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PERSPECTIVES

Interventional Glaucoma: Improving the Patient-Provider Educational Exchange

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Abstract: Glaucoma treatment is beginning to undergo an evolution, moving away from topical medication-based therapies toward more proactive minimally invasive interventions. This shift towards an "interventional glaucoma" treatment paradigm has been shown to benefit patients, providers, and society. A key component of effectively implementing this approach is education about the importance of glaucoma diagnosis and treatment, as well as the various treatment modalities available. Such education is relevant not only for patient but also patients' support networks, ophthalmologists, optometrists, third-party payers, and policy-makers. Education can occur both within and outside the clinical setting. The present article provides an overview of the diverse educational methods available for glaucoma patients, including those based on patient-provider interactions and those based on internet and printed material. Examples of the former could include general and specific verbal instruction, motivational interviewing, or community-based educational workshops, while examples of the latter could include office-based movies or printed materials, virtual reality headset educational videos, artificial intelligence-assisted education, or self-directed internet videos and articles. By empowering patients with knowledge and an up-to-date awareness of treatment options, effective education can be a valuable part of making an interventional glaucoma treatment paradigm possible.

Keywords: MIGS, education, intervention/interventional, glaucoma, surgery

Introduction

Glaucoma is the leading cause of permanent blindness globally,[1] with an estimated worldwide prevalence of 3.6 million as of 2020.[2] Glaucomatous vision loss can be prevented by timely diagnosis and adequate treatment, especially at an early stage. The treatment of glaucoma focuses on reduction of intraocular pressure (IOP), which is the single most consistently identified method of reducing glaucoma incidence and progression. Historically, in the traditional treatment paradigm, the approach to achieving IOP reduction typically involved extended trial periods using topical medications, often in a variety of combinations, and reserving surgical intervention until the disease had progressed. This made sense when the only surgical options were higher-risk filtering surgeries such as trabeculectomy and tube placement. However, over the past decade we have witnessed a dramatic rise in lower-risk minimally invasive surgical glaucoma interventions, which collectively allow for a reevaluation of the traditional longstanding glaucoma treatment paradigm.

Reevaluation of the treatment paradigm is fueled by the emergence of clinical evidence that supports the benefit-to-risk ratio of laser and minimally invasive glaucoma and procedural pharmaceuticals. The growing foundation of scientific information points to a reconsideration of the best clinical treatment algorithm to achieve good efficacy and safety. Proactively leveraging minimally invasive interventions, rather than reflexive reliance on topical medications, has been referred to as interventional glaucoma.[3–7] Such minimally invasive interventions can include selective laser trabeculoplasty, minimally invasive glaucoma surgery (MIGS), and procedural pharmaceuticals; and they can be done in standalone settings or in combination with cataract surgery.[3]

Proactive interventional approaches do not seek to eliminate medications, which can still play a central role in glaucoma treatment in many settings around the world. Rather, they question their use as the automatic reflexive first-line

