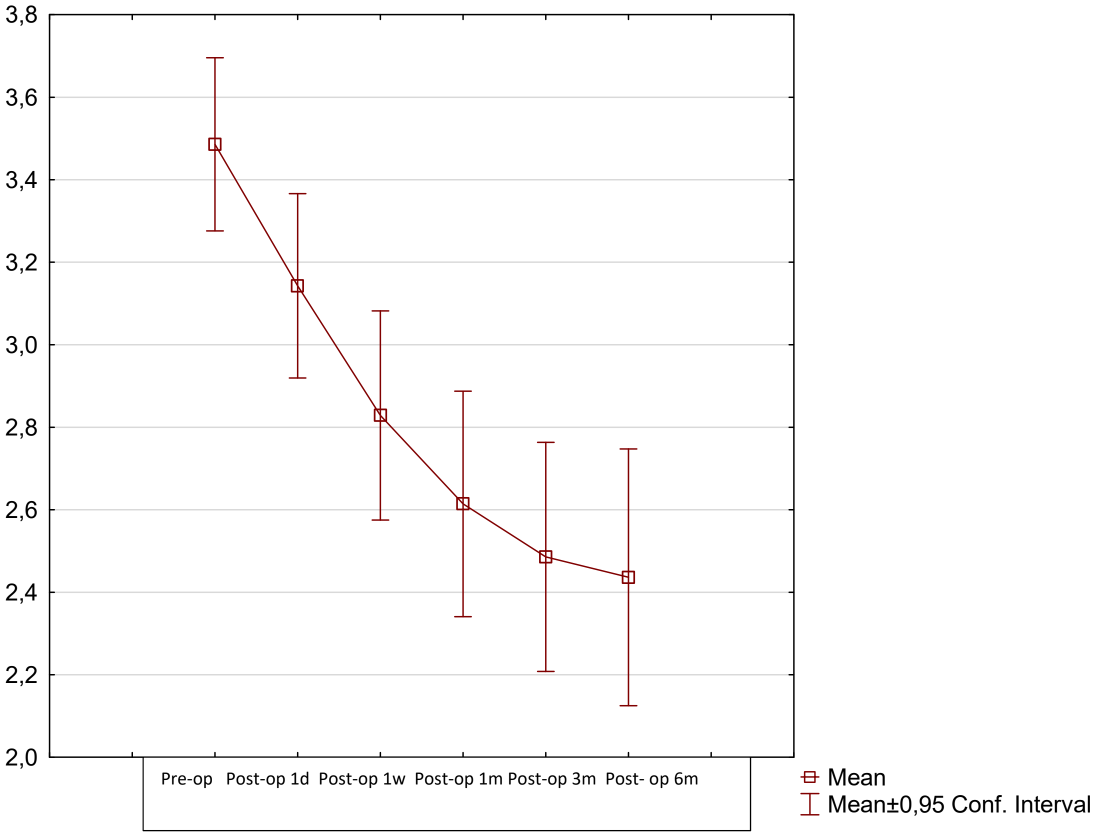

Figure 3. *Change in the total number of topical anti-glaucoma eye drops used*

DISCUSSION

Cataract surgery has an established role in the management of ACG. The results of the present study support previous reports rather than suggesting a change in current treatment paradigms.

The treatment selected for the management of chronic angle-closure glaucoma should primarily be based on the patient's clinical condition. Surgical treatment options for these patients include trabeculectomy, lensectomy, combined lensectomy and trabeculectomy, goniosynechialysis (GSL) and combined lensectomy and GSL.[7]

Angle closure becomes more prevalent with age and is therefore often seen alongside cataracts. Lensectomy can theoretically eliminate pupil block, allowing the angle to widen and IOP to decrease. However, particular caution should be exercised when planning surgery, especially in acute cases, due to factors such as high IOP, a shallow anterior chamber, corneal oedema, a reduced endothelial cell count, zonular instability and the risk of malignant glaucoma.[8]

Hayashi and colleagues used the Scheimpflug imaging system to compare anterior chamber depth and angle width before and after lensectomy in cases of angle-closure glaucoma, open-angle glaucoma and non-glaucoma.[9] They reported a significant increase in both parameters after lensectomy in all groups, and a decrease in IOP in all groups. However, there was no significant difference in IOP levels between groups. These findings support the idea that lensectomy may eliminate the anatomical mechanism of angle closure. However, it has been suggested that lensectomy alone may be ineffective in cases involving long-standing and widespread synechiae, as its ability to open adhesions may be limited.[10]

