Original Article

Combined Trabeculectomy with Manual Small-Incision Cataract Surgery in Primary Open-Angle and Angle-Closure Glaucoma with Cataract: Visual and Intraocular Pressure Outcomes

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Abstract

Background: Glaucoma is a major cause of irreversible blindness worldwide, greatly affecting vision and quality of life. This study aimed to assess visual outcomes and intraocular pressure changes following combined trabeculectomy and manual small-incision cataract surgery in patients with significant cataract and coexisting glaucoma whose pressure was uncontrolled or who poorly tolerated or complied with medications. **Methods:** This prospective observational case series study at the Department of Glaucoma, National Institute of Ophthalmology and Hospital, Bangladesh (July 2021–June 2022), included 80 patients with significant cataract and POAG or PACG. Patients underwent combined MSICS with PMMA IOL and mitomycin-C–assisted trabeculectomy performed by fellowship-trained surgeons. BCVA, IOP, optic nerve status, bleb morphology, complications, and additional interventions were recorded preoperatively and up to 6 months postoperatively. Data were analyzed using SPSS v16 (paired t-test, $p < 0.05$). **Results:** Among 80 patients (42 PACG, 38 POAG; mean age 60.1 ± 8.8 years), most had nuclear cataract (85%) and moderate to advanced glaucoma. At six months, 90% achieved BCVA of 6/6–6/18, mean IOP decreased by 16.6 ± 7.5 mmHg, Intra- and postoperative complications occurred in 15% and 27.5% of eyes, respectively, with PCO being the most common (11.2%). **Conclusion:** This study shows that performing combined trabeculectomy and cataract surgery at the same setting is an effective approach for patients with coexisting glaucoma and cataract.

Keywords: Visual Outcomes, Intraocular Pressure, Trabeculectomy, MSICS, PACG, POAG

https://doi.org/10.3329/jnio.v7i1.88004 *(J.Natl.Inst.Ophthalmol.2024;7(2):47-56)*

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Received: 2 Nov. 2024 **Accepted:** 23 Dec. 2024

Introduction

Glaucoma is an important cause of blindness worldwide, responsible for approximately 15% of global blindness, making it the second leading cause after cataract [1]. It causes irreversible vision loss, posing a major public health challenge. Worldwide, nearly 8 million people were bilaterally blind due to glaucoma in 2010, and this number is projected to rise to 11.1 million by 2020 [1]. In Bangladesh, the National Blindness and Low Vision Survey reported that 1.2% of adult blindness and 13.8% of low vision is due to glaucoma, indicating that the actual burden of disease may be underrecognized. With an estimated 26 million adults aged 40 years and older, up to 586,000 people in Bangladesh could have glaucoma [2].

Glaucoma is not a single disease but a group of disorders characterized by optic nerve head cupping, visual field loss, and often elevated

intraocular pressure (IOP). Early diagnosis and effective treatment are crucial to prevent blindness, especially in developing countries where patients are frequently undiagnosed or lack access to care. Management aims to preserve visual function while maintaining quality of life, primarily by lowering IOP to minimize further glaucomatous damage. Medical therapy is the first-line treatment, while surgical intervention is indicated when the target IOP is not achieved, glaucomatous progression occurs, or patients cannot tolerate or comply with anti-glaucoma medications [3].

Trabeculectomy is the most performed glaucoma surgery for adults, lowering IOP by creating a fistula from the anterior chamber to the sub-Tenon's space, protected by a superficial scleral flap [4]. When cataract coexists with glaucoma, which is frequent in older adults [5], surgeons must decide between cataract surgery alone or combined with trabeculectomy. Literature suggests that combined surgery is preferable if the patient may require cataract surgery after trabeculectomy, as separate procedures can compromise IOP control and bleb function [6,7].

