

A Retrospective Analysis of Outcomes in Patients Using Different Glaucoma Medications, Including IOP Control, Side Effects, and Patient Adherence

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Abstract

Background: Glaucoma is one of the major causes of permanent blindness globally, and the most important factor is increased Intraocular Pressure (IOP). The initial treatment should be medical therapy, although the effectiveness of drugs, adverse effects, and patient compliance may affect the treatment outcomes.

Methods: A retrospective observational study was carried out at JNKT Medical College & Hospital, Madhepura, during August 2023 to September 2025. There were 102 patients with glaucoma who were under medical therapy. Hospital records were used to gather data which consisted of demographics, glaucoma type, medication type prescribed, baseline and follow-up IOP, side effects and adherence patterns. The SPSS and Excel were used to conduct the statistical analysis with a significance level of $p < 0.05$.

Results: The mean baseline IOP of 26.4 ± 3.5 mmHg decreased significantly to 17.8 ± 2.9 mmHg at follow-up. The IOP reduction was the highest in the case of prostaglandin analogues, and then combination therapy. Beta-blockers had fewer side effects, whereas prostaglandin analogues tended to produce slight redness and irritation of the eyes. The total compliance was 72.5 %, and they had better compliance among patients receiving once-daily regimens. Cost, complexity in dosing, and information deficiency were some of the factors that affected adherence.

Conclusion: Prostaglandin analogues worked most effective in IOP reduction whereas beta-blockers were more tolerable. The adherence of the patient is a crucial factor in the success of the treatment, highlighting the importance of simplified regimens and patient education are a key factor in the effective management of glaucoma.

Keywords: Glaucoma, Intraocular Pressure, Prostaglandin Analogues, Beta-Blockers, Patient Adherence, Side Effects.

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Introduction

Glaucoma is the chronic, progressive optic neuropathy characterized by the irreversible damage of the optic nerve that is frequently accompanied by high IOP and currently one of the major causes of preventable blindness all over the world [1]. The burden of glaucoma is increase because of the rising life expectancy and aging population with millions of people being affected both in developed and developing nations [2].

Glaucoma is a serious public health issue in India, often underdiagnosed, as it does not asymptomatic nature during the first stages [3]. When not properly treated, it may cause progressive loss of the visual field and blindness, which is crucial to detect it early and manage it. The primary goal of

glaucoma treatment is to reduce and stabilize intraocular pressure in a range to prevent or delay the progression of the disease. The only risk factor that has been proven to affect the progression of the disease is IOP, and its management is the key in all treatment options [4,5]. The first-line therapy is usually medical therapy and consists of a range of topical medications [6]. The use of prostaglandin analogues has become widely used because of their strong IOP-reducing properties and easy once-per-day administration [7].

Another group of commonly prescribed drugs is the beta-blockers, which inhibit the aqueous humors production [8]. Alpha agonists have a two-fold role, reducing the aqueous production and

maximizing uveoscleral outflow [9]. Inhibitors of carbonic anhydrase, both topical and systemic, inhibit the synthesis of aqueous humor and may be used as adjunct therapy.

Although there are several effective pharmacological modalities available, the management of glaucoma is usually complicated with the challenges of treatment [10]. Ocular irritation, redness, dryness, allergic reactions, and in a few cases, systemic effects are side effects that might affect patient comfort and readiness to proceed with the therapy [11]. Moreover, compliance of glaucoma medications is a significant issue in the long term because in most cases, the disease is asymptomatic during the early stages, and patients do not realize the significance of regular intake of medication [12]. Sophisticated dosing schedules, drug affordability, ignorance, and insufficient follow-up are additional reasons that lead to low adherence, and challenges the treatment outcomes.

Though a number of clinical trials have reviewed the effectiveness of glaucoma drugs, there is a relative paucity of retrospective, real-world information available in Indian clinical practices, which not only considers the IOP control but also considers side effects and patient adhering behaviors. This type of data is essential in knowing real treatment effectiveness when used in practice. The purpose of the given study is to develop a retrospective analysis of the outcomes in patients taking various glaucoma medications in a tertiary care facility.

The aims involve assessing the efficacy of different drug classes in IOP management, the occurrence and the character of adverse effects, and the patient compliance with treatment programs.

Objectives

- To compare and assess effectiveness of various classes of anti-glaucoma drugs in management of IOP in patients.
- To evaluate and compare the side effects and overall treatment results, such as IOP control and tolerability, in different anti-glaucoma drug classes.
- To determine patient compliance with prescribed glaucoma medications and to model the determinants of compliance when managing glaucoma.

Materials and Methods

Study Design: This study was conducted as a retrospective observational study that aimed at evaluating the clinical outcomes of medical management of glaucoma patients. The retrospective aspect made it possible to evaluate the actual patterns of treatment, its efficacy, and other

patient-related factors including adherence and tolerability according to the past-recorded clinical data.