Managing cases of acute ACG that are resistant to medical and laser treatments can be challenging. One study reported a 56% success rate in patients with acute ACG who were resistant to medical treatment and underwent emergency trabeculectomy. However, this group experienced a high rate of complications. In contrast, when the acute attack was under medical control, the success rate of surgery increased to 87.5%. Due to the high failure rate and risk of complications, alternative surgical methods are therefore recommended for this subgroup of patients.[11]

Due to differences in the pattern of IOP increase in acute and chronic ACG, changes occur in RNFL.[12] It has been argued that the change in RNFL after an acute attack is a dynamic process. It has been shown that in the eye affected by an acute attack, the optic nerve is oedematous and the initial thickness of the RNFL is increased, but two weeks after the attack, the optic nerve oedema decreases and a thinning of the RNFL continues until the sixth month. No significant difference in average RNFL thickness was reported between the five different time points in eyes that had not experienced an acute attack or had chronic primary angle closure. In a study evaluating phacoemulsification and intraocular lens implantation in cataract patients with ACG in early-to-mid and advanced glaucoma groups, reported no significant decrease in the average postoperative RNFL of the three groups at six months compared to preoperative levels.[13] In normotensive and well-controlled open-angle glaucoma (OAG) eyes, cataract surgery was shown to result in a significant reduction in intraocular pressure (5.3 mmHg in OAG and 1.6 mmHg in normotensive eyes), while no statistically significant change was observed in RNFL thickness between the preoperative and postoperative periods.

If there is a sudden increase in IOP, intense blockage occurs in the cribriform plate. This can lead to disruption of axonal transport and axonal death.[14] Initially, the RNFL thickens, but over time it undergoes atrophy and begins to thin. However, in chronic ACG, since IOP increases gradually, no such change in the RNFL pattern is expected.[12]

Various studies have emphasised that lensectomy is a safer and more effective method than trabeculectomy for treating ACG.[15,16] In the 2021 EAGLE (Effectiveness of Early Lens Extraction for the Treatment of Primary Angle-Closure Glaucoma) study, patients who underwent phacoemulsification with clear lens extraction at baseline achieved long-term IOP control five times more frequently and were ten times more likely to avoid the need for medication or further surgery compared to those who underwent laser peripheral iridotomy as the initial treatment for ACG with high IOP or IOP of 21 mmHg or higher.[17] The rate of avoiding drops or surgery was 10 times higher than for those who underwent laser peripheral iridotomy as the initial treatment for ACG. The EAGLE trial excluded patients with visually significant cataracts. Therefore, its findings should not be generalised directly to cataract populations, but rather interpreted as supportive evidence for lens-based management strategies in angle-closure glaucoma.

Lensectomy does not pose a surgical problem in cases of cataracts; however, when the lens is transparent, the aim of surgery is to control glaucoma. Therefore, it is important to provide patients with detailed information. The main disadvantage of clear lens extraction is loss of accommodation. Nevertheless, given the long-term benefits of glaucoma control, prevention of optic nerve damage and avoidance of filtration surgery, this method is often recommended for presbyopic patients.[18] However, it should be noted that lens extraction in patients with angle-closure glaucoma is associated with potential intraoperative and postoperative risks. Therefore, such procedures should be performed by experienced surgeons in accordance with the recommendations of the European Glaucoma Society Guidelines (2025).[19]

Studies have shown that cataract surgery can improve visual acuity and effectively IOP in patients with ACG.[20,21] The main reason for this is that cataract surgery can deepen the anterior chamber, eliminate pupil blockage and correct narrowing of the anterior chamber angle caused by lens thickness and anterior position. Where there are no adhesions in the angle, IOP levels can be controlled by widening the angle. Cataract surgery involves a small incision and rapid wound healing. It also reduces intraoperative angle apposition caused by the effect of anterior chamber perfusion pressure on the angle.[22,23]

The effectiveness of cataract surgery in PAG/PACG cases with varying degrees of peripheral anterior synechia (PAS) is debatable. One study, it was demonstrated that surgery provided significant and sustained control of IOP in PACG patients with PAS >180°.[24] Sham et al. reported that the decrease in IOP was more pronounced in cases with higher degrees of PAS.[25]

