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RISKS OF GLAUCOMA TREATMENT IN PATIENTS WITH CATARACTS: A PROSPECTIVE COHORT STUDY

[1]Amrendra Kumar, [2]Anita Ambastha, [1]Vidya Bhushan Kumar

[1]Assistant Professor, Department of Ophthalmology, ESIC Medical College and Hospital, Bihta, Bihar, India.
[2]Additional Professor, Department of Regional Institute of Ophthalmology, Indira Gandhi Institute of Medical Sciences, Patna, Bihar, India.

ABSTRACT

Background

Glaucoma and cataracts frequently coexist in older adults, with glaucoma being a leading cause of irreversible blindness and cataracts contributing to reversible vision loss. Medical therapy for glaucoma primarily targets intraocular pressure (IOP) reduction, but its potential effects on cataract progression are not fully understood. This study assessed the risks associated with medical glaucoma therapy in patients with cataracts.

Methods

A total of 100 patients diagnosed with both glaucoma and cataracts were recruited. Baseline data included age, cataract severity, and IOP measurements. Patients were followed at 1, 3, and 6 months to assess cataract progression, visual acuity changes, and any side effects related to glaucoma treatment. Statistical analysis involved paired t-tests for intraocular pressure changes and Chi-square tests for cataract progression.

Results: A total of 100 participants (56 males, 44 females) aged 40 years and older (mean age 65.4 ± 10.2 years) diagnosed with both glaucoma and cataracts were included. Thirty-five percent of participants experienced significant cataract progression, with those having more advanced baseline cataracts being at higher risk ($p = 0.01$). Mean IOP decreased significantly from 24.1 mmHg to 16.8 mmHg ($p < 0.001$) over the study period, indicating effective glaucoma control. Visual acuity worsened from 0.4 LogMAR to 0.6 LogMAR in patients with cataract progression ($p = 0.02$). Ocular side effects, such as dry eye and hyperemia, were reported in 25% of the cohort.

Conclusion

While medical therapy effectively controls IOP in glaucoma patients, it is correlated with an increased risk of cataract progression, particularly in those with severe cataracts at baseline. The decline in visual acuity highlights the need for careful monitoring of cataract status during glaucoma treatment.

Recommendations

Regular cataract progression monitoring and glaucoma medication adjustments may be needed for coexisting cataract patients. Alternative treatments include cataract and minimally invasive glaucoma operations may improve results.

Keywords: *Glaucoma, Cataract, Intraocular pressure, Cataract progression, Visual acuity, Glaucoma therapy.*
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Corresponding Author: *Anita Ambastha**
Email: ***ambasthaanita@yahoo.in***
Additional Professor, Department of Regional Institute of Ophthalmology, Indira Gandhi Institute of Medical Sciences, Patna, Bihar, India.

INTRODUCTION

Two of the most prevalent eye diseases affecting older persons worldwide are glaucoma and cataracts, both of which carry serious threats to eyesight. Increased intraocular pressure is frequently the cause of glaucoma, a condition marked by progressive optic nerve injury and visual field loss (IOP). If left untreated, it is one of the main causes of irreversible blindness around the globe. On the other hand, cataracts, which are typically linked to aging, are the main cause of reversible blindness and are characterized by clouding of the natural lens of the eye [1].

Treating glaucoma in patients with cataracts presents unique challenges, as both conditions are prevalent in the same demographic. Current glaucoma therapies focus on lowering IOP using topical medications, laser treatments, or surgery. However, these treatments may impact the progression of cataracts, potentially worsening visual acuity. Additionally, patients undergoing cataract surgery often face increased risks of IOP fluctuations, which can exacerbate glaucoma progression or lead to complications such as optic nerve damage [2]. Managing these dual conditions requires careful balancing of IOP control and visual function preservation.

Recent advancements in medical and surgical interventions have introduced new options for patients with both glaucoma and cataracts. Minimally invasive glaucoma surgeries (MIGS), often performed in conjunction with cataract surgery, provide a promising avenue for reducing IOP while minimizing the need for long-term topical medications [3]. These procedures, such as iStent or Hydrus Microstent insertion, have been

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shown to provide sustained IOP reduction with fewer side effects compared to traditional therapies [1]. Additionally, innovations in extended-release medications and selective laser trabeculoplasty (SLT) offer non-invasive alternatives that allow for better long-term IOP control and reduced medication burden [3].

Nevertheless, the coexistence of glaucoma and cataracts introduces complexities. Patients with severe glaucoma often experience greater vulnerability to IOP spikes during cataract surgery, which can compromise optic nerve function. Moreover, certain glaucoma medications, especially preservative-containing eye drops, can exacerbate ocular surface disease, adding another layer of complexity to treatment plans [4].

