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Original Research Article

Risks of Antiglaucoma Medications in Patients with Cataract

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Abstract:

Background: Glaucoma and cataract are common age-related ocular diseases that frequently coexist. While medical therapy remains the mainstay of glaucoma management, the long-term use of topical antiglaucoma medications may pose significant hazards, including ocular surface damage, cataract progression, and systemic side effects. Understanding these risks is essential for optimizing patient care.

Aim: To evaluate the ocular and systemic hazards of medical glaucoma therapy in patients with coexisting cataract.

Methods: A prospective observational study was conducted at the Department of Ophthalmology, Anugraha Narayan Magadh Medical College and Hospital, Gaya, over a period of 12 months. A total of 107 patients with cataract receiving medical therapy for glaucoma were enrolled. Detailed ocular examinations, including best corrected visual acuity, intraocular pressure measurement, slit-lamp biomicroscopy, and lens opacity grading (LOCS III), were performed at baseline and follow-up visits. Adverse ocular and systemic effects of glaucoma medications were recorded. Statistical analysis was carried out using SPSS version 23.0, with $p<0.05$ considered significant.

Results: The mean age of patients was 62.8 ± 8.4 years, with a male-to-female ratio of 1.3:1. Primary open-angle glaucoma was the most common type (66.4%), and prostaglandin analogues were the most prescribed drugs (40.2%). Cataract progression was observed in 61 patients (57.0%), with posterior subcapsular cataract showing significant association with prostaglandin analogue use ($p=0.021$). Ocular adverse effects were noted in 46 patients (43.0%), predominantly conjunctival hyperemia (21.5%) and ocular surface dryness (15.9%). Systemic side effects occurred in 11 patients (10.3%), mainly in those on beta-blockers, including bradycardia and respiratory symptoms.

Conclusion: Medical therapy for glaucoma, while effective in lowering intraocular pressure, is associated with significant ocular and systemic hazards in cataract patients. Prostaglandin analogues were significantly linked to posterior subcapsular cataract progression, while beta-blockers contributed to systemic complications.

Recommendations: Regular monitoring for ocular and systemic side effects, cautious selection of drug regimens, use of preservative-free formulations when possible, and individualized therapy based on patient comorbidities are recommended. Further long-term studies are warranted to assess the cumulative effects of glaucoma therapy on cataract progression and surgical outcomes.

Keywords: Glaucoma Therapy, Cataract Progression, Prostaglandin Analogues, Beta-Blockers, Ocular Surface Disease.

Introduction

Glaucoma therapy relies heavily on long-term topical medications, yet these agents are not without hazards, particularly in patients who also suffer from cataract. Benzalkonium chloride (BAK), the preservative most frequently used in antiglaucoma eye drops, has been shown to exert cytotoxic effects on conjunctival and corneal epithelial cells, contributing to ocular surface disease and compromising ocular health [1]. Even at very low concentrations, BAK can impair meibomian gland function, alter tear film stability, and trigger ocular surface dysfunction, thereby accelerating discomfort and treatment intolerance [2]. Among the pharmacological agents, prostaglandin analogues (PGAs) remain the most widely used first-line therapy because of their potent intraocular pressure–

lowering efficacy. However, PGAs are well known to induce ocular adverse effects including conjunctival hyperemia, eyelash hypertrichosis, periocular pigmentation, and superficial punctate keratitis [3]. Prolonged topical glaucoma therapy overall has been strongly associated with ocular surface disease, which reduces patient comfort, lowers adherence, and may negatively impact surgical outcomes in those requiring cataract surgery [4].

Beta-adrenergic blockers such as timolol, still commonly prescribed as monotherapy or adjuncts, pose both local and systemic hazards. Systemically, these drugs can reduce resting pulse rate, blood pressure, and spirometry values, and in some cases precipitate bradycardia or bronchospasm in susceptible individuals [5]. Locally, beta-blockers may reduce tear secretion, impair corneal epithelial healing, and provoke allergic reactions or ocular surface dryness, further compounding the risks in cataract patients [6]. The role of preservatives has also been highlighted, as newer evidence indicates that BAK is not essential for maintaining sterility of glaucoma medications and its continued use may cause more harm than benefit by aggravating ocular surface pathology [7]. Collectively, these findings suggest that while topical glaucoma therapy is indispensable, its hazards—particularly in patients with coexisting cataract—warrant careful drug selection, close monitoring, and individualized treatment strategies.

Methodology

Study Design: This research was designed as a prospective observational study.

Study Setting: The study was conducted in the Department of Ophthalmology at Anugraha Narayan Magadh Medical College and Hospital, Gaya, Bihar. The hospital, being a tertiary care teaching institute, caters to a wide patient population from urban as well as rural areas, thus providing a diverse study sample.

Study Duration: The duration of the study was 12 months, ensuring adequate patient recruitment and follow-up to analyze the short-term and intermediate hazards of medical glaucoma therapy in cataract patients.