Recent studies published in 2025 indicate that cataract surgery, either alone or combined with trabecular meshwork–based procedures, is associated with effective and sustained IOP control in patients with PACG, including advanced cases.[26,27,28] In a recent comparative study, phacoemulsification alone and phacoemulsification combined with iStent implantation achieved comparable IOP reduction in PACG patients; however, cystoid macular edema and anterior uveitis were observed in 6% of cases undergoing phaco-iStent surgery.[29] Real-world data from the IRIS Registry indicate that phacoemulsification can provide sustained IOP reduction in eyes with angle-closure mechanisms. In PACG, baseline IOP, preoperative medication burden, and disease severity appear to influence the magnitude and durability of this effect.[30]

In our study, VA improved up to the sixth month. Possible reasons for this change include the slow regression of corneal oedema in the postoperative period, a decrease in IOP, and the regression of ocular surface disease with the reduction in medication use. Additionally, challenging factors such as shallow anterior chamber, difficult surgery, prolonged surgical duration, and post-acute attack edema in the surgery of these patients may have contributed to the prolonged recovery period.

The average IOP value was 27.79 ± 7.29 mmHg under maximum medical treatment in the preoperative period, compared to 17.44 ± 4.01 mmHg on the first day after surgery, 14.89 ± 3.60 mmHg in the first week, 14.63 ± 3.61 mmHg in the first month and 14.26 ± 3.53 mmHg six months after surgery. A statistically significant difference was found between preoperative and postoperative IOP levels ($p < 0.001$).

When these findings and data from the literature are evaluated together, it is shown that visual acuity is improved by cataract surgery in patients with ACG and IOP is significantly reduced. IOP decreases most markedly in the first week and remains stable in subsequent follow-ups. The reduction in IOP also correlates with a decrease in the amount of topical medication required. It should be noted that early postoperative changes in antiglaucoma medications may be influenced by transient perioperative factors, including postoperative inflammation and wound-related IOP fluctuations. Therefore, comparisons during the early postoperative period should be interpreted with caution and primarily reflect real-world clinical practice rather than long-term treatment efficacy. Anatomical changes, such as decreased intraocular volume, increased anterior chamber depth, reduced iris-lens contact and expanded iridocorneal angles, may explain this. Therefore, with appropriate patient selection, cataract surgery can be considered a safe and effective option in the surgical management of ACG.

Early phacoemulsification and IOL implantation can be considered a reliable and effective treatment method in ACG cases with concomitant cataracts. It has been reported that the effect of lowering IOP lasts up to 10 years.[16]

In this study, patients used an average of 3.49 ± 0.88 drops of topical anti-glaucoma eye drops per day in the preoperative period, compared to 3.14 ± 0.94 drops per day on the first postoperative day, 2.83 ± 1.06 drops per day in the first week, 2.61 ± 1.15 drops per day in the first month, and 2.44 ± 1.15 drops per day in the sixth month. Oral carbonic anhydrase inhibitors taken prior to surgery were not included in these calculations. A statistically significant difference was found in terms of the number of topical medications used between the pre- and post-surgical periods ($p<0.001$). Our findings are consistent with those in the literature and show that cataract surgery reduces both IOP and the need for anti-glaucoma medication in patients with ACG. Given its probable role in stabilising the RNFL, these results may encourage clinicians to consider cataract surgery at an earlier stage in ACG patients. This reduction is particularly noticeable in the first week, improving patients' quality of life and treatment compliance, and reducing the frequency and severity of potential side effects associated with topical medications. It also preserves ocular surface health and reduces the financial burden on the healthcare system. While most studies primarily focus on anatomical changes in the anterior chamber angle or intraocular pressure control, this study also assessed structural neuro-retinal protection by monitoring changes in RNFL thickness for up to six months. However, the absence of visual field testing is a limitation of this study. Accordingly, in the present analysis, the concept of progression prevention refers to structural stability based on RNFL measurements rather than functional visual field progression. Endothelial cell density was not evaluated, and the presence and extent of PAS were not systematically assessed by gonioscopy. The other limitations of the study include the relatively small number of patients, the lack of evaluation of the anterior chamber angle using anterior segment imaging methods before and after surgery.

CONCLUSION

Cataract surgery was associated with a reduction in IOP and antiglaucoma medication use in patients with ACG in a real-world clinical setting. Not only does cataract surgery control IOP, it may contribute to the structural stability of the RNFL, thereby preventing the development of advanced visual field defects.

However, it is important that the decision to perform surgery is made only after careful evaluation and consideration of each patient's individual characteristics.

Prospective studies with multi-centre, long-term follow-up data are needed in the future, including functional tests (e.g. visual field assessments) and monitoring of the anterior chamber angle over time.