Manual small-incision cataract surgery (MSICS) combined with trabeculectomy is a practical option in resource-limited settings or in cases of hard cataract or small pupil, where phacoemulsification may be challenging [8]. However, glaucoma surgery itself increases the risk of cataract development, with trabeculectomy raising the risk by 78% compared to non-operated eyes, due to factors such as age, prolonged miotics use, surgical manipulation, postoperative inflammation, and flat anterior chamber [7]. Conversely, cataract extraction after trabeculectomy may reduce bleb function, leading to higher postoperative IOP, with 10–38% of eyes requiring additional medications or glaucoma surgery after extracapsular cataract extraction with IOL implantation [9].

Although combined trabeculectomy with MSICS or ECCE is frequently performed, limited data exist from developing countries regarding outcomes, including IOP reduction and postoperative complications [8,10,11]. Adoption of refined surgical techniques may reduce complication rates [12,13].

Thus, this study was designed to evaluate visual outcomes and intraocular pressure changes following combined trabeculectomy and manual small-incision cataract surgery in patients with visually significant age-related cataract and coexisting primary open-angle glaucoma (POAG) or primary angle-closure glaucoma (PACG) whose IOP was not controlled with maximum medications or in patients with allergy or poor compliance to anti-glaucoma medications.

Methodology & Materials

This prospective, longitudinal observational case series study was conducted in the Department of Glaucoma at the National Institute of Ophthalmology and Hospital, Bangladesh, between July 2021 and June 2022. A total of 80 patients were enrolled using purposive sampling based on predefined inclusion and exclusion criteria to evaluate the outcomes of combined trabeculectomy and manual small-incision cataract surgery (MSICS). All examinations and surgeries were performed by fellowship-trained glaucoma surgeons.

Inclusion Criteria

- Visually significant age-related cataract.
- Diagnosed primary open-angle glaucoma (POAG) or primary angle-closure glaucoma (PACG).
- Intraocular pressure (IOP) not controlled with maximum tolerated medical therapy, or
- Allergy or intolerance to anti-glaucoma medications, or
- Poor compliance with anti-glaucoma medications.

Exclusion Criteria

For Glaucoma

- Secondary glaucoma associated with ocular or systemic abnormalities.
- History of previous glaucoma surgery.
- Planned glaucoma procedure other than trabeculectomy.

For Cataract

- Complicated cataract.
- Traumatic cataract.
- Secondary cataract.
- Hyper-mature cataract.

- Subluxated lens.
- Cataract with corneal opacity.
- Posterior segment diseases such as diabetic retinopathy or age-related macular degeneration.
- Planned cataract surgical technique other than MSICS.

Preoperative Evaluation

Preoperative data—including visual acuity, IOP, glaucoma type, prior surgeries, medications, and ocular comorbidities—were collected using a structured questionnaire. Visual acuity was measured using the Snellen chart and later converted to logMAR for analysis. IOP was assessed with Goldmann applanation tonometry. Slit-lamp biomicroscopy with a +78D lens was performed to evaluate the optic nerve head, and cataract type was documented.

Surgical Technique

All surgeries followed a standardized protocol. Peribulbar anesthesia was administered, followed by creation of a partial-thickness scleral tunnel and extension into clear cornea. MSICS was performed with PMMA intraocular lens implantation. Trabeculectomy was then completed with mitomycin-C–assisted scleral flap construction and placement of releasable sutures. Intra-operative events and their management were documented.

Postoperative Care and Follow-up

Postoperative management included topical antibiotics and steroids with gradual tapering. Additional treatments—such as anti-glaucoma medications, cycloplegics, bleb massage, or further surgical interventions—were given based on postoperative IOP and clinical findings. Follow-up examinations were conducted on day 1, day 7, and at 1, 3, and 6 months. At each visit, BCVA, IOP, bleb morphology, complications, and any additional interventions were recorded.

Outcome Measures and Data Analysis

Primary outcomes included complete success, qualified success, failure, postoperative visual acuity changes, and the need for additional procedures. Data were entered into SPSS (version 16) and analyzed using paired t-tests, with a significance threshold of $p < 0.05$.

Ethical Considerations

Ethical approval was obtained from the NIOH review boards. Written informed consent was obtained from all participants.