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(and often only) remedy in glaucoma care. Likewise, they do not eliminate filtering surgery for appropriate patients, but rather they advocate earlier interventions to hopefully prevent filtering surgery altogether. Glaucoma treatment is a continuum, with different interventions being indicated at different stages of the disease. No single therapy or approach is a cure-all, and each one comes with its own risks and benefits. A tempered and evidence-based approach should be taken to implement the best care possible for any given patient and for any given disease stage. Thus, the interventional and traditional approaches do not represent two discrete or opposing strategies; and maintaining patients' visual function is paramount, no matter which treatment modalities are chosen. An interventional treatment approach has demonstrable benefits for patients (such as more consistent IOP control, increased compliance, lower medication burden, faster recovery time); physicians (such as fewer intraoperative complications, easier follow-up care, and adequate tissue preservation in case another future surgery is needed); and society (such as lower costs, decreased disease severity and blindness care, and faster return of patients to the workforce).[3–7] Despite their promise, however, some related challenges emerge to adopting minimally invasive interventions into practice. For example, diagnosis may be delayed, especially when patients are asymptomatic and disease presentation is asymmetric; and late diagnosis and referral may require more aggressive intervention(s). Additionally, a large issue in many practices is hesitancy around departing from the topical-medications-first default paradigm, even though eyedrops cause undesirable side effects and diminished quality of life for patients. These challenges may be especially prevalent in resource-poor settings, where the ratio of provider to patient is lower and where diagnostic and educational tools may be strained. For each of these challenges, it is critical to educate not only patients, but also patients' support networks, ophthalmologists, optometrists, third-party payers, and policy-makers regarding the importance of glaucoma diagnosis and treatment, as well as the various treatment modalities available. Such education can motivate a fresh consideration of the evidence and lead to accepting a newer (and perhaps more effective) treatment approach. As will be discussed in this article, the challenges to glaucoma diagnosis and treatment may be ameliorated by the diverse educational modalities that have emerged in recent years: these constitute state of the art tactics in patient education. These methods can apply to all aspects of glaucoma care – including, for example, education regarding eyedrop instillation technique, need for regular and lifelong follow ups, warning signs, importance of family screening, identification of drug reactions, and postoperative care.

The importance of patient education is indisputable Increasing patients' understanding of glaucoma and its treatments has been shown to lead to better clinical outcomes, higher treatment adherence, and higher patient engagement.[8,9] Conversely, the lack of health literacy is stated by the World Health Organization to be associated with lower participation in disease detection activities, diminished adherence to medication, and lower management of chronic diseases.[10] Unfortunately, patient understanding of their disease is often lacking, such as in a real-world study of glaucoma patients which found approximately one-third of American adults and two-thirds of Brazilian patients had insufficient understanding of their condition.[11] The truth is, patients still go blind from glaucoma, despite the existence of effective diagnostic technologies and treatments. This discrepancy has been attributed to glaucoma under-diagnosis, inadequate treatment, and treatment noncompliance.[12] Insufficient or ineffective patient education is known to exacerbate the other three causes.[13]

Glaucoma education is also important among a patient's support network, such as relatives or friends. The absence of a supportive spouse, for example, has been cited as one of the top three barriers to medication adherence.[14] In addition, it is understandably difficult for patients to understand and remember everything that occurs during a clinic visit;[15,16] this issue may be especially true for older patients or those with visual or functional limitations. In these cases, family or friends could provide an additional level of support. Thus, educating these individuals could be a powerful way to promote better care and adherence to treatment.[17]

In the real world of busy ophthalmology and optometry outpatient clinics, a critical barrier to educating patients is the lack of structured time to do so. Patients' time in clinic visits is dedicated to thorough examination and medical guidance. However, there is also a compelling need to underscore the importance of glaucoma diagnosis and treatment with the patient. This may be accomplished by a concise education program that may be shared during the office visit. A robust prospective time-motion study of 12 ophthalmologists at an academic glaucoma clinic diagrammed the clinic flow from a patient's perspective. The study reported that new and returning patients had total wait times of approximately 64 minutes and 53 minutes, constituting ~33% and ~49% of total appointment time, respectively.[18] In the study, all new patients and ~88% of returning patients had at least one ≥10 minute wait time during their clinic visit.

These windows of wait-time a patient experiences in the clinic can be a useful opportunity for education. Patients can also engage with educational platforms outside the clinic, such as with home-based video and printed materials. As noted above, glaucoma education is important for both patients and their support networks, such as relatives or friends. Thus, when the term "patient" is used in this article, it refers to patients as well as their supports. The present article provides an overview of the diverse educational methods available for glaucoma patients [Box 1], including those based on patient–provider interactions and those based on internet and printed material. Such education can be seen as a central part of an interventional glaucoma practice and mindset.