Study Setting: The research was carried out in the JNKT Medical College and Hospital, Madhepura, a tertiary care institution, which offers ophthalmology care to a wide range of patients. The institution keeps detailed medical records, which allows organizing the data systematically to conduct a retrospective assessment.

Study Duration: The research was a two-year duration, between August 2023 to September 2025. This period was used to examine the patient records to guarantee the sufficient follow-up as well as consistency in treatment evaluation.

Sample Size: The study involved a total of 102 patients who had been diagnosed with glaucoma and were managed with medical therapy. The size of the sample was decided according to the availability of complete and eligible records of the patients at the time of the research.

Inclusion Criteria

- Cases of glaucoma as diagnosed by an ophthalmologist.
- Patients undergoing anti-glaucoma drugs (one or more).
- Patients who have followed up at least six months.
- Access to full clinical history with IOP measurements and treatment history.

Exclusion Criteria

- Lacking or incomplete medical records.
- Patients who underwent surgery and did not have a sufficient medication follow-up.
- Other instances of secondary glaucoma, not covered by the study.
- Irregular follow-up or lack of data about follow-up treatment outcomes among patients.

Data Collection: Hospital medical records and ophthalmology department registers was used to gather data. Relevant variables were retrieved including demographic information, age and gender, type of glaucoma diagnosed and information about the prescribed medications. Measurements of the clinical parameters including the baseline IOP along with the follow-up IOP levels were taken to determine the effectiveness of the treatment. Side effects and complaints were reported by patients. Patient adherence information, such as missed doses and attendance of schedule follow-up visits, was also obtained to assess the level of consistency in treatment.

Outcome Measures: The main outcome measure was the average change of intraocular pressure between baseline and the last visit. Frequency and

type of side effects of various forms of medication classes and overall patient adherence rates, in terms of percentage as defined by compliance indicators, were used as secondary outcome measures.

Statistical Analysis: The statistical software was used in the analysis of the data which included SPSS and Microsoft Excel. Demographic and clinical characteristics were summarized using descriptive statistics. The statistical tests (the independent t-test or one-way ANOVA) were used to compare various groups of medications based on appropriate statistical tests that included continuous variables like IOP reduction. Chi-square test was used to determine the relationship between

categorical variables such as side effects and adherence pattern. All analyses had a p-value of less than 0.05 as statistically significant.

Results

Demographic Profile: A total of 102 patients diagnosed with glaucoma were included in the study. The ages of the patients were between 35-80 years, most of them were between 51-70 years of age and these represented high prevalence in the elderly group.

The study population was aged about 58.6 ± 10.2 years. Gender distribution was indicating a slight male dominance in the study group.

Table 1: Demographic Characteristics of Patients

Variable	Category	Number (n)	Percentage (%)
Age Group	35–50 years	22	21.6%
	51–70 years	56	54.9%
	>70 years	24	23.5%
Gender	Male	58	56.9%
	Female	44	43.1%

Distribution of Medications: The prostaglandin analogues were most frequently prescribed among the population of the study, followed by beta-blockers. A small sample of patients also

underwent combination therapy, especially in patients with uncontrolled IOP. Alpha agonists and carbonic anhydrase inhibitors were used either as monotherapy or adjunct therapy.

Table 2: Distribution of Glaucoma Medications

Drug Class	Number (n)	Percentage (%)
Prostaglandin analogues	40	39.2%
Beta-blockers	26	25.5%
Alpha agonists	14	13.7%
Carbonic anhydrase inhibitors	12	11.8%
Combination therapy	10	9.8%

IOP Control: The IOP had a considerable decrease in all medication groups. The average baseline IOP was 26.4 ± 3.5 mmHg and at the end of the follow-up, the baseline IOP was 17.8 ± 2.9 mmHg.

Prostaglandin analogues proved to have the greatest decrease in IOP followed by combination therapy. Other classes of drugs such as beta-blockers were also moderately effective in controlling IOP.

Table 3: Comparison of Baseline and Follow-up IOP

Drug Class	Baseline IOP (mmHg)	Follow-up IOP (mmHg)	Mean Reduction
Prostaglandin analogues	27.1 ± 3.2	16.9 ± 2.5	10.2
Beta-blockers	25.8 ± 3.6	18.2 ± 3.0	7.6
Alpha agonists	26.3 ± 3.4	18.9 ± 2.8	7.4
Carbonic anhydrase inhibitors	25.9 ± 3.7	19.1 ± 3.1	6.8
Combination therapy	27.5 ± 3.1	17.2 ± 2.6	10.3

Side Effects: Side effects were reported in a proportion of patients, the most common one also being ocular redness and irritation. The prostaglandin analogues were linked to increased cases of conjunctival hyperemia, whereas the beta-blockers had fewer ocular side effects with some systemic side effects of fatigue. Generally, the majority of the side effects were mild and did not require therapy.