Results

The study included 80 patients, with 42 diagnosed with PACG and 38 with POAG. The mean age of the study population was 60.11 ± 8.8 years, ranging from 35 to 85 years, with most patients in the 56–65 years (48.8%, n = 39) and 66–85 years (22.5%, n = 18) age groups. Overall, 51.2% (n = 41) were male and 48.8% (n = 39) were female. Among PACG patients, 24 were female and 18 were male, while in the POAG group, 23 were male and 15 were female. A majority of patients (85%, n = 68) presented with nuclear cataract of varying grades, while 12.5% (n = 10) had posterior subcapsular cataract. (Table 1)

Table 1: Baseline Ocular Characteristics of Study Participants (n = 80)

Characteristics		PACG, n(%)	POAG, n(%)	P Value
Sex	Male	18 (42.9%)	23 (60.5%)	0.088
	Female	24 (57.1%)	15 (39.5%)	
Age (years)	Mean age (SD)	59.02 ± 8.94	61.32 ± 8.69	0.249
	Range	38 – 75	44 – 82	
Visual Acuity	LogMAR VA	0.9571 ± 0.54466	0.9053 ± 0.49097	0.655
Pre - IOP	Mean IOP (mmHg)	29.90 ± 6.596	29.79 ± 5.951	0.935
Types of Cataract	Nuclear Sclerosis	34 (80.9%)	34 (89.5%)	0.332
	Cortical	2 (4.8%)	0 (0%)	
	Posterior Subcapsular	6 (14.3%)	4 (10.5%)	

Over half of the patients (56.2%, n = 45) had systemic diseases, with hypertension being the most common (21.2%, n = 17), diabetes mellitus alone in 6.2% (n = 5), and both hypertension and diabetes in 17.5% (n = 14); 35 patients had no systemic diseases. No significant differences were observed between PACG and POAG groups in baseline ocular characteristics.

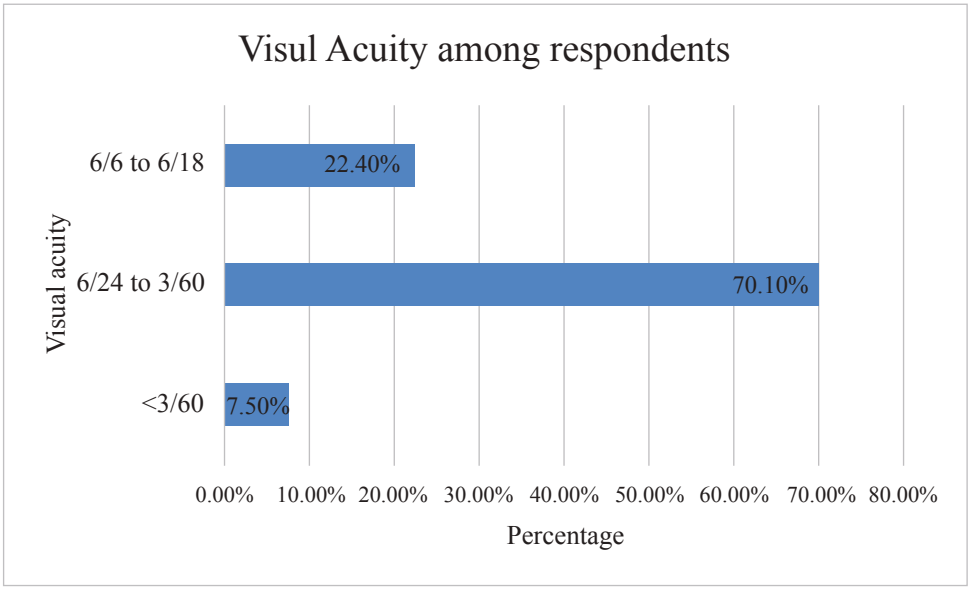

Figure 1: Distribution of Pre-operative Visual Acuity in Study Patients (n = 80)

Pre-operative visual acuity was categorized into three groups. Among the study participants, 7.50% of patients had a visual acuity worse than 3/60, 22.40% had visual acuity between 6/24 and 3/60, and 70.10% had visual acuity between 6/6 and 6/18. The mean pre-operative logMAR visual acuity of the study population was 0.9325 ± 0.5172. (figure 1)