Patient Engagement with Staff and Physicians

The first area of opportunity for patient engagement can involve the intake staff, such as technicians or medical assistants who are trained to deliver highly educational teaching about certain subjects to patients while they are waiting. Such education can help ensure the time spent with the doctor and remaining staff members is productive. One potential subject of relevance to most glaucoma patients could be the disease process itself, including the need to treat in order to prevent vision loss. A second subject could be the importance of serial monitoring of subjective testing such as routine visual field performance, which is known to be completed less frequently than is recommended by current glaucoma guidelines.[19] A third topic could be the importance of objective testing such as optic nerve scans, which can detect or predict glaucomatous damage before measurable visual field loss.[20,21] And a fourth critical focus is the variety of options to treat glaucoma, from medications to procedures, and the relevant pros and cons of each. Patients are often very receptive to newer science, such as recent studies favoring laser trabeculoplasty over eyedrop medication[22] and equivalent outcomes of sustained-release procedural pharmaceuticals to eyedrops.[23–25]

A practical example of a standardized staff-based educational intervention was characterized in a recent study by Sng et al.[26] In the study, there was improvement in patient knowledge and compliance motivation up to one year after a standardized nurse-led education intervention consisting of didactic glaucoma modules and practical training in eyedrop instillation.[26] A second example was the Glaucoma Australia Educational Impact Study, a randomized controlled trial evaluating the effectiveness of telephone-based and mail-out glaucoma education in Australia. The study found higher knowledge levels and lower patient anxiety scores after the educational intervention, in comparison to the control group who received physician education alone.[27]

Box 1 Educational Interventions

Office-based verbal instruction, general
Office-based verbal instruction, specific
Motivational interviewing
Virtual reality (VR) headset educational videos
Office-based video or PowerPoint presentation
Office-based printed material
Office-based artificial intelligence-assisted education
Office-based QR codes linking to internet resources
Community-based educational workshops
Internet-based videos
Internet-based printed material
Telephone outreach
Mailed educational brochure

A third example of a standardized educational intervention was the Philadelphia Glaucoma Detection and Treatment Project, which consisted of educational workshops at 43 community-based sites in Philadelphia.[28] Each workshop included an educational brochure about glaucoma, a 10-question survey about demographics, and an 8-question pre-test and post-test to gauge level of glaucoma knowledge. Following the workshops, there was a significant increase in the level of knowledge about glaucoma ($p < 0.001$). In the five largest community sites, 44% of workshop attendees scheduled a glaucoma examination and 76% of these attendees completed the visit.[29]

In addition to general education, patients can receive targeted, personalized counseling by ophthalmic technicians or medical assistants who are trained to cover a topic of the patient's choice from a list. Such topics could include patients' specific questions regarding disease information, diagnostic testing, and/or possible treatments. Given that most patients experience more than one ≥10-minute wait time in the clinic,[18] different topics could be covered during different encounters over the course of the visit. Additionally, health information technologies such as electronic medical records (EMR) can be used by trained staff members to deliver both standardized and personalized information on these topics.[30] Staff can help patients understand their own risk factors, such as family history, advanced age, African American or Asian race, Hispanic/Latino ethnicity, elevated IOP, thin corneas, myopia, or diabetes.[28] Staff can also tailor education to the patient's particular glaucoma diagnosis, test results, and ophthalmologist's recommendations.

In another particularly effective method of patient education, physicians and staff can use motivational interviewing-based health coaching, which involves asking patients what they already know and what they want to learn about before giving further information.[31,32] This technique is designed to engage patients by strengthening their own motivation and commitment to change a health behavior. There are five core skills to motivational interviewing: asking open-ended questions, affirming, reflecting, summarizing, and obtaining permission to provide information and advice [Box 2]. [33] Staff members can gain experience with this interviewing technique by completing training session(s) through the Motivational Interviewing Network of Trainers (MINT).[33] During a motivational interviewing interaction, ophthalmology staff members can write down patients' questions in order to facilitate more productive discussion during the eventual physician encounter; and physicians can tailor their responses based upon individual patient interests. Such coaching has been used for many chronic diseases such as diabetes,[34,35] obesity,[36] hypertension,[36–38] and tobacco abuse.[39] It also has been evaluated as a potential method of improving medication adherence in glaucoma patients.[40] For example, one such program – the Support, Educate, Empower (SEE) glaucoma coaching program – used in-person and telephone-based motivational interviewing sessions to identify adherence barriers and possible solutions. Following the program, 95% of patients showed an improvement in medication adherence.[41]