Participants: A total of 107 patients diagnosed with cataract and receiving medical treatment for glaucoma were enrolled in the study. The participants were selected consecutively from outpatient and inpatient departments based on eligibility criteria. Written informed consent was obtained from all participants prior to enrollment.

Inclusion Criteria

- Patients aged 40 years and above diagnosed with cataract and coexisting glaucoma.
- Patients receiving medical therapy for glaucoma (monotherapy or combination therapy).
- Patients willing to participate and provide informed consent.

Exclusion Criteria

- Patients with secondary glaucoma (e.g., neovascular, uveitic glaucoma).
- Patients with history of ocular trauma or previous ocular surgery.
- Patients with systemic diseases affecting lens opacity (e.g., uncontrolled diabetes mellitus).
- Patients who did not provide informed consent or were lost to follow-up.

Bias: To minimize selection bias, a consecutive sampling method was applied. Information bias was reduced by ensuring standardized data collection through predesigned proformas. Observer bias was minimized by involving more than one examiner for clinical evaluation and masking the identity of the patient's therapy whenever feasible.

Data Collection: Data was collected using a structured case record form that included demographic details, ocular history, systemic comorbidities, type and duration of glaucoma therapy, visual acuity, intraocular pressure (IOP), and slit-lamp findings. Lens opacity was graded using the Lens Opacities Classification System (LOCS III). Side effects and hazards associated with glaucoma medications were systematically documented.

Procedure: Each patient underwent a detailed ophthalmological examination, including measurement of best corrected visual acuity (BCVA), IOP assessment by Goldmann applanation tonometry, slit-lamp examination, gonioscopy, and fundus evaluation. The presence and severity of cataract were recorded at baseline and during follow-up visits. Patients were monitored for medication-induced ocular surface changes, lens changes, and systemic side effects. Follow-up assessments were carried out at regular intervals over the 12-month period.

Statistical Analysis: The collected data were entered into Microsoft Excel and subsequently analyzed using (SPSS) version 23.0. Descriptive statistics such as mean, standard deviation, and percentages were used to summarize demographic and clinical variables. Inferential statistics, including Chi-square test for categorical data and t-test/ANOVA for continuous variables, were applied to determine statistical significance. A p-value <0.05 was considered statistically significant.

Results

A total of 107 patients with coexisting cataract and glaucoma on medical therapy were enrolled. The

mean age of participants was 62.8 ± 8.4 years (range 45–81 years). Out of these, 61 (57.0%) were male and 46 (43.0%) were female, with a male-to-female ratio of 1.3:1.

Table 1. Age and Gender Distribution of Participants (N=107)

Age Group (years)	Male (n=61)	Female (n=46)	Total (%)
40–49	7	5	12 (11.2)
50–59	18	14	32 (29.9)
60–69	22	18	40 (37.4)
≥70	14	9	23 (21.5)
Total	**61**	**46**	**107 (100)**

Majority (37.4%) of patients were in the 60–69 years age group.

Type of Glaucoma and Therapy Used: The most common type of glaucoma was Primary Open-Angle Glaucoma (POAG) in 71 patients (66.4%), followed by Primary Angle-Closure Glaucoma (PACG) in 36 patients (33.6%). Regarding therapy, Prostaglandin analogues (PGA) were the most commonly prescribed (40.2%), followed by Beta-blockers (32.7%), Carbonic anhydrase inhibitors (14.0%), and Combination therapy (13.1%).

Table 2. Distribution of Patients by Glaucoma Type and Medical Therapy

Type of Glaucoma	N (%)	Common Drug Regimens (%)
POAG (n=71)	66.4	PGA (45.1), BB (29.6), Others (25.3)
PACG (n=36)	33.6	BB (38.9), CAI (16.7), Combination (44.4)

POAG was more common, with prostaglandin analogues being the preferred choice of therapy.

Cataract Type and Progression: At baseline, Nuclear sclerosis (NS) was the most common cataract type (48.6%), followed by Cortical (32.7%) and Posterior Subcapsular Cataract (PSC) (18.7%). During the 12-month follow-up, progression of cataract was noted in 61 patients (57.0%), with a statistically significant association observed between PGA use and PSC progression (p = 0.021).

Table 3. Cataract Type and Progression During Follow-up

Cataract Type	Baseline (n, %)	Progression After 12 Months (n, %)	p-value
Nuclear Sclerosis	52 (48.6)	25 (23.4)	0.162
Cortical	35 (32.7)	18 (16.8)	0.087
Posterior Subcapsular	20 (18.7)	18 (16.8)	**0.021***

Posterior subcapsular cataract showed the strongest progression, especially in patients on prostaglandin analogues.

Adverse Ocular Effects of Glaucoma Therapy: Among the 107 patients, 46 (43.0%) experienced ocular side effects attributable to glaucoma medications. The most common were conjunctival hyperemia (21.5%), ocular surface dryness (15.9%), and punctate epithelial erosions (5.6%).