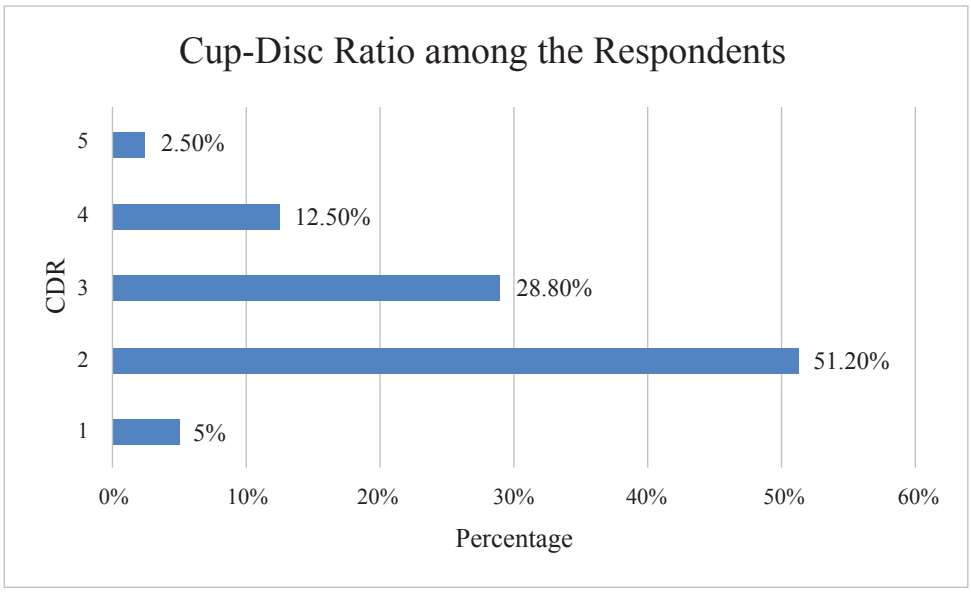

Figure 2: Distribution of Cup–Disc Ratio (CDR) in the Study Population (n = 80)

The cup–disc ratio (CDR) of study participants was assessed to evaluate the severity of glaucomatous optic neuropathy. Among the patients, 2.5% (n = 2) presented with advanced glaucoma with a CDR of 0.9 at diagnosis. In 5% of patients (n = 4), the fundus was not assessable due to hazy media. The remaining patients had moderate glaucomatous optic neuropathy, with CDR values predominantly between 0.6 and 0.8. (Figure 2)

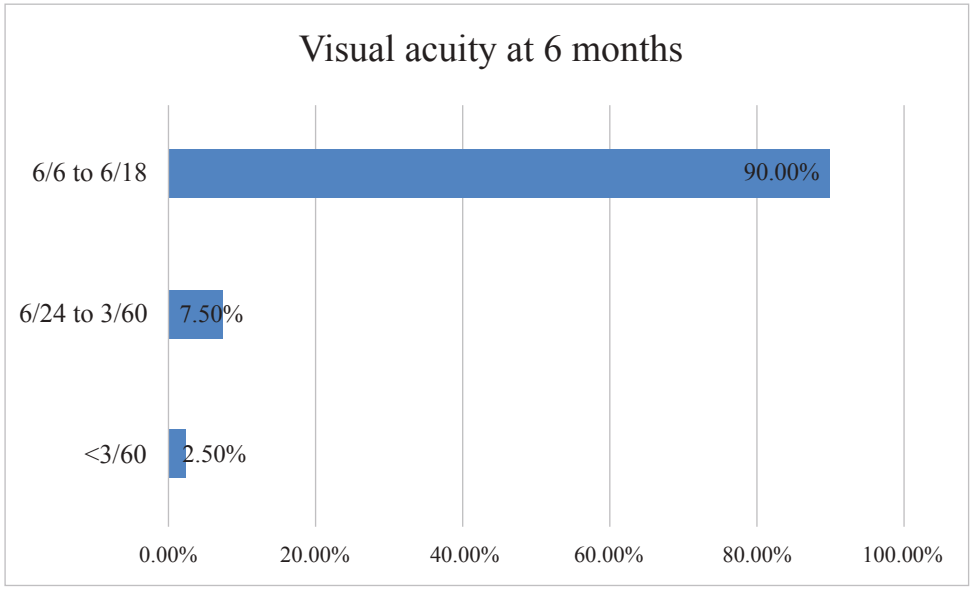

Figure 3: Postoperative Visual Acuity at 6 Months in Study Patients (n = 80)