Finally, given the challenges these more resource-intensive interventions present, research on the use of artificial intelligence approaches to patient counseling sessions such as customized chatbots, machine learning methods, and large language learning models is of interest in many medical settings.[42–45] In brief, these automated approaches have demonstrated potential in improving patient and physician education, enhancing research productivity, promoting administrative efficiency, and triaging and diagnosing patient symptoms.[42,43] In some cases, they have shown high accuracy in diagnosing cases of

Box 2 Motivational Interviewing Core Skills*

Motivational Interviewing Core Skills
Asking open-ended questions
Affirming
Reflecting
Summarizing
Obtaining permission to provide information and advice

Notes: *Newman-Casey PA, Killeen O, Miller S, MacKenzie C, Niziol LM, Resnicow K, Creswell JW, Cook P, Heisler M. A Glaucoma-Specific Brief Motivational Interviewing Training Program for Ophthalmology Para-professionals: Assessment of Feasibility and Initial Patient Impact. Health Commun. 2020 Feb;35(2):233–241.

glaucoma based on examination findings.[44,45] However, they also have numerous limitations that necessitate using them in a complementary – rather than primary – capacity with human guidance.[43,46,47] Artificial intelligence programs are still in their infancy, and further refinement is needed before more widespread adoption is appropriate.

Internet-Based and Printed Education

The second major area of opportunity for patient education can involve internet-based or printed materials. Online resources may have particularly high impact given that approximately two-thirds of adults are estimated to consult the internet first when searching for medical information.[48,49] Rather than shying away from such internet searches, glaucoma specialists can direct patients to websites known to provide reliable information [Table 1]. For example, surveyed glaucoma specialists have identified videos from the American Academy of Ophthalmology (AAO)(https://www.aao.org/eye-health) and Glaucoma Research Foundation (GRF)(https://glaucoma.org/understanding-glaucoma/videos-webinars) websites,[50] as well as the AAO Preferred Practice Patterns (https://www.aao.org/education/guidelines-browse?filter=Preferred%20Practice%20Patternsandsub=AllPreferredPracticePatterns),[51] as informative and reliable resources. Other reliable websites may include the National Eye Institute (https://www.nei.nih.gov/learn-about-eye-health/eye-conditions-and-diseases/glaucoma#:~:text=What%20is%20glaucoma%3F,a%20comprehensive%20dilated%20eye%20exam), the Mayo Clinic (https://www.mayoclinic.org/diseases-conditions/glaucoma/symptoms-causes/syc-20372839), and the Cleveland Clinic (https://my.clevelandclinic.org/health/diseases/4212-glaucoma). One potential advantage of an internet platform, and particularly educational videos, is that in comparison to traditional text-based patient education, video-based educational material can provide audio and visual components that are better for individuals with low vision or limited literacy. They also can be experienced across multiple technologies such as phones, tablets, and computers.

