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RISKS ASSOCIATED WITH MEDICAL GLAUCOMA TREATMENT FOR CATARACT PATIENTS: A PROSPECTIVE OBSERVATIONAL COHORT STUDY

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Abstract

Background

Glaucoma and cataracts are common ocular conditions often found together, posing significant challenges in patient management. The concurrent presence of both conditions can complicate treatment strategies, as glaucoma medications may accelerate cataract formation. This study examines the impact of glaucoma treatment on cataract progression and visual outcomes.

Methods

This prospective observational cohort study at Mahaveer Institute of Medical Sciences, Telangana, enrolled 80 adults with glaucoma and cataracts. Participants received glaucoma treatment and were monitored for IOP, visual acuity, and cataract progression over six months. Data collected at baseline, 1, 3, and 6 months were analyzed using SPSS. Ethical approval and informed consent were obtained.

Results

The study included 80 participants with glaucoma and cataracts, with a mean age of 65.4 years. Cataract progression occurred in 35% of participants, with higher rates in those with more severe baseline cataracts. Intraocular pressure (IOP) decreased significantly from 24.1 mmHg at baseline to 16.8 mmHg at 6 months ($p < 0.001$). Visual acuity worsened considerably over the study period ($p = 0.02$). Ocular side effects were reported in 31.3% of participants, but these were not significantly correlated with specific glaucoma treatments ($p > 0.05$).

Conclusion

The study found that glaucoma medications significantly reduce intraocular pressure but may contribute to cataract progression and a decline in visual acuity. Ocular side effects were common, though not linked considerably to specific treatments.

Recommendation

We recommend lifelong annual examinations by an ophthalmologist for patients who have had surgery for cataracts. Future studies are needed to assess the long-term glaucoma risk for patients treated with current aspiration techniques.

Keywords: *Glaucoma, Cataracts, Intraocular Pressure, Visual Acuity, Ocular Side Effects.*
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Introduction

Glaucoma and cataracts are among the most common eye diseases affecting older adults globally, each posing significant risks to vision. Glaucoma is often caused by elevated intraocular pressure (IOP), resulting in progressive damage to the optic nerve and loss of visual fields; without treatment, it becomes an important etiological factor for the manifestation of permanent blindness worldwide. Cataracts, predominantly age-related, result from the clouding of the eye's natural lens and are a leading cause of reversible blindness [1-3]. Treating glaucoma in patients who also have cataracts poses unique challenges, as both conditions frequently occur in the same demographic. While glaucoma treatments primarily aim to lower IOP through topical medications, laser therapy, or surgery, these approaches can influence cataract progression, potentially worsening visual acuity. Additionally, cataract surgery in glaucoma patients can lead to IOP fluctuations, which may increase the risk of complications like optic nerve damage [4-6].

Recent advances in both glaucoma and cataract treatments have introduced new options that allow for more balanced management of these coexisting conditions. Minimally invasive glaucoma surgeries (MIGS), which can be performed alongside cataract surgery, offer a promising solution by lowering IOP with fewer side effects than traditional glaucoma therapies [7-9]. Procedures such as iStent or Hydrus Microstent insertions have shown sustained IOP control and decreased reliance on long-term therapeutic agents [10,11]. Non-invasive alternatives,

including extended-release medications and selective laser trabeculoplasty (SLT), also offer effective IOP management with a lower medication burden. Despite these innovations, the combined treatment of glaucoma and cataracts remains complex. Patients with severe glaucoma, in particular, are susceptible to IOP spikes during cataract surgery, which can compromise optic nerve health. Moreover, some glaucoma medications, particularly those with preservatives, can exacerbate ocular surface disease, complicating treatment further [12,13]. This study intends to screen and explore the potential hazards associated with medical glaucoma therapy in patients with cataracts, focusing on the adverse effects these treatments may have on both ocular health and surgical outcomes.

Aim of the study
This study examines the impact of glaucoma treatment on cataract progression and visual outcomes.

Methods
Study Design
This research was a prospective observational cohort study.

Study setting
This study was conducted over six months, at Mahaveer Institute of Medical Sciences, Vikarabad, Telangana, India.

Study Population
The study enrolled a total of 80 participants, each diagnosed with both glaucoma and cataracts and receiving medical treatment specifically for glaucoma. This population allowed the study to assess potential risks associated with glaucoma medications in patients also affected by cataracts.

Inclusion Criteria
Eligible participants were adults aged 40 years and older who were undergoing topical glaucoma treatments. These treatments included medications such as prostaglandins, carbonic anhydrase inhibitors, alpha agonists, or beta-blockers, all commonly used in managing intraocular pressure in glaucoma patients.

Exclusion Criteria
Participants were excluded if they had been subjected to eye surgery for either glaucoma or cataracts within the previous six months. Additionally, individuals with secondary glaucoma (e.g., caused by trauma or uveitis), other ocular conditions such as diabetic retinopathy or macular degeneration, or any systemic diseases like uncontrolled diabetes or hypertension were also excluded, as these conditions could affect ocular health or interfere with the study's outcomes.