Postoperative best-corrected visual acuity (BCVA) at 6 months was categorized into three groups. The majority of patients (90%) achieved a visual acuity between 6/6 and 6/18. Visual acuity between 6/24 and 3/60 was observed in 7.5% of patients, while only 2.5% of patients had a postoperative visual acuity worse than 3/60. (Figure 3)

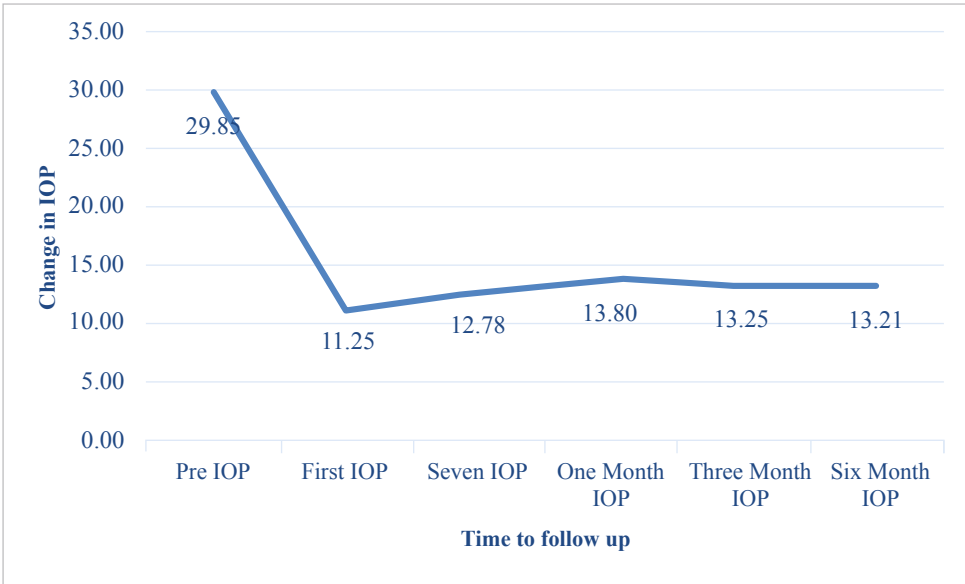

Figure 4: Changes in Mean Intraocular Pressure (IOP) Before and Six Months After Surgery (n = 80)

Mean intraocular pressure (IOP) was significantly reduced after combined trabeculectomy and manual small incision cataract surgery. The mean IOP reduction at six months postoperatively was 16.64 ± 7.54 mmHg. Postoperative IOP was further categorized into three ranges: <6 mmHg, 6–21 mmHg, and >21 mmHg. Most of the patients achieved target IOP within the 6–21 mmHg range at all follow-up intervals. (Figure 4)

Table 2: Intra-operative Complications During Combined Surgery (n = 80)

Complications	Frequency	%
No	68	85.0
Premature entry	1	1.2
Posterior capsular rupture	1	1.2
Zonular dialysis	1	1.2
Descemets detachment	1	1.2
Rhexis extension	2	2.5
Hyphaema	2	2.5
Conjunctival button hole	1	1.2
Loose suture	3	3.8
Total	**80**	**100.0**

Intra-operatively, 85% of surgeries (n = 68) were uneventful. The most common complications included hyphaema, loose scleral flap sutures, and rhexis extension. Less frequent complications were premature entry, Descemet's detachment, and conjunctival buttonhole. Posterior capsular rupture occurred in one patient. (Table 2). Two cases of hyphaema resolved spontaneously within two weeks, while three cases of loose scleral flap sutures required flap re-suturing due to persistent over-filtration.

