

Patient Practices and Challenges in Eye Drop Administration for Glaucoma Management: A Cross-Sectional Analysis

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Abstract: *Glaucoma is a leading cause of blindness, primarily managed with topical medications. This study assessed the knowledge, attitudes, and practices of glaucoma patients regarding eye drop administration at a tertiary eye hospital in Salem, Tamil Nadu, India. A cross-sectional survey and observation of 200 patients revealed knowledge gaps, inconsistent adherence, and poor techniques in medication use. Tailored educational interventions are needed to improve medication practices and outcomes.*

Keywords: glaucoma, eye drop technique, patient education, medication adherence, rural healthcare

1. Introduction

Glaucoma is the second leading cause of blindness worldwide and is characterized by a group of ocular disorders with multifactorial origins. All forms of glaucoma are marked by glaucomatous optic neuropathy and corresponding visual field defects, with or without elevated intraocular pressure (IOP)^(1,2). In India, glaucoma is the third leading cause of blindness.⁽³⁾ Currently, IOP is the most significant modifiable and treatable risk factor for glaucoma. Topical antiglaucoma medications are the first-line treatment for reducing IOP, followed by laser or surgical interventions.⁽⁴⁾

Adherence and correct administration of glaucoma medications are crucial for effective management.⁽⁵⁾ However, adherence to glaucoma medications remains a significant challenge, with 24–59% of patients not receiving the full intended benefit of their treatment. Non-compliance reduces the effectiveness of prescribed therapies and may lead clinicians to question treatment efficacy, potentially altering clinical decisions.⁽⁶⁾

As topical medications play a vital role in glaucoma management, both patients and healthcare providers need to understand their importance within the overall treatment strategy.⁽²⁾ This study used a simple, open-ended questionnaire to assess knowledge, attitudes, and practices related to anti-glaucoma medication use among patients visiting our clinic. By gaining a better understanding of these factors, physicians can enhance patient awareness and adherence to medications and identify areas for improvement. Additionally, we evaluated the eye drop instillation technique in our patients because improper application may lead to treatment failure.

2. Methodology

A glaucoma specialist thoroughly examined all patients before their inclusion in the study. Basic demographic information, including age, sex, educational status, and diagnosis, was recorded for each patient. The Knowledge, Attitude, and Practice (KAP) survey comprised 10 questions aimed at evaluating patients' awareness and knowledge regarding eye drops, as well as analyzing their drop instillation technique. The glaucoma specialist who diagnosed the glaucoma and the interviewer were two separate individuals. An in-depth, one-on-one interview was conducted by the same interviewer for all participants. The second author served as the interviewer. Each interview lasted approximately 10 minutes and was typically conducted during one of the patients' follow-up visits before they consulted with the doctor. The interviewer used non-leading questions in an open-discussion format to prevent biased responses.

This cross-sectional, questionnaire-based study was conducted at the Glaucoma Services, Ophthalmology Outpatient Department, Aravind Eye Hospital, over a period of fifteen days. A total of 200 patients with primary or secondary open-angle or angle-closure glaucoma, who were on medication, were examined. The inclusion criteria for the study were patients diagnosed with glaucoma who had been self-administering topical anti-glaucoma medication for at least six months. Exclusion criteria included patients who declined consent, who were debilitated, or had conditions such as Parkinson's disease, Alzheimer's disease, or other mental illnesses.

The questionnaire was adapted from a study conducted by Dr. Parul et al.⁽²⁾, with permission from the author. It was pretested on 10 patients to ensure relevance to our population before being administered to all study participants. No negative questions were included to avoid confusion. The

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questions were designed to be neither difficult nor unusual for patients to understand. Each question was unique, avoiding the repetition of ideas. The questions were clear, simple, grammatically correct, and free from technical jargon. The interviewer translated the questionnaire into Tamil to accommodate illiterate patients in the study group.