Study Method
To control potential sources of bias, the study enrolled participants consecutively from the ophthalmology department, thereby minimizing selection bias. Standardized data collection tools were employed to reduce observer bias, and outcome assessors were blinded to the specific glaucoma treatment each patient received to enhance objectivity. Additionally, excluding participants with other ocular or systemic conditions minimized confounding effects, allowing for a clearer assessment of glaucoma therapy's impact on cataracts.

Procedure
Participants received their prescribed glaucoma therapy continuously throughout the study, with any necessary adjustments to treatment noted during follow-up. During each scheduled visit, detailed ophthalmic assessments were conducted, including visual acuity testing, slit-lamp examination, and IOP measurement. This approach ensured consistent monitoring of both glaucoma control and any potential cataract progression over the study period.

Data Collection
Data was systematically collected through structured case report forms for each participant. At baseline, information gathered included demographics, relevant medical history, a comprehensive ocular examination, intraocular pressure (IOP) measurements, visual acuity, and the severity of cataracts. Follow-up data were collected at 1, 3, and 6 months, documenting changes in IOP, visual acuity, ocular surface condition, and any side effects or signs of cataract progression.

Statistical Analysis
The data was analyzed using SPSS version 24.0, with descriptive statistics (mean, standard deviation) used to describe baseline characteristics and study results. Paired t-tests or Wilcoxon signed-rank tests were used to compare baseline and follow-up values for IOP, visual acuity, and cataract progression, while categorical variables like side effect frequency were analyzed with chi-square or Fisher's exact tests.

Ethical Considerations
The study was approved by the institutional ethics committee, and all participants provided informed written consent before enrolment.

Results
The study enrolled 80 participants, all diagnosed with both glaucoma and cataracts and undergoing medical therapy for glaucoma. The mean age was 65.4 years (± 10.2), ranging from 40 to 82 years, with a gender distribution of 56 males and 44 females. The baseline intraocular pressure (IOP) averaged 24.1 mmHg (± 3.8) with a range from 18 to 32 mmHg. Visual acuity was initially measured at a mean of 0.4 LogMAR (± 0.2), and cataracts were graded using the LOC III scale, with 45

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participants having Grade II, 35 with Grade III, and 20 with Grade IV cataracts. The mean duration of glaucoma among participants was 3.2 years (± 1.5), with a range of 1 to 6 years (Table 1).

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

Variable	Category	Value
Age (years)	Mean (± SD)	65.4 (± 10.2)
	Range	40 – 82
Gender	Male	56 (70%)
	Female	24 (30%)
Baseline IOP (mmHg)	Mean (± SD)	24.1 (± 3.8)
	Range	18 – 32
Visual Acuity (LogMAR)	Mean (± SD)	0.4 (± 0.2)
	Range	0.1 - 1.0
Cataract Grade	Grade II	36 (45%)
	Grade III	28 (35%)
	Grade IV	16 (20%)
Duration of Glaucoma (years)	Mean (± SD)	3.2 (± 1.5)
	Range	1 – 6

Over the 6-month study period, cataract progression was observed in 35% of the participants, with a higher progression rate noted in those with more severe baseline cataracts. Specifically, 22.2% of participants with Grade II cataracts experienced progression, compared to 42.9% for Grade III and 50% for Grade IV. Intraocular pressure (IOP) significantly decreased throughout the study, with a reduction from a baseline mean of 24.1 mmHg to 16.8 mmHg at the 6-month follow-up ($p < 0.001$). The decrease in IOP was statistically significant at each follow-up interval (1, 3, and 6 months) (Table 2).

Table 2: Cataract Progression and Changes in Intraocular Pressure Over Time (n = 80):

Baseline Cataract Grade	Participants (n)	Progression (n)	Progression Percentage (%)	Mean IOP (mmHg) ± SD	p-value (vs Baseline)
Grade II	36	8	22.2%	24.1 (± 3.8)	-
Grade III	28	12	42.9%	19.5 (± 2.9)	< 0.001
Grade IV	16	8	50%	17.8 (± 2.7)	< 0.001
Total	80	28	35%	16.8 (± 2.6)	< 0.001

The results of the visual acuity changes revealed a significant decline in visual acuity over the 6 months, as assessed by the LogMAR scale. The mean visual acuity at baseline was 0.4 (± 0.2), which worsened over time, reaching 0.6 (± 0.3) by the 6-month follow-up ($p = 0.02$). A notable increase in LogMAR scores was observed at the 3-month (0.52 ± 0.25) and 6-month (0.6 ± 0.3) marks compared to baseline, with the most significant change occurring between baseline and the 6-month follow-up ($p = 0.02$). This deterioration in visual acuity was particularly pronounced in patients experiencing cataract progression during the study period (Table 3).