Practices can promote the sharing of educational resources by having lists of internet resources printed and available in every examination room that can be given to patients and their supports at any opportunity by technicians and physicians. The use of QR codes also may facilitate sharing of materials. These QR codes linking to online resources can be shared by printed material or by text or Email to patients and their supports, allowing later access and re-engagement.[52]

Despite its attributes, an important caveat to note about online or digital content is that it must be both accessible and understandable in order to be effective. General websites should be designed for a 6th-grade or lower reading level per the American Medical Association and the National Institutes of Health recommendations.[50] Meanwhile, patients desiring more in-depth information can be directed to the aforementioned reliable websites for self-directed education. Understandability needs to encompass cultural and linguistic factors, as well as appropriate reading level, in order to achieve the desired impact. Unfortunately this is often not the case, such as in a study by Dahshan of the accessibility and cultural inclusivity of online video content;[50] or the documentation of patient frustration when interpreting online health information.[49] Studies have also documented the lack of readability of online patient education materials, with the majority of materials being written at a level too difficult for the general population to interpret.[53,54] In a systematic analysis of online glaucoma content, for example, Jia et al

Table 1 Reliable Websites for Patient Education

Source	URL
American Academy of Ophthalmology (AAO)	https://www.aao.org/eye-health
Glaucoma Research Foundation	https://glaucoma.org/understanding-glaucoma/videos-webinars
AAO Preferred Practice Patterns	https://www.aao.org/education/guidelines-browse?filter=Preferred%20Practice%20Patternsandsub=AllPreferredPracticePatterns
National Eye Institute	https://www.nei.nih.gov/learn-about-eye-health/eye-conditions-and-diseases/glaucoma#:~:text=What%20is%20glaucoma%3F,a%20comprehensive%20dilated%20eye%20exam.
Mayo Clinic	https://www.mayoclinic.org/diseases-conditions/glaucoma/symptoms-causes/syc-20372839
Cleveland Clinic	https://my.clevelandclinic.org/health/diseases/4212-glaucoma

found a mean reading grade level of 9.3, well above the recommended 6th-grade level.[55] Thus, online content holds promise but also must be designed intentionally with the patient and the patients' education level in mind.

In addition to self-directed online video content, printed or video materials can be shown in the office waiting room, examination room, or during a telehealth visit. One such example was a study by Tran et al, in which a PowerPoint presentation and educational YouTube video educated patients on the utility of selective laser trabeculoplasty as first-line glaucoma treatment.[56] Patients were shown a 23-slide PowerPoint (printed in color and presented in a binder) and a 3-minute video covering similar topics as the slides. After receiving this education, 19% of education-group patients changed positively toward SLT; 50% scheduled an SLT appointment; and approximately twice the proportion of educational-intervention patients underwent SLT compared to control-group patients.[56]

While most literature on educational interventions has focused on the patient, education of physicians also can leverage digital or printed materials. In a study by Bonafede et al, physicians were given an online survey and educational narrated slide presentation about the role of SLT as first-line treatment for glaucoma. SLT has been identified as an effective and safe first-line treatment option for glaucoma, as supported by the AAO Primary Open-Angle Glaucoma Preferred Practice Pattern Guidelines[57] and the findings of the LiGHT trial.[22,58] However, before the education, only 28% of physicians preferred SLT over medication. After the education, 47.2% of physicians stated they would use SLT as first-line therapy, with 94.3% of these subjects stating that the educational program had convinced them to change their mind.[51]

Another avenue for leveraging in-office digital content involves virtual reality (VR) headsets. Given the windows of wait time patients spend in the waiting room and exam room, the use of VR headsets has received growing attention as a potential avenue for patient education. VR-based content has been shown to improve patients' retention and recall of relevant clinical information.[59,60] It has been employed to educate patients about various areas of medicine such as hypertension,[61] radiation therapy,[62] advanced care planning,[63] and oncology-related immunotherapy.[64] Within glaucoma, there are several virtual reality headsets that measure visual fields (eg RadiusXR VR perimeter,[65] Olleyes VisALL-K pediatric perimeter[66]), which also house a repository of educational videos for patients to view while in the clinic waiting room, thereby making effective use of any wait-time a patient may experience. Within other areas of ophthalmology, a recent study examined the utility of a VR headset in educating patients about diabetic macular edema (DME). The study found that after using the VR Headset, over 85% of patients and companions felt better informed about DME and its treatment, and patients showed improvement in answering questions correctly regarding their condition.[67] Patients and their companions overwhelmingly rated the VR headset as a positive experience, and most physicians and all medical assistants also rated the effect on patient satisfaction as positive. The study concluded that patients, physicians, and staff could benefit from a VR Headset as a useful adjunct for conveying disease- and treatment-related information.