Funding

The authors declare that they did not receive any funding, grants or other support during the preparation of this article.

Conflict of Interest

The authors have no financial or non-financial interests to disclose.

Author Contributions

All authors contributed to the concept and design of the study. Material preparation was carried out by [Hamdi Sena UYDURAN]. Data collection and analysis were carried out by [Hamdi Sena UYDURAN], [Pınar ERÖZ], [Özer DURSUN] and [Ayça YILMAZ]. The first draft of the article was written by [Pınar ERÖZ]. All cataract surgeries were performed by [Ayça YILMAZ]. All authors have read and approved the final article.

Ethical approval

This study was conducted in accordance with the principles of the Helsinki Declaration. Approval was granted by the Mersin University Clinical Research Ethics Committee (07/02/2024-03-129).

Participant consent

Informed consent was obtained from all individual participants included in the study.

REFERENCES

1. Allison K, Patel D, Alabi O, Epidemiology of Glaucoma: The Past, Present, and Predictions for the Future, Cureus. 2020 Nov; 12(11): e11686.

2. Xie J, Li W, Han B. The Treatment of Primary Angle-Closure Glaucoma with Cataract: A Systematic Review and Meta-Analysis of Randomized Controlled Trails. Ophthalmol Ther. 2023 Apr;12(2):675-689.
3. Baillif S, Roure-Sobas C, Le-Duff F, Kodjikian L. Aqueous humor contamination during phacoemulsification in a university teaching hospital. J Fr Ophtalmol. 2012;35(3):153-156. doi:10.1016/j.jfo.2011.05.007
4. He Y, Zhang R, Zhang C, et al. Clinical outcome of phacoemulsification combined with intraocular lens implantation for primary angle closure/glaucoma (PAC/PACG) with cataract. Am J Transl Res. 2021 Dec 15;13(12):13498-13507.
5. Latifi G, Moghimi S, Eslami Y, Fakhraie G, Zarei R, Lin S. Effect of phacoemulsification on drainage angle status in angle closure eyes with or without extensive peripheral anterior synechiae. Eur J Ophthalmol. 2013;23(1):70-79. doi:10.5301/ejo.5000191
6. Özyol P, Özyol E. Katarakt cerrahisinin primer açı kapanması glokomuna etkisi. GloKat 2013;8:148-152.
7. Tun TA, Baskaran M, Perera SA, Htoon HM, Aung T, Husain R. Swept source optical coherence tomography assessment of iris-trabecular contact after phacoemulsification with or without goniosynechialysis in eyes with primary angle closure glaucoma. Br J Ophthalmol. 2015 Jul;99(7):927-31.
8. Tamçelik N, Atalay E, Özkök A et al. Primer Açı Kapanması Glokomunun Medikal ve Cerrahi Tedavisi. Turk J Ophthalmol. 2012 Dec;42(1):1-7. doi:10.4274/tjo.42.s1.
9. Hayashi K, Hayashi H, Nakao F, Hayashi F. Changes in anterior chamber angle width and depth after intraocular lens implantation in eyes with glaucoma. Ophthalmology. 2000 Apr;107(4):698-703.
10. Vizzeri G, Weinreb RN. Cataract surgery and glaucoma. Curr Opin Ophthalmol. 2010 Jan;21(1):20-4.
11. Aung T, Tow SL, Yap EY, Chan SP, Seah SK. Trabeculectomy for acute primary angle closure. Ophthalmology. 2000 Jul;107(7):1298-302.
12. Liu X, Li M, Zhong YM, Xiao H, Huang JJ, Kong XY. Damage patterns of retinal nerve fiber layer in acute and chronic intraocular pressure elevation in primary angle closure glaucoma. Int J Ophthalmol. 2010;3(2):152-7.
13. He Y, Zhang R, Zhang C, Jia J, Liu H, He B, Quan Z, Clinical outcome of phacoemulsification combined with intraocular lens implantation for primary angle closure/glaucoma (PAC/PACG) with cataract, Am J Transl Res. 2021; 13(12): 13498–13507.
14. Knox DL, Eagle RC Jr, Green WR. Optic nerve hydropic axonal degeneration and blocked retrograde axoplasmic transport: histopathologic features in human high-pressure secondary glaucoma. Arch Ophthalmol. 2007 Mar;125(3):347-53.