Eye Drop Administration Technique: The interviewer separately assessed the patients' eye drop administration techniques by observing them as they self-administered their eye drops. If the patients did not have their medication, a sample bottle of lubricating drops was provided, and their technique was evaluated during the application. The technique was scored based on a grading chart used by Tatham et al⁽⁷⁾ with scores ranging from -1 to 4. Grades 4 and 3 indicated a good technique, while grades 2 to -1 indicated a poor technique. The interviewer maintained a comfortable viewing distance and angle to accurately observe and record the eye-drop instillation technique.

Ethical Considerations: Informed consent was obtained from all participants before enrolment, and the study protocol adhered to the principles outlined in the Declaration of Helsinki.

Statistical Analysis: Statistical analysis using IBM SPSS version 25 evaluated explanatory variables (age, sex, residence, education) and outcome variables (knowledge, attitude, practice). T-tests/ANOVA were applied, reporting means, 95% Confidence intervals, and p-value of <0.05 was considered statistically significant.

3. Results

A total of 200 participants were included in the study, with ages ranging from 18 to 87 years and a mean age of 62.62 ± 15.48 years. Of the participants, 53 (26.5%) were male, and 133 (66.5%) resided in rural areas. According to the modified Kuppusamy scale, 30.5% of participants were illiterate, 16% had completed primary school, and 4.5% held a professional degree. A majority of the patients (64.5%) were using a single anti-glaucoma medication, while only 0.5% were using five different anti-glaucoma medications.

Regarding knowledge of eye drops, 85% (170 participants) understood the purpose of their eye drops. However, only 23.5% knew that eye drops should be stored in cool and wet places, while 21.5% believed that eye drops should be stored in cool and dry places. The majority, 55% (110 participants), thought that eye drops could be stored in warm places. Additionally, 51% of the participants knew that two eye drops should not be instilled back-to-back without an interval. (fig 1) Of the participants, 79% reported using the drops to manage eye pressure, 7.5% mentioned glaucoma specifically, and 13% were unsure of the reason for their medication use.

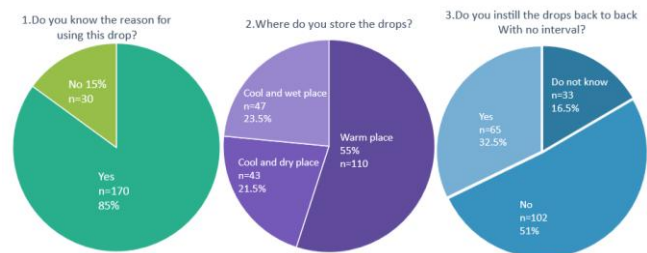


Figure 1: Knowledge related questions and responses of the patients

In terms of adherence, 43.5% (87 participants) reported never missing a dose of their medication, and 89.5% regularly inquired about dosage and timing from their doctors. However, 45% of participants did not adhere to the 40-day vial-use limit after opening. Additionally, 29.5% (59 participants) believed they could discontinue the medication without consulting their doctor once their symptoms improved. (Figure 2a, Figure 2b)

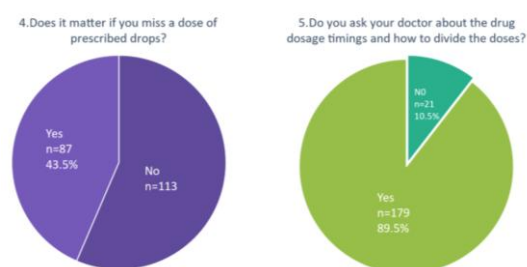


Figure 2a: Attitude related questions and responses of the patients.