Table 4: Frequency of Side Effects

Side Effect	Number (n)	Percentage (%)
Redness (Hyperemia)	28	27.5%
Ocular irritation	22	21.6%
Dryness	14	13.7%
Blurred vision	10	9.8%
Systemic effects (fatigue, headache)	8	7.8%
No side effects	20	19.6%

Patient Adherence: The general compliance rate of the sample population was at about 72.5 %.

Most of the patients showed excellent adherence to drugs given to them, with some significant percentage indicating lack of adherence to drug. The factors that affected adherence were

complexity of dosing schedule and cost of drugs and ignorance about the progression of the disease. Better adherence was observed among patients taking once-daily regimens, especially prostaglandin analogues, as compared to patients on several drugs.

Table 5: Patient Adherence Patterns

Adherence Level	Number (n)	Percentage (%)
Good adherence (>80%)	50	49.0%
Moderate adherence (50–80%)	24	23.5%
Poor adherence (<50%)	28	27.5%

Overall, the results show that the use of prostaglandin analogues and combination therapies was more successful to obtain significant reduction of IOP, and adherence was a vital factor that affected the results of treatment. The presence of side effects was mostly mild and manageable, which emphasizes the need to develop individualized treatment plans and educate patients about glaucoma management.

Discussion

This retrospective study is insightful on the effectiveness, safety, and adherence behavior of various anti-glaucoma drugs in a real-life clinical environment. Among all the classes of drugs tested, the prostaglandin analogues had the greatest effect of causing a decrease in the IOP and this was closely followed by combination therapy. This is a higher efficacy that can be explained by their action of uveoscleral outflow promotion and by their regimen of one dose per day, which promotes more patient compliance. Moderate IOP-lowering effects were also observed with beta-blockers, alpha agonists, and carbonic anhydrase inhibitors, but were relatively ineffective compared to prostaglandin analogues.

Regarding the safety, beta-blockers were linked to the fewest ocular side effects with a higher prevalence of mild side effects with conjunctival hyperemia and irritation with prostaglandin analogues. Patterns of adherence showed that patients who were on simpler dosing regimens especially once-daily drugs such as the prostaglandin analogues showed better compliance than those who were on multiple-drug regimens. Poor adherence was found to be caused by factors

like cost, complexity of treatment, and lack of awareness.

Comparison with Existing Literature: The results of this study align with other studies, which indicate that prostaglandin analogues are the best first-line agents in reducing IOP. Similar results have been reported by [13], highlighting their high effectiveness and positive dosing regimen. Also, the side effect profile observed is consistent with the available literature, in which the prostaglandin analogues are typically linked with the development of redness of the eyes, whereas the beta-blockers are not usually linked with local adverse effects, but they can be associated with systemic effects [14].

This study also reveals the same adherence patterns as [15] studies that have found that the simpler the treatment regimen, the higher the compliance rates. Nevertheless, the comparatively average adherence rate in this research highlights the persistence of issues in managing glaucoma in the long term, especially in resource-deprived environments.

Clinical Implications: The results of this study have important implications for clinical practice. The use of prostaglandin analogues can be regarded as the first-line treatment of a majority of patients since they demonstrate better effectiveness in lowering IOP and their dosing schedule is convenient, therefore, enhances compliance. Nevertheless, tolerance, contraindications, and cost, are individual patient considerations that must be taken into account when choosing therapy. The results further demonstrate the importance of patient adherence in the attainment of optimal treatment results.

Strengths of the study: The research has numerous strengths such as the employment of real-world data based on a tertiary care hospital, which increases the applicability of findings in practice. The various drug classes used enable a thorough comparison of the treatment outcomes. Also, the analysis of clinical (reduction of IOP) and patient-related (adherence and side effects) variables will be a comprehensive overview on managing glaucoma.

Limitations of the Study: Although the study has its strengths, it does have some limitations. A retrospective design limits the capacity to establish causal connections then relies on the accuracy as well as the completeness of the medical records. The study has small sample size of 102 patients may affect the generalizability. As a single-center study, the findings may not adequately reflect the wider population dynamics or practices in other healthcare environments.

Conclusion

Prostaglandin analogues were the most effective medications to achieve a clinically significant decrease in IOP, whereas beta-blockers appeared better tolerated with less side effects among patients with glaucoma. Patient adherence was a critical finding affecting treatment success, with dosing regimens that were easier showing better compliance. Pain management strategies need to be personalized to the individual patient that balance efficacy, safety and convenience. Therapies with proven pharmacological efficacy should be prioritized on the basis of adherence factors to achieve optimal long-term outcomes amongst patients when selecting therapy in glaucoma management.

Recommendations

Based on the study findings, it is recommended that patient education programs should be reinforced to raise the general medicine perspective, there is a lack of awareness about glaucoma and medication adherence. Follow up visits, to monitor disease progression and reinforce compliance, should be encouraged. Larger, multicentric studies are also validate to ascertain the reproducibility of these findings. Prospective clinical trials are required to provide stronger evidence regarding the real-life long-term effectiveness and safety of various glaucoma medications.

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