Conclusion

Glaucoma is a major public health challenge worldwide, causing irreversible vision loss if not adequately addressed. Fortunately, vision loss can be prevented by timely diagnosis and treatment, especially at an early stage. However, diagnosis and early treatment can be difficult given the asymptomatic, slowly progressive, painless, often asymmetric nature of the disease.[68] Furthermore, glaucoma treatments such as topical medications can produce unwanted side effects that ultimately contribute to poor patient compliance and diminished quality of life. Patients are faced with the immediate downsides of topical treatments compared to the distant risks of vision loss. In this context, education is critical to underscoring the importance of diagnosis and treatment with the patient. Unfortunately, patients still go blind from glaucoma, despite effective diagnostic technologies and treatments. This discrepancy can be ameliorated by effective patient education which can empower both clinicians and patients to proactively manage the disease.

Patient education is clearly valuable in a humanitarian sense, especially when it enables diagnosis and treatment at earlier stages of the disease, thereby preserving patients' vision. However, it is also important to recognize that there may be practical financial benefits of diagnosing and treating earlier, as facilitated by adequate education. These cost benefits can extend to patients, clinics, hospitals, and healthcare systems as a whole. For example, there is substantial literature on the cost-effectiveness of intervening with MIGS,[69–71] as well as SLT.[22,58,72,73] Conversely, greater disease severity is associated with higher direct costs and ophthalmology-related resource use, including in ophthalmology visits, glaucoma surgeries, and medication use.[74] With limited funding for healthcare, including in under-resourced settings, it is imperative to determine where money is best spent.

This may require taking a hard look at the economic driving forces behind treatment decisions and being realistic about the best uses of expenditure, recognizing the critical role that education might play in enabling earlier disease detection and intervention.

Of note, the educational strategies presented in this paper may be realistic in some settings but aspirational in others, depending on the resources available. Indeed, not all educational methods may be realistic or possible in all locations; and issues of cost and manpower may be especially challenging in settings with limited healthcare resources. For example, limited manpower can constrain the number of supportive staff available to educate patients; limited medical facilities can force doctors to rely on topical eyedrops rather than employing earlier procedural interventions; and limited technology or internet access can reduce the breadth of viable educational resources. This paper does not sidestep these limitations, but rather summarizes a best-practices set of ideas that can be used wherever possible.

The present article has characterized two broad areas of education: those based on staff and provider interaction, and those based on digital and printed materials. These methods can be incorporated into clinic flow, taking advantage of the windows of wait time a patient may experience as part of their clinic visit. General and directed interactions with staff members can both educate the patient and ultimately facilitate a productive physician visit; and digital modalities such as online videos or VR headsets can be used to provide general and patient-specific information. Educational modalities, particularly online materials, also can be employed outside the clinic, either in a self-directed manner or at the recommendation of a clinician.

Patients and physicians may be limited by a historical bias towards glaucoma therapy that was based on exhausting eyedrop approaches first. By enriching patients' educational experience and disease awareness, a more proactive approach can be taken to glaucoma management that may enhance outcomes and reduce the burdens of treatment for patients. Patients can examine currently held treatment approaches and consider alternative – potentially better – ways of managing glaucoma. This perspective change is consistent with the underlying reevaluation of the glaucoma treatment paradigm that is occurring within the ophthalmic community: an evolution away from reflexive reliance on topical medications and toward the proactive use of minimally invasive interventions, a shift known as interventional glaucoma.[3–7] By empowering patients with knowledge and an up-to-date awareness of treatment options, effective education can be a valuable part of making an interventional glaucoma practice possible.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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