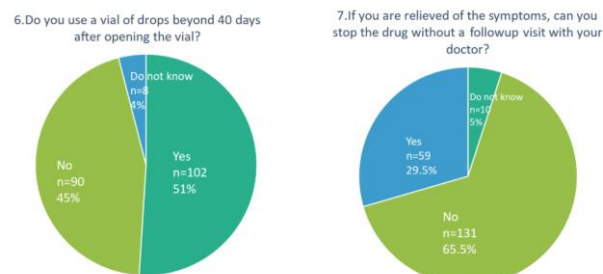


Figure 2b: Attitude related questions and responses of the patients

Among the participants, 69.5% (139 participants) checked the vial for the correct drug name and expiry date before purchase. Hand hygiene practices varied, with 40.5% (81 participants) reporting that they consistently washed their hands before administering eye drops, 16.5% (33 participants) did not wash their hands, and 43% (86 participants) occasionally practiced hand hygiene. Furthermore, 41.5% (83 participants) asked their doctors for an alternative medication if the primary one was unavailable. (Figure 3)

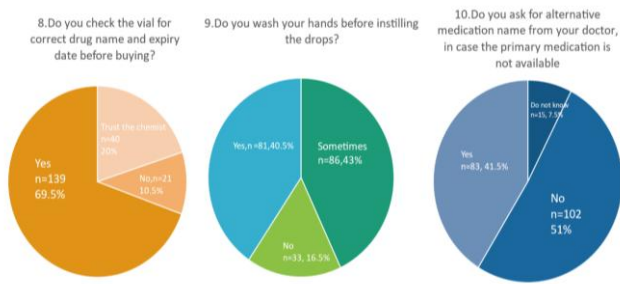


Figure 3: Practice related questions and responses of the patients

The study found that only 49.5% (99 participants) demonstrated a good technique in self-instillation of eye drops. Common issues included contact between the dropper tip and the eye or eyelid. Additionally, 8% (16 participants) missed their eyes entirely during administration. A total of 22.5% (44 participants) contaminated their medication by touching the dropper tip to their eyes, eyelids, lashes, or corneas. (Figure 4).

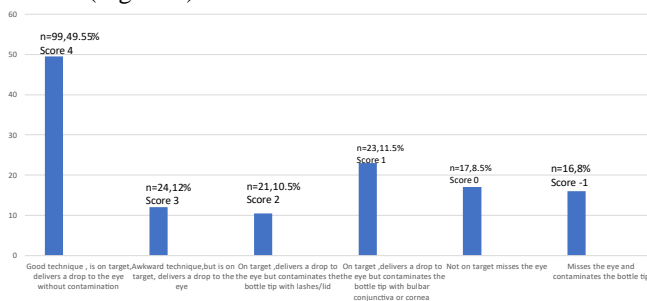


Figure 4: Eye drop instillation scores of the patients

4. Discussion

The study found that a significant proportion of participants (85%) understood the purpose of using eye drops, indicating a reasonable level of awareness regarding their treatment. Additionally, the male population demonstrated a higher level of knowledge compared to female patients. However, our study found that neither residence nor education significantly influenced patients' knowledge. Only 23.5% of participants were aware that they should store eye drops in a cool and dry place, indicating significant confusion about proper storage. This misunderstanding could potentially compromise the effectiveness of treatment, as improper storage can reduce the potency of the medication. These findings are consistent with previous studies that identified gaps in patients' knowledge regarding the correct use and storage of glaucoma medications, especially in populations with lower educational attainment. Moreover, only 51% of the participants were aware of the correct technique for administering eye drops, specifically the importance of leaving an interval between drops. Incorrect administration may result in suboptimal drug absorption, reduced therapeutic effectiveness, and potentially worsening disease progression. (8)

The study also found that while a large proportion of patients (89.5%) sought advice from their doctors regarding dosage and timing, a significant number (29.5%) believed that they could discontinue their medication once the symptoms had subsided. This highlights a common misconception about glaucoma, where symptom relief may be incorrectly equated

with disease control⁹Since glaucoma is often asymptomatic in its early stages and can lead to irreversible vision loss if left untreated⁽¹⁰⁾, patients must understand the chronic nature of the condition and the importance of continuous treatment. Other studies have reported similar findings, indicating that symptomatology, rather than disease awareness, influences patients' attitudes toward long-term medication adherence.⁽¹¹⁾ Interestingly, 45% of the participants did not adhere to the guidelines for discarding their eye drops within 40 days of opening the vial. This may be due to a lack of awareness of the degradation of medication over time.