This study aimed at identifying the risks associated with glaucoma therapy in cataract patients.

METHODOLOGY

Study Design

A prospective observational cohort study.

Study Setting

The study took place over 6 months (April 2024 to September 2024) at ESIC Medical College and Hospital, Bihta, India.

Participants

A total of 100 participants were involved in the study, all of whom were patients diagnosed with both glaucoma and cataracts and undergoing medical treatment for glaucoma.

Inclusion Criteria

- Patients aged 40 years and above are diagnosed with both glaucoma and cataracts.
- Patients receiving medical therapy for glaucoma, including eye drops (such as prostaglandins, beta-blockers, alpha agonists, or carbonic anhydrase inhibitors).

Exclusion Criteria

- Patients with a history of eye surgery for glaucoma or cataracts within the past 6 months.
- Patients with secondary causes of glaucoma (e.g., trauma, uveitis).
- Patients with any ocular conditions other than cataracts and glaucoma that could confound the results (e.g., diabetic retinopathy, macular degeneration).
- Patients with systemic diseases (e.g., uncontrolled diabetes, hypertension) that may influence ocular health or affect study outcomes.

Bias

To minimize selection bias, participants were consecutively recruited from the ophthalmology department. Observer bias was controlled by using standardized data collection tools and blinding outcome assessors to the type of glaucoma therapy received. Additionally, patients who met the exclusion criteria were carefully screened and excluded to prevent confounding effects.

Variables

Variables included development of complications or worsening of cataract as a result of glaucoma therapy, intraocular pressure (IOP) control over time, visual acuity changes over the 6 months, side effects related to medical glaucoma therapy (e.g., ocular surface disease, inflammation), rate of cataract progression (if any), age, gender, duration of glaucoma treatment, type of glaucoma medication, presence of other ocular or systemic conditions, medication adherence, and baseline cataract severity.

Data Collection

Data was collected using a structured case report form (CRF) for each participant. Baseline assessments were carried out at the start of the study and follow-up assessments at regular intervals (1 month, 3 months, and 6 months).

- Baseline Data: Demographics, medical history, ocular examination, baseline intraocular pressure, visual acuity, and cataract severity.
- Follow-up Data: Intraocular pressure, visual acuity, ocular surface condition, and any documented side effects or progression of cataract.

Procedure

Eligible patients were recruited from the ophthalmology outpatient clinic. All participants underwent a detailed ophthalmic examination, including visual acuity testing, slit-lamp examination, and intraocular pressure measurement. Follow-up visits were scheduled at 1 month, 3 months, and 6 months. Data was collected regarding any changes in vision, intraocular pressure, and other ocular health parameters, particularly cataract progression and side effects of glaucoma medication. Participants continued receiving their prescribed glaucoma therapy, and any necessary adjustments to their treatment will be noted.

Statistical Analysis

Data was analysed using SPSS 24.0. Results and baseline characteristics were described using descriptive statistics (mean, standard deviation). Wilcoxon signed-rank tests or paired t-tests compared baseline and follow-up intraocular pressure, visual acuity, and cataract progression. For categorical variables like a problem or side effect frequency, chi-square or Fisher's exact tests were used. Confounders were accounted for using multivariate regression analysis with a significance criterion of $p < 0.05$.

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Ethical considerations

The study protocol was approved by the Ethics Committee and written informed consent was received from all the participants.

RESULTS

Table 1: Baseline Characteristics

Variable	Mean (± SD)	Range
Age (years)	65.4 (± 10.2)	40 - 82
Gender (Male/Female)	56/44	-
Baseline IOP (mmHg)	24.1 (± 3.8)	18 - 32
Visual Acuity (LogMAR)	0.4 (± 0.2)	0.1 - 1.0
Cataract Grade (LOC III)		
Grade II	45	-
Grade III	35	
Grade IV	20	
Duration of Glaucoma (years)	3.2 (± 1.5)	1 - 6

A total of 100 participants were enrolled in the study over the 6 months. An overview of the participants' demographic and baseline characteristics may be found in Table 1.

Table 2: Cataract Progression by Baseline Cataract Grade

Baseline Cataract Grade	Participants (n)	Progression (n)	Percentage (%)
Grade II	45	10	22.2%
Grade III	35	15	42.9%
Grade IV	20	10	50%

Over the 6 months, 35 participants (35%) showed significant progression in their cataracts, as assessed by slit-lamp examination and patient reports of worsening vision. The progression was primarily noted in those with higher baseline cataract grades. Table 2 presents a breakdown of cataract progression by baseline cataract grade.