Table 4. Ocular Adverse Effects Observed (N=107)

Adverse Effect	Number of Patients (%)
Conjunctival Hyperemia	23 (21.5)
Ocular Surface Dryness	17 (15.9)
Punctate Epithelial Erosions	6 (5.6)
Iris Pigmentation Changes	5 (4.7)
Periorbital Fat Atrophy	4 (3.7)
Total	**46 (43.0)**

Nearly half of the patients developed ocular side effects, with conjunctival hyperemia being the most frequent.

Systemic Side Effects of Glaucoma Therapy: Systemic adverse events were observed in 11 patients (10.3%), with beta-blockers being the primary contributor. Bradycardia (3.7%), respiratory symptoms (2.8%), and fatigue (3.7%) were among the commonly reported effects.

Statistical Correlation Between Drug Use and Cataract Hazards: Analysis revealed a significant correlation between:

- PGA use and PSC progression (p=0.021, Chi-square test).

- Beta-blockers and systemic side effects (p=0.034).
- Combination therapy and increased ocular surface toxicity (p=0.011).

Summary of Findings

- Mean age: 62.8 years, male predominance.
- POAG was more common than PACG.
- Prostaglandin analogues were the most used drugs.
- Cataract progression occurred in 57% of patients, with PSC progression significantly linked to PGA use.
- 43% developed ocular side effects; 10.3% systemic side effects.
- Significant statistical associations confirmed drug-related hazards.

Summary and Interpretation of Results

In the present study, 107 patients with coexisting cataract and glaucoma on medical therapy were evaluated over a 12-month period to assess the hazards associated with glaucoma medications. The mean age of the participants was 62.8 years, with a slight male predominance, reflecting the common age group affected by both cataract and glaucoma. Most patients belonged to the 60–69 years age group, which correlates with the known age-related increase in both conditions.

Primary open-angle glaucoma (POAG) was more prevalent than primary angle-closure glaucoma (PACG), consistent with global epidemiological patterns. Prostaglandin analogues (PGAs) emerged as the most commonly prescribed agents, followed by beta-blockers and other medications. This reflects current treatment practices where PGAs are the first-line choice due to their efficacy in lowering intraocular pressure. However, their frequent use also highlighted important safety concerns.

Cataract progression was observed in more than half of the patients during the follow-up period. Nuclear sclerosis was the most common baseline cataract type, but posterior subcapsular cataract (PSC) demonstrated the greatest progression over time. Statistical analysis revealed a significant association between PGA use and PSC progression, suggesting a possible role of prostaglandins in accelerating cataract changes. This finding underlines the need for cautious long-term use of these drugs in cataract-prone individuals.

Ocular side effects were common, occurring in 43% of patients. The most frequent manifestations included conjunctival hyperemia and ocular surface dryness, particularly in those on prostaglandin analogues and combination therapy. Though generally mild, these adverse effects can impair treatment compliance and quality of life. Systemic side effects were reported in 10.3% of patients, mainly among those on beta-blockers, with bradycardia and respiratory complaints being the notable complications. This emphasizes the importance of systemic monitoring, especially in elderly patients with comorbidities.

The statistical correlations between specific drug classes and adverse events reinforce the clinical observations. PGAs were significantly associated with PSC progression, beta-blockers with systemic adverse effects, and combination therapies with ocular surface toxicity. These associations provide evidence that while medical glaucoma therapy is effective, it is not without hazards, particularly in patients with coexisting cataract.

Several studies published after 2018 highlight the risks associated with antiglaucoma medications in patients with cataracts. Topical glaucoma medications have been shown to worsen ocular surface disease, including meibomian gland dysfunction, which can negatively affect tear film stability and ultimately reduce the success of cataract surgery [8]. Chronic use of preserved glaucoma eye drops, especially those containing benzalkonium chloride, has been linked to increased postoperative inflammation and delayed corneal healing after cataract surgery [9].

Long-term use of miotic agents, particularly pilocarpine, has been associated with accelerated cataract formation, contributing to earlier lens opacification and increased surgical demand [10]. Similarly, patients undergoing polytherapy with multiple antiglaucoma medications are at significantly higher risk for ocular surface disease and surgical complications, which may compromise postoperative visual outcomes [11].

Further evidence shows that the presence of ocular surface disease induced by glaucoma treatment reduces visual quality and patient satisfaction following cataract surgery [12]. In addition, fixed-combination glaucoma medications, though useful in lowering intraocular pressure, have also been reported to exacerbate ocular surface instability, thereby increasing the risk of adverse surgical outcomes [13].

Conclusion

Medical therapy for glaucoma in cataract patients, while effective in lowering intraocular pressure, is associated with significant ocular and systemic hazards. Prostaglandin analogues were linked to posterior subcapsular cataract progression, while beta-blockers contributed to systemic side effects. Nearly half of the patients experienced ocular adverse effects, underscoring the need for careful drug selection, regular monitoring, and individualized treatment planning to minimize risks and optimize visual outcomes.

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