In terms of practice, most participants (69.5%) checked the vial for the correct drug name and expiry date before purchasing, demonstrating a high level of engagement with their treatment. However, practices related to hygiene during eye drop instillation were suboptimal, with only 40.5% of participants consistently washing their hands before administering drops. Poor hygiene practices increase the risk of infection and contribute to complications that exacerbate an underlying condition.

The fact that only 41.5% of the participants sought alternative medications from their doctors when their primary option was unavailable suggests a lack of proactive management among the majority of patients. This indicates a missed opportunity to improve disease management through better patient engagement and communication with healthcare providers.

On the other hand, the knowledge score concerning sex, residence, and education did not demonstrate statistical significance. Additionally, our study found no significant differences in patients' attitudes and practices based on their sex, place of residence, or their educational status.

Another important aspect of our study is monitoring and scoring the eye drop instillation technique. Proper eye drop technique is essential to ensure medication efficacy and prevent contamination-related complications.

Previous studies have demonstrated a high prevalence of improper eye drop administration. Singh et al. conducted a study in North India and reported that 36% of patients used improper techniques when administering eye drops.⁽¹²⁾ Similarly, Brown et al found that 13% of patients failed to place a drop in their eyes on their first attempt.⁽¹³⁾ In comparison, our study observed that 8% of patients missed the eye.

Another major concern is bottle tip contamination, which can reduce medication efficacy and increase infection risk. Contaminated eye drops are one of the leading sources of preventable ocular infections globally.⁽¹⁴⁾ Studies have demonstrated that repeated use of ophthalmic solutions can lead to microorganism contamination, with contamination rates ranging from 0.07 to 70%⁽¹⁵⁾. Despite the general inactivation of pathogens in residual liquid by preservatives in eye drop solutions, reports of infections such as gram-negative keratitis, conjunctivitis, and even endophthalmitis remain.⁽¹⁶⁾ Although rare, these infections can cause significant damage to the corneal epithelium, leading to surface ulcers and blindness in severe cases.^{(14, 17).}

In terms of contamination, 15.3% of Tatham et al.'s patients touched the bottle tip to the bulbar conjunctiva or cornea, while 11.5% of our patients touched the bottle tip. (7)

Additionally, 27.1% of their patients touched the bottle tip to the eyelids or lashes, compared to 10.5% in our study. These behaviors highlight a key risk factor for contamination, as improper handling and direct contact of the bottle tip with ocular surfaces can introduce pathogens, thereby increasing the risk of infection.

By highlighting the variation in mistakes, such as poor drop technique, missing the eye, and bottle-tip contamination, it becomes evident that educational interventions and training on proper techniques are crucial for improving patient compliance and reducing the risk of infection or ineffective treatment.

In our study, we have found a statistically significant correlation between the literacy level of patients (Table 1) and their eye drop instillation technique (Table 2). Patients with higher literacy levels were more likely to demonstrate correct

eye drop administration, including proper handling of the bottle and avoidance of contamination. This suggests that individuals with better reading and comprehension skills may easily understand the instructions provided for medication use. Conversely, those with lower literacy levels often exhibit improper techniques, such as missing the eye or contaminating the bottle tip, potentially increasing the risk of infections and reducing the efficacy of treatment. Previous studies have also demonstrated the need for tailored patient education and technique training, particularly for individuals with limited literacy, to ensure safe and effective eye drop use. (13)

Table 1: Modified Kuppuswamy scale

Education	Score
Profession or honours	7
Graduate	6
Intermediate or diploma	5
High school certificate	4
Middle school certificate	3
Primary school certificate	2
Illiterate	1