Table 3: Changes in Intraocular Pressure Over Time

Time Point	Mean IOP (mmHg) ± SD	p-value (vs Baseline)
Baseline	24.1 (± 3.8)	-
1 Month	19.5 (± 2.9)	< 0.001
3 Months	17.8 (± 2.7)	< 0.001
6 Months	16.8 (± 2.6)	< 0.001

There was a statistically significant association between higher baseline cataract grade and cataract progression during the study ($p = 0.01$, Chi-square test).
Intraocular pressure (IOP) was effectively controlled in the majority of patients throughout the study. At baseline, the mean IOP was 24.1 ± 3.8 mmHg, which decreased to 16.8 ± 2.6 mmHg at the 6-month follow-up. A significant reduction in IOP was observed at each follow-up interval ($p < 0.001$, paired t-test). Table 3 outlines the changes in IOP over the study period.

Table 4: Visual Acuity Changes Over Time (LogMAR)

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

There was a significant decline in visual acuity over the study period, particularly in patients with cataract progression (Table 4). The mean visual acuity at baseline was 0.4 ± 0.2 LogMAR, which worsened to 0.6 ± 0.3 LogMAR at the 6-month follow-up ($p = 0.02$, paired t-test). Visual acuity decline was more

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pronounced in patients who experienced cataract progression ($p = 0.01$).

Table 5: Side Effects of Glaucoma Therapy

Side Effect	Number of Patients (n)	Percentage (%)
Ocular Surface Disease (Dry Eye)	18	18%
Conjunctival Hyperemia	10	10%
Ocular Irritation	7	7%

A total of 25 patients (25%) reported ocular side effects associated with medical glaucoma therapy. The most common side effect was ocular surface disease, including dry eye symptoms, which affected 18 participants (18%). Other side effects included conjunctival hyperemia (10%), and transient ocular irritation (7%). There were no cases of serious ocular or systemic side effects (Table 5).

Table 6: Multivariate Regression Analysis for Cataract Progression

Variable	Coefficient (β)	p-value
Age	0.12	0.07
Gender (Male)	0.05	0.15
Baseline Cataract Grade	0.28	0.005
Duration of Glaucoma Therapy	0.23	0.02
Type of Glaucoma Medication	0.10	0.12

A multivariate regression analysis was conducted to determine the factors associated with cataract progression (Table 6). Variables included in the model were age, gender, baseline cataract grade, duration of glaucoma treatment, and type of glaucoma medication. The results showed that higher baseline cataract grade ($p = 0.005$) and longer duration of glaucoma treatment ($p = 0.02$) were significantly associated with cataract progression.

DISCUSSION

The study enrolled 100 participants diagnosed with both glaucoma and cataracts, aiming to evaluate the risks associated with glaucoma therapy on cataract progression over 6 months. The average age of participants was 65.4 years, with a slightly higher proportion of males. At baseline, intraocular pressure (IOP) was 24.1 mmHg, and participants had varying degrees of cataract severity, with the majority having Grade II or III cataracts.

Over the 6 months, 35% of participants showed significant cataract progression, particularly those with higher baseline cataract grades. This suggests that patients with more advanced cataracts may be more susceptible to the effects of glaucoma therapy on cataract progression. Statistically significant differences were observed in cataract progression rates among the different baseline grades, with Grade IV cataract patients experiencing a 50% progression rate ($p = 0.01$). This highlights the need for vigilant monitoring of cataract progression in glaucoma patients, especially those with advanced cataracts.

Intraocular pressure was successfully controlled in most participants, with a substantial reduction from 24.1 mmHg at baseline to 16.8 mmHg by the end of the study. This reduction was statistically significant at all follow-up points ($p < 0.001$), indicating that medical therapy effectively managed glaucoma in these patients. However, despite good IOP control, visual acuity declined in some patients, especially those with cataract progression. The mean visual acuity worsened from 0.4 to 0.6 LogMAR over the 6 months, which was statistically significant ($p = 0.02$). This decline underscores the trade-off between managing glaucoma and the risk of worsening visual function due to cataract progression.

Ocular side effects 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, but they indicate that long-term glaucoma treatment can affect ocular comfort.

Finally, multivariate regression analysis revealed that higher baseline cataract grade and longer duration of glaucoma therapy were significantly associated with cataract progression ($p = 0.005$ and $p = 0.02$, respectively). This finding suggests that, in patients with advanced cataracts or a prolonged history of glaucoma treatment, careful consideration is needed regarding the choice of therapy, as they are more prone to cataract progression.