15. Man X, Chan NC, Baig N, et al. Anatomical effects of clear lens extraction by phacoemulsification versus trabeculectomy on anterior chamber drainage angle in primary angle-closure glaucoma (PACG) patients. Graefes Arch Clin Exp Ophthalmol. 2015;253(5):773-778. doi:10.1007/s00417-015-2936-z
16. Helmy H. Long-Term Effect of Early Phacoemulsification in Primary Angle Closure Glaucoma Patients with Cataract: A 10-Year Follow-Up Study. Clin Ophthalmol. 2021;15:3969-3981. Published 2021 Sep 29. doi:10.2147/OPTH.S333202
17. Mitchell WG, Azuara-Blanco A, Foster PJ, et al. Predictors of long-term intraocular pressure control after lens extraction in primary angle closure glaucoma: results from the EAGLE trial. Br J Ophthalmol. 2023;107(8):1072-1078. doi:10.1136/bjophthalmol-2021-319765
18. Azuara-Blanco A, Burr J, Ramsay C, et al; EAGLE study group. Effectiveness of early lens extraction for the treatment of primary angle closure glaucoma (EAGLE): a randomised controlled trial. Lancet. 2016 Oct 1;388(10052):1389-1397.
19. Pazos M, Traverso CE, Viswanathan A, et al. European Glaucoma Society - Terminology and guidelines for glaucoma, 6th Edition. Br J Ophthalmol. 2025;109(Suppl 1):1-212. Published 2025 Sep 8. doi:10.1136/bjophthalmol-2025-egsguidelines
20. Römkens HCS, Beckers HJM, Schouten JSAG, et al. Early Phacoemulsification After Acute Angle Closure in Patients With Coexisting Cataract. J Glaucoma. 2018 Aug;27(8):711-716.
21. Bayraktar S, Yıldırım Erdal BD, Altaş FB, Türkay M, Şen E. The Effects of Lens Extraction Surgery on Intraocular Pressure and Anterior Segment Parameters in Primary Angle-Closure Glaucoma. Turk J Ophthalmol. 2024;54(1):32-37. doi:10.4274/tjo.galenos.2023.82453
22. Kohnen T, Baumeister M, Kook D, Klaproth OK, Ohrloff C. Cataract surgery with implantation of an artificial lens. Dtsch Arztebl Int. 2009 Oct;106(43):695-702
23. Hansapinyo L, Choy BNK, Lai JSM, Tham CC. Phacoemulsification Versus Phacotrabeculectomy in Primary Angle-closure Glaucoma With Cataract: Long-Term Clinical Outcomes. J Glaucoma. 2020 Jan;29(1):15 23.
24. Zhuo YH, Wang M, Li Y, et al. Phacoemulsification treatment of subjects with acute primary angle closure and chronic primary angle-closure glaucoma. J Glaucoma. 2009 Dec;18(9):646-51.
25. Shams PN, Foster PJ. Clinical outcomes after lens extraction for visually significant cataract in eyes with primary angle closure. J Glaucoma. 2012;21(8):545-50.
26. Fang Z, Song Y, Jin L, Han Y, Zhang X. Phacoemulsification combined with trabecular meshwork-Schlemm canal-based minimally invasive glaucoma surgery in primary angle-closure glaucoma: a systematic review and meta-analysis. BMC Ophthalmol. 2025;25(1):168. Published 2025 Apr 3. doi:10.1186/s12886-025-04005-y
27. Song Y, Fan S, Tang L, et al. Two-Year Outcomes of Phacogoniotomy vs Phacotrabeculectomy for Advanced Primary Angle-Closure Glaucoma With Cataract: A Noninferiority Rando-

mized Clinical Trial. JAMA Ophthalmol. 2025;143(6):462-469. doi:10.1001/jamaophthalmol.2025.0685

28. Sozen-Delil FI, Simsek S. Impact of preoperative factors on intraocular pressure following phacoemulsification in acute primary angle-closure glaucoma. Turk J Clin Exp Ophthalmol. 2025;20:159-167. doi:10.37844/TJ-CEO.2025.20.22
29. Issa S, Ginés-Gallego C, Griffin B, et al. Cataract surgery with and without trabecular micro-bypass stent in primary angle-closure glaucoma: a multi-centre cohort study. Eye (Lond). 2025;39(14):2671-2677. doi:10.1038/s41433-025-03923-x
30. Rothman AL, Chang TC, Lum F, Vanner EA. Predictors of intraocular pressure response and survival after phacoemulsification for glaucomatous eyes in the IRIS registry (Intelligent Research in Sight). Sci Rep. 2024;14(1):19050. Published 2024 Aug 17. doi:10.1038/s41598-024-70148-5