Table 2: Association of Education with Drop Instillation Technique Scoring

Education	Technique							P value
	-1	0	1	2	3	4	Total	
	0	2(11.7)	0	0	2(8.33)	0	4(2)	<0.0001
1	5(31.25)	11(64.7)	7(30.4)	13(61.9)	9(37.5)	12(12.12)	57(28.5)	
2	1(6.25)	3(17.6)	9(39.1)	1(4.76)	0	18(18.18)	32(16)	
3	3(18.75)	0	2(8.70)	3(14.3)	6(25)	9(9.09)	23(11.5)	
4	5(31.25)	0	2(8.70)	2(9.52)	4(16.7)	25(25.25)	38(19)	
5	1(6.25)	1(5.88)	0	1(4.76)	1(4.17)	10(10.10)	14(7)	
6	1(6.25)	0	2(8.7)	0	1(4.17)	19(19.2)	23(11.5)	
7	0	0	1(4.35)	1(4.76)	1(4.17)	6(6.06)	9(4.5)	

There is a significant association between Education and technique score. Here p value was <0.0001.

In our study, we also compared patient age with eye drop instillation technique; however, this relationship was not statistically significant. Unlike literacy levels, age did not appear to have a clear influence on the ability to correctly administer eye drops. While older patients may face physical challenges, such as reduced dexterity or vision impairment, these factors did not significantly affect the overall technique in our cohort. This finding suggests that age alone is not a strong predictor of proper drop administration. In contrast, literacy level plays a pivotal role in determining technique accuracy. These findings highlight that while age-related support may be beneficial, focused educational interventions based on literacy levels are more crucial for improving patient outcomes and reducing the risk of improper eye drop use.

This study emphasizes the critical role of patient education and proper medication practices in enhancing glaucoma management, especially in underserved populations. While effective patient education demands time and resources, both of which are increasingly limited in healthcare settings, investing in this education is likely to yield cost-effective results and enhance patient satisfaction. Inadequate drug delivery not only wastes medication but can also result in poor intraocular pressure management and frequent medication changes, leading to an increase in hospital visits. This can be

particularly challenging for older patients, patients with more severe visual field defects, less educated patients, and patients with comorbidities such as arthritis, who are particularly vulnerable to poor technique. (18) Conversely, mastering the correct instillation technique could enhance drug delivery and treatment efficacy, potentially reducing the need for additional patient visits. In summary, allocating resources to improve drop techniques may result in broader healthcare savings.

The findings of this study have significant implications for enhancing glaucoma management, particularly in underserved rural areas. First, we should develop targeted educational interventions to enhance patients' understanding of proper medication storage, eye drop administration, and the significance of adhering to lifelong treatment. By improving their understanding of these aspects, patients are more likely to follow prescribed regimens, leading to better intraocular pressure control and, ultimately, slowing disease progression. Second, we must improve hygiene practices during eye drop instillation to minimize the risk of infection. Simple, low-cost interventions such as educational pamphlets or hands-on demonstrations of proper eye drop techniques during patient consultations can significantly reduce complications such as eye infections, which often disrupt glaucoma treatment. Patients who adopt improved instillation techniques and practices enhance the efficacy of medical interventions. Together, these strategies have the potential to improve both

treatment adherence and overall patient outcomes, thereby ensuring more effective and sustained glaucoma management.

One limitation of this study is its reliance on self-reported data, which may be subject to recall or social desirability bias. Furthermore, the cross-sectional design limits our ability to determine the causality of the observed relationships between knowledge, attitude, and practice.

Future research should focus on longitudinal studies assessing the impact of education on adherence and disease progression. Targeted educational interventions, such as multimedia tools and mobile health apps, could improve patients' self-care practices, eye drop techniques, and continuous medication use. Research should also explore the effectiveness of technology, like reminder systems, in promoting adherence and reducing missed doses or improper storage.

5. Conclusion

This study identifies significant gaps in patient practices and understanding of glaucoma medication use. Addressing these through targeted education can improve adherence, reduce complications, and enhance treatment outcomes, especially in resource-limited settings.

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