Table 3: Postoperative Complications Following Combined Surgery (n = 80)

Complications	N	%
No	58	72.5
PCO	9	11.2
Hyphaema	1	1.2
Vitreous hemorrhage	1	1.2
Late postoperative uveitis	1	1.2
Cystic bleb	2	2.5
Severe postoperative uveitis	1	1.2
IOL decentration	2	2.5
Iridodialysis	1	1.2
Wipe-out	1	1.2
Over-filtration	3	3.8
Total	**80**	**100.0**

Postoperatively, 72.5% of patients (n = 58) experienced no significant complications, while 27.5% (n = 22) developed various complications. Posterior capsular opacification (PCO) was the most common (11.2%, n = 9), followed by over-filtration (3.8%, n = 3), cystic bleb (2.5%, n = 2), and IOL decentration (2.5%, n = 2). One patient developed no perception of light (No PL) postoperatively, classified as surgical failure. Among patients without significant complications, 40% were PACG and 33% POAG. PCO was more frequent in POAG (8.8%, n = 7) compared to PACG (2.5%, n = 2). Other complications were distributed equally between the two groups. Contributing factors for PCO development included younger age (<50 years), diabetes, posterior subcapsular cataract, use of PMMA IOLs, multiple surgeons, and manual SICS technique. (Table 3)

Discussion

The coexistence of cataract and glaucoma and their management remain a challenging and unresolved issue. This study evaluated the outcomes of combined cataract extraction and trabeculectomy at National Institute of Ophthalmology and Hospital, Bangladesh.

As per the study selection criteria, 80 patients were included in the analysis. There were no statistically significant differences in baseline characteristics among the patients. The mean IOP reduction from baseline to 24 weeks was 16.64 ± 7.54 mmHg. At baseline, all patients (100%) had an IOP of 21 mmHg or higher. The results in terms of IOP control were similar to or better than previous studies; for instance, Kabiru et al. reported 73% of eyes achieving postoperative IOP ≤15 mmHg and 90% ≤21 mmHg over 8 months of follow-up [14]. Soatiana et al. and Bowman et al. observed comparable results with no significant differences across varying follow-up periods [15,16]. In this study, the target IOP of ≤21 mmHg was achieved in over 90% of eyes, which is higher than the 66% and 62% reported by Bowman et al. and Chang et al.[16,17], respectively.

The mean preoperative IOP was 29.90 ± 6.5 mmHg, slightly higher in PACG compared to POAG eyes, though the success rate in terms of IOP control was higher in POAG. The mean percentage reduction in IOP was 55%, exceeding that reported in earlier combined surgery studies [18,19], reported mean reductions of 12–19.2% in a retrospective analysis of phacotrabeculectomy without antimetabolites. The greater percentage reduction in this study may be attributable to the higher preoperative IOP, which should be considered when comparing outcomes across studies. Various studies report IOP changes after combined trabeculectomy and cataract extraction, ranging from 12–18 mmHg over follow-ups of 8 to 70 months, consistent with our findings [12,13,20]. While previous studies suggest that higher preoperative IOP may reduce trabeculectomy success, in this study, preoperative IOP did not influence the success or failure of combined surgery. These results align with a retrospective South Indian study using scleral tunnel combined surgery with a 6-month follow-up [8]. Other preoperative variables, including systemic diseases, prior laser peripheral iridotomy, and the number of anti-glaucoma medications, were also not associated with significant postoperative IOP increases.

Visual outcomes were encouraging, with 90% of patients returning for 24-week follow-up achieving improvement to 6/18 or better. Bowman reported a 40% improvement to 6/18 or better, while Coleman observed similar logMAR visual acuity improvements (p = 0.01) in patients undergoing phaco alone [16,21]. Phacoemulsification remains uncommon in developing countries like Bangladesh [16]. Studies from developed countries with less advanced disease report higher visual gains, such as 96% improvement in study Stark et al [19]. In this study, combined trabeculectomy with manual small incision cataract surgery (MSICS) with PIOL implantation produced visual outcomes comparable to phacoemulsification combined surgery. Jampel et al. and Venkatesh et al. reported insufficient evidence to favor phaco

over MSICS in combined glaucoma and cataract surgery [8,20]. Gender, cataract type, and preoperative IOP did not significantly influence visual outcomes. Bowman et al.[16] similarly found that operation type, surgeon, and intra- or postoperative complications did not significantly affect visual results.