Table 3: Visual Acuity Changes Over Time (LogMAR) (n = 80):

Time Point	Mean Visual Acuity (LogMAR) ± SD	p-value (vs Baseline)
Baseline	0.4 (± 0.2)	-
1 Month	0.42 (± 0.2)	0.10
3 Months	0.52 (± 0.25)	0.04
6 Months	0.6 (± 0.3)	0.02

A total of 25 patients (31.3%) reported ocular side effects associated with medical glaucoma therapy. The Chi-square test was used to determine whether the occurrence of these side effects was significantly different across the different categories. The Chi-square statistic was calculated as 5.67 ($p = 0.059$), which indicates that there was no statistically significant association between glaucoma therapy and the occurrence of specific side effects ($p > 0.05$). This suggests that while the side effects were common, they were not significantly distributed differently across the categories of ocular surface disease, conjunctival hyperemia, and ocular irritation (Table 4).

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Table 4 Side Effects of Glaucoma Therapy (n = 80):

Side Effect	Number of Patients (n)	Percentage (%)
Ocular Surface Disease (Dry Eye)	18	22.5%
Conjunctival Hyperemia	10	12.5%
Ocular Irritation	7	8.8%
None	45	56.25%

Discussion

This study enrolled 80 participants with both glaucoma and cataracts, to assess the risks associated with glaucoma therapy and its impact on cataract progression over 6 months. The mean age of participants was 65.4 years, with a slightly higher proportion of males. At baseline, the average intraocular pressure (IOP) was 24.1 mmHg, and participants exhibited varying degrees of cataract severity, with most having Grade II or III cataracts. Throughout the study, 35% of participants showed significant cataract progression, particularly those with more advanced cataracts at baseline. This indicates that patients with more severe cataracts may be more susceptible to the effects of glaucoma treatment on cataract progression, aligning with earlier studies [14]. Statistically significant differences were noted in progression rates, with Grade IV cataracts showing the highest progression at 50% ($p = 0.01$). These findings emphasize the need for close monitoring of cataract progression, especially in patients with advanced cataracts.

In terms of glaucoma management, IOP was effectively controlled in most participants, with a significant reduction from 24.1 mmHg at baseline to 16.8 mmHg at 6 months. This reduction was statistically significant at all follow-up intervals ($p < 0.001$), demonstrating the effectiveness of medical therapy in managing glaucoma. However, despite successful IOP control, visual acuity declined in several patients, particularly those with cataract progression. The mean visual acuity worsened from 0.4 to 0.6 LogMAR, which was statistically significant ($p = 0.02$). This highlights the trade-off between controlling IOP and the risk of worsening visual function due to cataract progression, which underscores the importance of balancing both aspects in treatment planning.

Side effects of glaucoma therapy were reported by 25% of participants, with the most common being ocular surface disease (18%), followed by conjunctival hyperemia (10%) and transient ocular irritation (7%). These side effects were generally mild and manageable, indicating that while glaucoma medications are effective, they can affect ocular comfort over time. This information is useful for clinicians when considering long-term glaucoma therapy, as ocular side effects may impact patient satisfaction and compliance.

Several studies support these findings. For example, research has demonstrated the efficacy of micropulse laser therapy in reducing IOP without significantly advancing cataract progression, highlighting its potential as a safer option for glaucoma patients with existing cataracts [15]. Additionally, a randomized trial comparing the EX-PRESS Glaucoma Device and trabeculectomy found that although both procedures were effective in reducing IOP, trabeculectomy led to a higher incidence of cataract formation, necessitating cataract surgery in the follow-up period [16]. Newer glaucoma medications, which both lower IOP and minimize adverse effects like ocular surface disease and cataract progression, have also shown promise, particularly for patients at higher risk for cataract development [17].

Furthermore, studies on combined cataract and glaucoma surgeries, such as those involving iStent or Hydrus Microstent, suggest sustained IOP reductions and stable cataract progression, reducing the need for future glaucoma medications and overall treatment burden [18,19]. Minimally invasive glaucoma surgeries (MIGS) have also shown effectiveness in lowering IOP while preserving visual field function, with a lower incidence of cataract formation compared to traditional surgeries [20]. These findings further prove that MIGS is a safer alternative in patients with concurrent cataracts, ensuring better long-term outcomes. Laser-assisted cataract surgery has also been found to improve visual acuity and stabilize IOP in glaucoma patients without exacerbating glaucoma, further confirming the importance of choosing the appropriate surgical approach.

Conclusion

This study highlights the complexities of managing glaucoma in patients with concurrent cataracts. While medical therapy effectively controls intraocular pressure (IOP), it can contribute to cataract progression, particularly in those with advanced cataracts at baseline. The findings emphasize the need for careful monitoring and tailored treatment strategies to balance IOP control with the preservation of visual function. Additionally, the observed ocular side effects of glaucoma medications, though generally mild, underline the importance of addressing patient comfort and ensuring long-term compliance. Ultimately, the study underscores the need for a holistic approach to treating coexisting glaucoma and cataracts, with a focus on individualized care to minimize risks and optimize outcomes.

Recommendation: We recommend lifelong annual examinations by an ophthalmologist for patients who have had surgery for cataracts. Future studies are needed to assess the long-term glaucoma risk for patients treated with current aspiration techniques.

Limitations: The study is limited by its short duration and small sample size.

Acknowledgment
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List of Abbreviations
IOP- Intraocular pressure
MIGS- Minimally invasive glaucoma surgeries
SLT- Selective laser trabeculoplasty

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Conflict of interest
No conflict of interest.

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