Overall, while medical glaucoma therapy is effective in controlling intraocular pressure, it may contribute to cataract progression in certain patients, particularly those with more severe cataracts at baseline. Careful monitoring and potential adjustments to treatment are essential to balance the benefits of IOP control with the risk of declining vision due to cataract progression.

A study demonstrated the efficacy of micropulse laser therapy in reducing intraocular pressure (IOP) without inducing significant cataract progression, making it a safer option for glaucoma patients already presenting with cataracts [5]. The study highlights the importance

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of non-invasive treatment options in managing glaucoma while minimizing the risk of cataract formation.

A randomized trial comparing the EX-PRESS Glaucoma Device and Trabeculectomy found that while both procedures were effective in reducing IOP, trabeculectomy patients exhibited a higher incidence of cataract formation. Specifically, trabeculectomy led to a more significant decrease in IOP but was associated with an increased need for cataract surgery in the follow-up period [6].

A study offers insights into newer glaucoma medications that both lower IOP and reduce the likelihood of adverse side effects, such as ocular surface disease and cataract progression. The study found that these medications are particularly beneficial for patients who are at higher risk for cataract development due to their dual-action mechanism targeting IOP reduction [7].

The study on intraocular pressure changes after cataract surgery in glaucoma patients reveals that combined cataract and glaucoma surgeries, such as those involving iStent or Hydrus Microstent, result in sustained IOP reductions. The study also found that such combined procedures decrease the need for future glaucoma medications, while cataract progression remained stable, reducing the overall treatment burden on patients [8].

A review highlights the long-term effectiveness of minimally invasive glaucoma surgeries (MIGS) in reducing IOP and preserving visual field function, with a lower incidence of cataract formation compared to traditional glaucoma surgeries like trabeculectomy [9]. These findings underscore the role of MIGS in providing a safer alternative for patients with concurrent cataracts.

The study on MIGS and cataract surgery outcomes further confirms that combining cataract surgery with MIGS, such as the Hydrus Microstent or iStent, significantly reduces IOP with fewer postoperative complications. The study showed that this approach helps prevent cataract progression in glaucoma patients, ensuring better long-term visual outcomes [10].

Long-term effects of femtosecond laser-assisted cataract surgery in glaucoma patients provided evidence that laser-assisted cataract surgery not only improves visual acuity but also stabilizes IOP in glaucoma patients. This study found that patients who underwent laser-assisted cataract surgery had better visual outcomes without exacerbating their glaucoma [11].

Finally, a study on glaucoma progression and risk factors in patients undergoing cataract surgery identified that fluctuations in IOP during and after cataract surgery are key contributors to glaucoma progression. However, patients who underwent combined glaucoma-cataract surgeries experienced better IOP control and reduced risks of glaucoma-related vision loss over time [12].

Generalizability

The generalizability of this study is somewhat limited due to its specific population and design. Conducted at a single institution with a relatively small sample size of 100 participants, primarily consisting of older adults diagnosed with both glaucoma and cataracts, the findings may not be broadly applicable to diverse populations or those with different underlying health conditions. Additionally, factors such as geographic location, healthcare access, and variations in treatment protocols could influence outcomes in other settings. Therefore, while the results provide valuable insights into the risks associated with glaucoma therapy in cataract patients, further research across varied populations and clinical environments is needed to enhance the external validity of these findings.

CONCLUSION

The study demonstrated that medical therapy for glaucoma is effective in controlling intraocular pressure but may be associated with cataract progression in a significant portion of patients, especially those with higher baseline cataract grades. Ocular side effects were relatively common but generally mild. These findings underscore the importance of closely monitoring cataract progression in glaucoma patients receiving medical therapy, particularly in those with advanced cataracts at baseline.

Limitations

The limitations of this study include a small sample population who were included in this study. Furthermore, the lack of a comparison group also poses a limitation for this study's findings.

Recommendation

Regular monitoring of cataract progression in glaucoma patients is essential, particularly for those on long-term medication therapy. Preservative-free glaucoma medications should be considered to reduce the incidence of ocular surface disease. For patients with advanced cataracts and glaucoma, early consideration of combined cataract and MIGS procedures may help minimize visual acuity decline and reduce dependence on glaucoma medications.

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List of abbreviations

IOP – Intraocular Pressure
LogMAR – Logarithm of the Minimum Angle of Resolution
MIGS – Minimally Invasive Glaucoma Surgeries
LT – Selective Laser Trabeculoplasty
CRF – Case Report Form
ESIC – Employees' State Insurance Corporation
SPSS – Statistical Package for the Social Sciences
LOC III – Lens Opacities Classification System III

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Conflict of interest
The authors have no conflicting interests to declare.

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