Overall surgical success, with or without medications, exceeded 90%, higher than that reported in Indian study [22], where a success rate of 58% was reported in East African 5-fluorouracil-augmented combined surgery [16]. Stalmans et al. reported 90.9% success beyond 12 months following safe-surgery trabeculectomy, while Dhingra et al. found 74% of eyes maintaining IOP <15 mmHg at 3 years without medications [18,23]. The outcomes in this study align with medium and long-term results of safe-surgery trabeculectomy combined with cataract extraction.

Most patients experienced minimal surgical complications. Surgery was uneventful in 85% of cases. Hypotony due to over-filtration and diffuse blebs were the most common complications within the first month postoperatively. Bowman et al. reported corneal epithelial defects as a high-risk complication [16], which were rare in this study. Other postoperative complications included uveitis, hyphaema, and IOL decentration, consistent with previous reports [20,22]. Posterior capsular opacification (PCO) was the most common complication (11.2%). Early PCO development may be influenced by younger age (<50 years), diabetes, PMMA IOLs, multiple surgeons, and MSICS technique. These factors require further investigation, which was not conducted in this study, representing a limitation.

Penetrating glaucoma surgery carries a risk of infection compared with non-penetrating procedures. The risk of endophthalmitis with MMC or 5-FU is comparable [27,28]. In this study, no bleb-related complications or endophthalmitis occurred despite universal MMC use. The Collaborative Initial Glaucoma Treatment Study reported a 1.1% endophthalmitis risk at 7 years and 14% requiring bleb revision; blebitis, bleb leak, and hypotony were also noted. In contrast, none of these complications occurred in this study [13,20,22].

Eighty percent (n = 64) of patients presented with advanced glaucomatous cupping at first visit. In developing countries like Bangladesh, glaucoma often presents with symptomatic severe visual loss or acute painful attacks [29.30]. Disease management is challenging in areas with limited access to affordable care [31].

Anterior chamber angle configuration significantly influences IOP reduction after cataract surgery. In PACG, the width and depth of the anterior chamber angle increase after lens extraction and IOL implantation, producing greater IOP reduction than in POAG or normal eyes [24,25]. Increased mechanical tension on the annulus and widening of trabecular spaces facilitate aqueous outflow [25]. Filtering bleb efficacy diminishes over time, particularly when cataract surgery follows trabeculectomy soon after, increasing bleb failure risk [32]. Cataract is the most common complication in eyes undergoing trabeculectomy with MMC [7]. In this study, most patients maintained a well-functioning bleb, and IOP remained within target levels, though long-term follow-up is needed.

Trabeculectomy in pseudophakic eyes has been associated with lower success, partly due to Tenon's cyst formation. Some authors recommend antimetabolite use or alternative procedures in pseudophakic eyes [27]. Considering limited infrastructure, resources, inconsistent follow-up, and patient non-compliance, combined cataract and glaucoma surgery represents a cost-effective and practical approach in developing countries [31,33,34]. Therefore, careful surgical decision-making is essential when cataract and glaucoma coexist.

Limitations of the study

The study had a few limitations:

- Follow-up limited to six months, restricting assessment of long-term outcomes.
- Single-center, non-randomized design may limit generalizability and introduce selection bias.
- Lack of comparison group limits direct comparative conclusions.

Conclusion

Combined trabeculectomy with manual small-incision cataract surgery provides effective intraocular pressure control and favorable visual outcomes in patients with coexisting glaucoma and cataract. In resource-limited settings, this single-stage procedure represents a safe, cost-effective, and practical surgical strategy.

Conflict of interest

None

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